



# Yerevan Green City Action Plan



Yerevan 2017



*Disclaimer*

*This Green City Action Plan was prepared for the City of Yerevan by an international team of experts led by Ernst & Young, s.r.o. (Czech Republic). Other members of the consortium included GEOtest, SWECO, SEVEN and local experts.*

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# Executive Summary

In the light of continuous global urbanization, sustainable development challenges increasingly stem from cities. Yerevan is fully aware of these challenges, as the administrative as well as economic centre of Armenia, the overall economic prosperity of the country is substantially anchored on Yerevan's economic development

The quality of the urban environment, including air, water, soil, biodiversity, environmental assets and ecosystems are negatively impacted by human activities such as transport, energy, water use and waste management. In the recent years, many measures have already been taken to remedy the situation, but the measures should be doubled in the coming years to raise the quality of life in the City to standards seen in many European cities. These efforts will also help Yerevan contribute to global efforts in climate change mitigation and the transition to green economy.

## Methodology

The Green City Action Plan (GCAP) was developed by applying 4 stage methodology, which is as follows:

Stage 1 focused on relevant information and data identification, collection, processing and analysis to establish the baseline indicators, which rank the city compared to internationally recognized benchmarks. The baseline consists of three sets of indicators along the axis Pressure-State-Response.

Stage 2 was dedicated to the actual GCAP development where City of Yerevan worked with the team of experts on the definition of the vision and long-term strategic objectives along with a roadmap represented by mid-term targets and short-term actions.

Implementation of the actions will fall under Stage 3 of the GCAP process and includes also continuous monitoring of progress. After the first three year period within which the short-term actions should be implemented, Yerevan will need to go through Stage 4 of the GCAP process which should map successes and areas for improvement of the implementation.

## State of the Environment in Yerevan

The state of environmental assets, including air, soil, water and biodiversity, is influenced by pressures of human activity. The main challenge related to air quality in Yerevan are high concentrations of dust particles as well as SO<sub>2</sub> and NO<sub>x</sub> emissions. Biodiversity has been negatively impacted by a substantial decline of green spaces in the 1990s, leading to loss of biodiversity of the Yerevan area. Soils are marked with various forms of contamination, water sector analysis reports surface water contamination issues and lack of information on ground water, and the need for substantial further development of water and wastewater infrastructure. These are dealt with in more detail in respective chapters on water and land use.

Key proposed short term actions to address challenges related to the state of environment include:

- ▶ Improvement of the air quality policy and methodology and monitoring system
- ▶ Establishment of a "Green City Awareness Centre"

## Transport

Yerevan municipality considers transport the key area for strategic development of the city. It has a significant impact on local air quality, economic growth as well as social inclusion. The main areas of concern are the transport infrastructure and management as well as the age of the fleet. Even though Yerevan's road network has been extensively developed in recent years and further extension and enhancements are planned, Yerevan still needs to introduce a strategy regarding road use for public transport (as no dedicated lanes exist) and other alternative transport modes such as cycling. Reducing the age of the fleet is a long term process, begun with the replacement of older vehicles in public transportation, in combination with fuel switching.

Key proposed short term actions to address these challenges include:

- ▶ Implementing a new bus network model and upgrade of the electric public transport
- ▶ Development of road infrastructure,
- ▶ Pilot introduction of 10 electric vehicles in municipal fleet by the end of 2020

## Energy

Yerevan considers the city's energy and carbon footprint a high priority. Key challenges in terms of energy are low energy efficiency in buildings, due to lack of energy planning, management and awareness; low energy efficiency of external lighting, due to limited financial resources and conceptual approach; and low share of renewable energy sources, due to inexperience with renewable energy and lack of effective solutions.

Key proposed short term actions to address these challenges include:

- ▶ Introducing energy management in municipal institutions and investment in energy efficient solutions
- ▶ Using energy efficient luminaires in the internal lighting systems of administrative buildings
- ▶ Using renewable energy, such as solar energy, captured methane from municipal solid waste, in municipal buildings

## Industries

The industry's impact on the local environment is undisputable. Nevertheless, the oversight and regulatory competencies over industrial facilities in Yerevan lie with the Ministry of Nature Protection and the Yerevan municipality has limited direct tools to influence the different industrial sectors. While the low efficiency of resource use and heavy waste and pollution load from the industrial sector in Yerevan is a major challenge, the local government does not have any formal power to take action in this regard, aside from promoting local economic activity and investment environment. Especially worth noting is the significant impact some industries have on the air quality situation. Key challenges in relation to industries are the lack of information and cooperation platform between the City and the industry, as a result of the limited scope of municipal competences; low industrial material efficiency and high levels of waste and pollution; industrial energy efficiency as well as industrial energy system sustainability.

Key proposed short term actions to address these challenges include:

- ▶ Development of a public-private dialogue platform and local green business development action plan
- ▶ Incorporation of green business support into public procurement procedures
- ▶ Establishment of voluntary agreements on energy audits in industry to motivate companies (e.g. via small grants) to increase energy efficiency

## Waste management

Waste management is a key sector for transitioning to a green city. Although the Yerevan municipality has started reforming the collection of municipal solid waste in recent years, significant challenges remain:

- ▶ Waste disposal practices, as no municipal solid waste, hazardous waste or other waste is disposed of in EU-compliant sanitary landfills
- ▶ Low material efficiency, linked to limited sorting and recycling of waste.

Key proposed short term actions to address these challenges include:

- ▶ Construction of the new sanitary landfill for municipal solid waste
- ▶ Closure and reclamation of existing dumpsites in Nubarashen and Ajapnyak

## Water

Yerevan citizens enjoy a high quality of drinking water thanks to the high quality of groundwater resources. However, we have identified certain key environmental issues associated with Yerevan's

water supply and infrastructure management. In comparison with the drinking water, the benchmarking of the surface water quality shows poor performance. This is due to insufficient treatment of waste water and its collection system. The high level of non-revenue water, which represents more than 73 % within the drinking water supply system is also a major challenge as well as inefficient water usage. Additionally, the changing climate poses greater pressures on the city's storm-water removal systems. The quality and quantity of groundwater resources was not possible to assess due to lack of nation-wide systematic groundwater protection and monitoring.

Key proposed short term actions to address these challenges include:

- ▶ Installation of metering devices by the water utility
- ▶ Development of Leak Reduction Action Plan
- ▶ Enforcement of the concession agreement between the Ministry of Energy Infrastructure and Natural Resources and the water utility
- ▶ Repairing and rehabilitation of parts of the water supply system with the highest water leakages
- ▶ Repairing of connections between sewage and storm sewers

### **Land use**

Yerevan went through severe deforestation in the 1990s due to the energy crisis. As a result of City's efforts, the size of public green space (green spaces of common use) in Yerevan has started to return to the pre-1990 level. Nonetheless, important challenges remain. These include the amount of green space per capita, which is below the 9m<sup>2</sup>/ca minimum recommended by the World Health Organization and thus not functioning properly as a dust barrier for the city; the rapid growth, and the pressure it exerts upon urban and public space of Yerevan's city centre.

Key proposed short term actions to address these challenges include:

- ▶ Installing green transport infrastructure in selected public buildings or their vicinity
- ▶ Developing rules on the implementation of green transport infrastructure in new buildings and major renovations
- ▶ Developing and starting implementation of a long-term development plan for re-vegetation of Yerevan
- ▶ Rehabilitation and expansion of green spaces and forests
- ▶ Developing a thorough inventory of Yerevan's potentially contaminated sites

It can be concluded that this GCAP, that is its implementation, will have a positive impact on the environmental assets and enhance the quality of life in the city. This assessment is also confirmed by the respective Strategic Environmental Assessment.

## List of Abbreviations

AD	Administrative district (of Yerevan municipality)
ADB	Asian Development Bank
AUA	American University of Armenia
CDM	Clean Development Mechanism
CNG	Compressed natural gas
CO <sub>2</sub> e	Carbon dioxide emission equivalent
E5P	Eastern Energy Efficiency and Environment Partnership
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EE	Energy Efficiency
EIB	European Investment Bank
EPC	Energy Performance Contracting
EVSE	Electric vehicle Supply Equipment (electric charging stations)
EU	European Union
FDI	Foreign direct investment
GCF	Green Climate Fund
GEF	Global Environment Fund (GEF)
GEG	Gas engine electric generator
GHG	Greenhouse gas
GHGE	Greenhouse gas emissions
GRS	Gas refuelling stations
GW	Groundwater
GWh	Gigawatt hour = 1,000 MWh =1,000,000 kWh
ha	Hectare = 10,000 m <sup>2</sup>
HEV	Hybrid electric vehicles
HFHA	Habitat for Humanity Armenia
IEA	International Energy Agency
IFI	International financial institutions
IPCC	Intergovernmental Panel on Climate Change
kcal	kilocalorie
KW	Kilowatt
KWh	Kilowatt hour
LPG	Liquefied petroleum gas
MAB	Multi-apartment building
MNCO	Municipal non-commercial organization
MNP	Ministry for Natural Protection of Republic of Armenia
MSW	Municipal Solid Waste
MWh	Megawatt hour = 1,000 kWh
na	Not available or Not applicable
NEEAP	National Energy Efficiency Action Plan
NGO	Non-governmental organization
NH <sub>3</sub>	Molecular formula for Ammonia
NO <sub>x</sub>	Molecular formula for Nitric oxides
m <sup>2</sup>	Square meters

m <sup>3</sup>	Cubic meters
NSS	National Statistical Service
O <sub>3</sub>	Molecular formula for Ozone
PM	Particulate matter
R2E2	Armenia Renewable Resources and Energy Efficiency Fund
RoA	Republic of Armenia
SEA	Strategic Environmental Assessment
SEAP	Sustainable Energy Action Plan
SO <sub>x</sub>	Molecular formula for Sulphur oxides
SNCO	State non-commercial organization
tbd	To be determined
TPP	Thermal power plant
UN	The United Nations
UNDP	United Nations Development Program
USAID	United States Agency for International Development
WHO	World Health Organisation
YM	Yerevan Municipality

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## Introduction

In the light of continuous global urbanization, sustainable development challenges increasingly stem from cities. The progress and development of different countries of the world is dependent on cities, which are vital and represent much of the national economic activity, government, commerce and transportation. They provide links with rural areas, between cities, and across international borders. Cities attract people and enterprises. But only those with a strategic vision underpinned by sustainability, innovation, safety and friendly urban environment will be able to attract skilled workforce and advanced, innovative firms that will sustain an organic growth and social coherence.

Yerevan is fully aware of these challenges. We are the administrative as well as economic centre of Armenia and the overall economic prosperity of the country is critically dependent on our economic development. We have 86% of service income in the country, 83% of retail trade, 54% share of construction and 42% share of industry. Additionally, 78% of new buildings are put into operation and 33% of the hotel business is located in Yerevan.<sup>1</sup> We are also the education centre of Armenia. Forty-eight (48) out of the total number of 60 higher education institutions in the country are located here.

These assets notwithstanding, Yerevan faces challenges of its own. According to RoA National Statistical Service survey results, nearly 50% of the students imagine their future perspectives to be realized abroad<sup>2</sup>, mostly due to economic and development factors. We need to ensure that we create conditions that persuade our young talent to stay and help build Yerevan and Armenia to standards they seek abroad. These are standards that include not only individual income and wealth but also quality of life, social equity, and environmental health.

### **Environmental awareness**

Environmental awareness has been indeed growing around the globe, especially in cities as they account for an estimated 67% of global energy use and 71% of global energy-related CO<sub>2</sub> emissions<sup>3</sup>. Citizens more than ever demand clean air, more green spaces as well as products and services that reduce negative environmental externalities (e.g. energy efficient technologies)<sup>4</sup>.

Environmental awareness is also on the rise in Yerevan, though work to do to catch up with many of our comparable European or Asian cities. The environmental problems facing us, however, are similar to our comparable global cities. It is very important to engage both the citizens of Yerevan as well as the private sector and academia in activities aimed at improving the environmental assets of the city. In 2014, we joined the EU Covenant of Mayors for Climate & Energy and committed to achieve at least 20% reduction of greenhouse gas emissions by 2020 compared to the baseline figures of 2012. This Green City Action Plan is an expression of further commitment to the environment and enhanced quality of life in our city.

### **Sustainability**

Sustainability issues have gained momentum in recent years and have been addressed on multiple international platforms and occasions, such as the Rio+20 United Nations Conference on Sustainable Development, “The future we want”; and the 2015 United Nations Climate Change Conference. In 2016, the UN Conference on Housing and Sustainable Urban Development (Habitat III) taking place in Quito, Ecuador, where Armenia was represented through its Ministry of Territorial Administration and Development, adopted the New Urban Agenda<sup>5</sup> which outlines a shared “vision for cities for all” underpinned by a set of shared principles and commitments that governments at all levels should strive

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<sup>1</sup> Source: (National Statistical Service of Armenia, 2015) and Yerevan Municipality, 2016

<sup>2</sup> Source: National Statistical Service of Armenia , 2015

<sup>3</sup> OECD. Green Growth in Cities, Key Messages from the OECD [online]. OECD Publishing, Retrieved from: [https://www.oecd.org/gov/regional-policy/GGIC%20flyer\\_v4.pdf](https://www.oecd.org/gov/regional-policy/GGIC%20flyer_v4.pdf)

<sup>4</sup> OECD. Green Cities Programme [online]. OECD Publishing, Retrieved from: <http://www.oecd.org/regional/greening-cities-regions/46811501.pdf>

<sup>5</sup> Habitat III conference adopted the Draft of the New Urban Agenda which was later (January 2017) confirmed by the General Assembly of the United Nations. Through the New Urban Agenda, the UN expressed a “[shared] vision of cities for all, referring to the equal use and enjoyment of cities and human settlements, seeking to promote inclusivity and ensure that all inhabitants, of present and future generations, without discrimination of any kind, are able to inhabit and produce just, safe, healthy, accessible, affordable, resilient and sustainable cities and human settlements to foster prosperity and quality of life for all

to implement. In the same year, Armenia signed on to pursue the UN Sustainable Development Goals (SDGs), many of which have direct bearing on sustainable city development.

We perceive the need for sustainable growth as an opportunity. Green urban activities are becoming an effective way of addressing environmental challenges, including climate change, while creating jobs, attracting firms and investment, increasing the local production of green goods and services and encouraging sustainable urban redevelopment. The challenges outlined in this GCAP suggest that the potential for green growth is large and the strategic targets as well as short-term actions considered for the following three years aim at making full use of that potential.

### **Context of Yerevan**

Yerevan faces challenges on multiple fronts. Environmental assets of air, water, soil are negatively impacted by human activities such as transport, energy, water use and waste management. In the recent years, many measures have already been taken to remedy the situation, e.g. the construction of new road infrastructure, launch of overhaul of the city bus fleet, gradual introduction of energy efficient technologies in public buildings and public lighting, consolidation of the water operations, preparatory work for Nubarashen dump site rehabilitation and new sanitary landfill construction integrated with a waste sorting plant. In the framework of public-private partnership, the community also considers the possibility of building a waste sorting and recycling plant in case if self-covering or profitability principle is maintained.

More needs to be done in the coming years to raise the quality of life in the City to standards seen in many European cities. Our city can benefit from a complete overhaul of its public transport system, creation of alternative mobility options, modernisation of the water and waste water system, introduction of energy management systems and smart grid technologies as well as further measures in the area of waste management in the direction of circular economy. Such measures will call for more engagement of the public, private sector and academia, introduction of new business models and, last but not least, substantial capital investment.

We also recognize the importance of partnerships with other cities globally that will enable learning from each other's successes and failures. While learning from other cities' experience, we also commit to respect Yerevan's context and account for its baseline conditions. We hope that the strategic framework of this GCAP will help us face the challenge of keeping the balance between the dynamism brought about by the need to pursue building a modern, sustainable city on the one hand and the stability of preserving valuable history and traditions on the other.

# 1 Green City Action Plan methodology (GCAP)

We undertook to develop this Green City Action Plan in cooperation with EBRD and with the assistance of an international team led by EY Czech Republic and consisting of independent Armenian experts as well as international experts from EY (transport, air quality) and specialized EY partner companies – SEVEN (energy efficiency), GeoTest (waste-related topics) and SWECO (water-related topics). This development was funded by the Czech government through the EBRD's Green Economy Transition Policy Dialogue Framework. It is based on EBRD's methodology developed together with ICLEI and OECD.

Yerevan's GCAP is the first application of the Bank's Green Cities approach. We are proud to conduct such pioneering work which will help other cities in the region to set off along the green growth path.

This is a strategic document that identifies Yerevan's key environmental challenges, outlines its long-term strategic objectives as well as proposes mid-term targets and short-term priority actions to address these challenges. It was developed within Stage 1 and Stage 2 of the GCAP process which builds on cycles<sup>6</sup> and iteration as illustrated by Figure 1 below.<sup>7</sup>



Figure 1: Green City Action Plan cycle overview

**Stage 1** focused on relevant information and data identification, collection, processing and analysis to establish the baseline on which the long-term vision and the actions to fulfil it can be built. The baseline consists of three sets of indicators along the axis Pressure-State-Response. This approach assesses the negative impact of human activities (Pressure indicators) on the state of environmental assets and identifies gaps in the policy framework (Response indicators). Human activities are mapped in particular through the transport, buildings, external lighting, industries and land use sectors. The analysis of the policy framework covers the national legal and regulatory framework as well as Yerevan's previous strategies, reports and actions that can inform and influence the GCAP's direction across all the sectors

<sup>6</sup> The GCAP cycle is to be set for 3-5 years in accordance with the city's preferences and governance framework. The cycle determines the approximate time scope for short-term actions. Some short-term actions may however extend beyond one cycle.

<sup>7</sup> The cycle does not mention the Strategic Environmental Assessment that was developed along with GCAP in compliance with the Armenian legislative framework as this requirement is not applicable in all countries where GCAP is or could be developed in the future.

covered. The policy framework is referenced throughout the GCAP and more detail is provided where necessary.

The Pressure-State-Response Indicators framework is further illustrated below.

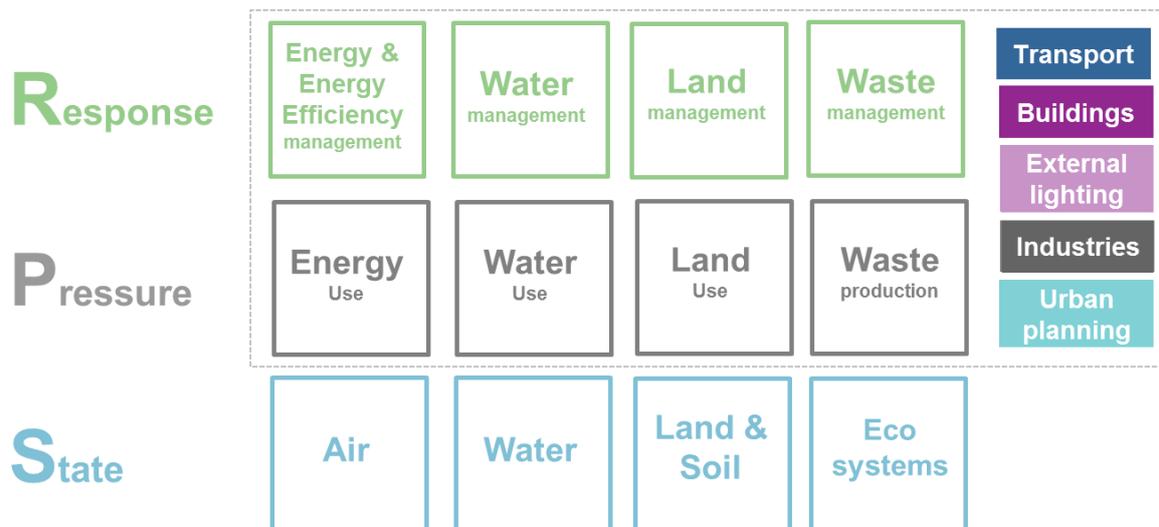


Figure 2: Pressure-State-Response Indicators Approach

The baseline mapping concluded with a prioritization of Yerevan’s challenges carried out along a three-step process. The international team of experts collected the data and carried out the respective analysis involving us and stakeholders from the very beginning. Stakeholders were identified in cooperation with local experts and with us. Stakeholders included non-governmental organisations, representatives of international donor organisations as well as relevant ministries and their agencies (See Annex 8 for a full list of stakeholders). Discussions were held both on bilateral basis and through public workshops. Two such workshops were held in December 2016<sup>8</sup> to discuss and receive feedback on the preliminary results of analysis of environmental challenges. Subsequently, discussion was held with us, through the responsible departments’<sup>9</sup> heads to finalise the prioritisation of challenges in preparation of the next stage.

**Stage 2** was dedicated to the actual GCAP development where we worked with the team of experts on the definition of the vision and long-term strategic objectives along with a roadmap represented by mid-term targets and short-term actions. We held a number of discussions to reflect on the great number of challenges Yerevan is facing while taking into account the need for prioritisation in the short-term to ensure feasibility. We aimed to optimise the environmental, economic and social wins we can achieve while also considering the budgetary constraints. By defining mid-term and long-term targets, we make sure that all challenges are addressed in due time and we keep the holistic picture of the city always in mind.

As part of Stage 2, we organised four public workshops (public hearing)<sup>10</sup> to receive feedback from stakeholders on the strategic framework and short-term actions as well as on the Strategic Environmental Assessment (SEA) that was developed in parallel with GCAP to comply with the Armenian legislative framework<sup>11</sup>. As part of the SEA process, we also received comments from the Ministry of Emergency Situations, Ministry of Health, Ministry of Territorial Administration and Development as well as Ministry of Natural Protection. Subsequently, for the purpose of environmental impact assessment, the draft GCAP and draft SEA were submitted to the EIA Agency for review. According to the RoA law on Environmental impact assessment and examination, the GCAP draft has undergone a strategic environmental assessment process, for which the RA Minister of Nature

<sup>8</sup> 1<sup>st</sup> public workshop was held on 8 December 2016, 2<sup>nd</sup> public workshop was held on 19 December 2016; 2<sup>nd</sup> workshop was held in line with Strategic Environmental Assessment process to which GCAP has been subject to. Summary of the feedback received is covered in Annex 6.

<sup>9</sup> The following departments participated: transport, nature protection, communal services (utilities), urban development, development and investment programmes

<sup>10</sup> 3<sup>rd</sup> public workshop was held on 16 June 2017. Summary of the feedback is covered in Annex 7.

<sup>11</sup> The RoA law on Environmental impact assessment and examination (21.06.2014, HO -110)

Protection issued the positive conclusion of state expertise, N ԲՖ77 as of August 21, 2017. The process was concluded by a 4<sup>th</sup> public workshop and involvement of the advisory committee of the mayor whose members also provided feedback on the draft GCAP. All feedback was processed by the team of experts in cooperation with us and we aimed to give all comments received the utmost consideration.

Once the GCAP has been adopted by the Council of Elders, we plan to use it as basis for the elaboration of Yerevan's next 5-year plan. Implementation of the actions falls under **Stage 3** of the GCAP process and includes also continuous monitoring of progress.

After the first three year period within which the short-term actions should be implemented, we plan to go through **Stage 4** of the GCAP process which should map successes and areas for improvement of implementation, involve stakeholders for feedback and carry out an update of the GCAP where new actions are defined in direction of the strategic objectives. These may be updated in the process to take account of major new developments.

## 2 How to read this GCAP

This GCAP aims to present information in a clear way while providing concise explanations of key elements and justification for the strategic framework and recommended actions. This is further underpinned by the provision of detailed data and their assessment in the Annexes.

When we were developing the GCAP baseline, we realised that a major obstacle was the lack of data or their poor quality. This conclusion applies across almost all indicators considered. That is why this GCAP places a great emphasis on actions leading to better monitoring and data processing.

**We recall that the Green City Action Plan is a strategic document for the implementation of our green activities until 2030. The strategic framework is built along the vision - strategic objectives - mid-term targets axis which is then complemented by short-term actions. This structure provides a roadmap for us to follow within the next 15 years.**

As explained in chapter 1, the GCAP cycle allows for a periodic review and hence an update of the strategic framework in accordance with the green projects implementation progress as well as major city, and possibly also country, developments.

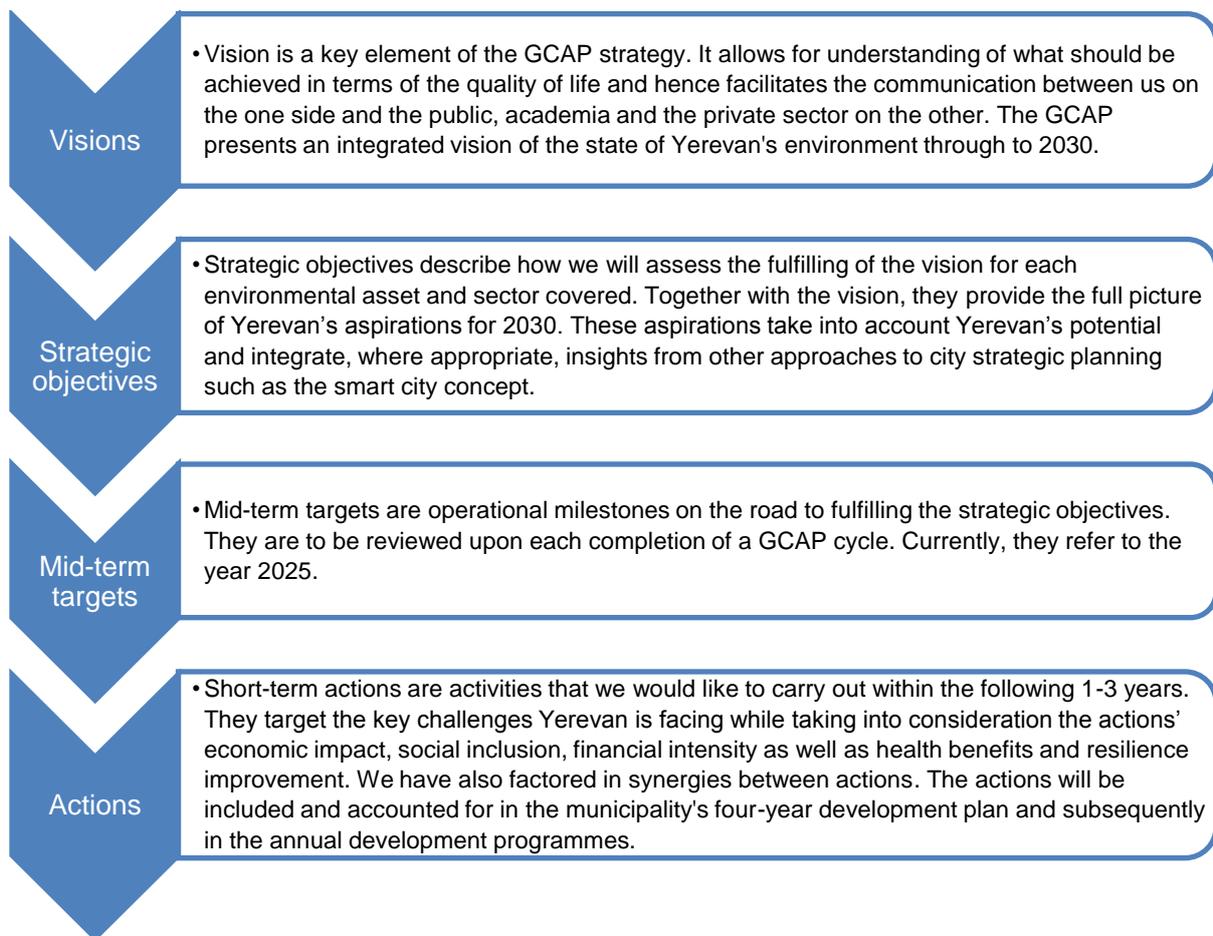


Figure 3: GCAP cycle

As this is the very first GCAP we have developed, there may be gaps in our understanding of all the elements covered. The development of the plan involved a wide number of stakeholders to minimise these gaps, and we hope that their involvement will grow in the future to help us implement the GCAP as well as further enhance its quality. Such involvement will only be possible if there is more awareness about the challenges Yerevan faces and understanding of how each stakeholder can contribute so that our vision can indeed be reached by 2030. We hence plan to organise multiple awareness campaigns and in cooperation with the academia and private sector launch targeted pilot projects. These actions form a core part of the short-term actions for 2017-2020.



To facilitate reading of this document, the main body of the GCAP focuses on the results of the baseline mapping and indicators analysis, and presents the strategic framework and short-term actions addressing the key challenges identified. The detailed information on all the indicators covered, including the problem trees which illustrate the assessment of their seriousness and the links between them are included in the Annexes.

The indicators assessment is based on a three level scale where the most urgent environmental problems faced by Yerevan are marked as “red”, areas which do not present a critical priority but require improvement nonetheless are “amber” and areas demonstrating high compliance with green city parameters are marked as “green”.

### 3 Introduction of Yerevan

Before presenting the GCAP baseline and sustainability challenges and actions, we would like to provide some introductory information on our City and its administrative framework. We hope that this document will be read more widely and serve as an example to other cities.

First, we briefly describe the geography and economy of Armenia and Yerevan and then explain the governance framework, incl. financing.

#### 3.1 Armenia and Yerevan

Yerevan is the capital and largest city of Armenia which is situated in the Transcaucasian region in the southern part of the Caucasus mountain range. Armenia borders Georgia in the North, Azerbaijan in the East, Iran in the South and Turkey in the West and South West. Its landlocked position is further exacerbated by the absence of any diplomatic relations with two out of its four neighbouring countries: Turkey and Azerbaijan, and by Armenia's dependence on commodity imports and large capital inflows to finance the high current-account deficit.<sup>12</sup>



Figure 4: Map of Armenia



Figure 5: Official insignia of Yerevan

The country is divided into 10 administrative-territorial regions. Yerevan is not part of this territorial division and enjoys a special administrative status due to its economic and political importance.

The City of Yerevan was established in 782 BC and, in 2017, is celebrating its 2799th year of existence. It became the capital of Armenia in 1918 and has been the administrative and economic centre of Armenia since.

Table 1: Yerevan statistical data

Yerevan 2016 statistical data	
Area	223 km <sup>2</sup>
Max. Length	19.7 km from North to South
Max. Width	19.1 km from East to West
Altitude	900 to 1,400 meters
Average summer temperatures	22 to 36°C
Average winter temperatures	-10 to -5°C
Population	1.074 mil.
Population density	4,816 people/ m <sup>2</sup>
Estimated <sup>13</sup> GDP	AMD 2,317,924 mil. (USD 4,850 mil.)
Estimated GDP per capita, AMD	AMD 2.1 mil. (USD 4.4 thousand )
Deflation 2016/ Inflation 2015 rate (Armenia)	1.4%/3.7%
Unemployment rate (Armenia)	18%
Time zone	UTC+4

<sup>12</sup> Source: Knarik Ayvazyan and Teresa Dabán IMF Working Paper: Spillovers from Global and Regional Shocks to Armenia

<sup>13</sup> The GDP indicators are not officially reported in Armenia on regional basis. The estimation is done based on the "Per capita GDP ratio of Yerevan and Marzes to republican average" calculated and estimated based on NSS data for Development Program 2014-2025, and increased by the GDP growth rate in Armenia for the period 2012-2015.

### 3.1.1 Geography

#### 3.1.1.1 Location and climate

Yerevan lies on a plain on the edge of the Ararat Valley at altitudes of 860-1,400m. It has a dry continental climate. Average annual air temperature is between 9.1 and 12.1°C. Winters are quite cold with a lot of snowfall and average temperatures in January between -5°C and -2.5°C, with absolute minimum air temperature between -21°C and -31°C. Springs are brief, and with volatile weather. Summers are long, hot and dry, with average temperatures between 22.1-25.4°C. The absolute maximums of air temperature registered in July are between 40°C and 42°C. During summer, winds blowing from the mountain-valley sometimes reach a speed of 15-20 m/sec. The annual average temperature ranges between 9.1-12.1°C, which represents a seasonal fluctuation of 27°C between average summer and average winter temperatures. The duration of the heating season is between 137 and 161 days.

Annual rainfall is 286-440mm peaking in November while the highest share of rainy days is in May.

Armenia also enjoys a lot of sunshine. The annual average is 2,578 hours. Hours of sunshine per day will vary from an average of 7 in winter to 13 in summer.<sup>14</sup>

#### 3.1.1.2 Implications for environment and sustainability

As highlighted above, Yerevan's climate is characterized by hot summers and cold winters, which creates need for heating and cooling and subsequent energy demand. On the other hand, the relatively high amount of sunlight allows effective use of solar energy. The total solar radiation on a horizontal surface under medium cloud cover equals to 1,690 kWh/m<sup>2</sup>/year, annual average share of direct radiation under the same conditions is 62%. It is estimated that the planned introduction of solar heating systems in the public buildings will result in nearly 3,343 MWh/year natural gas savings and 66 MWh/year of electrical energy savings.<sup>15</sup>

Another green source for the energy generation could be the collected solid and liquid waste.

In winter, heavy snowfall can become an issue in the City of Yerevan. Snow may accumulate in the streets, slow down traffic and when melted may cause minor flooding due to low drainage system capacity. Similarly, in case of heavy rainfall, the drainage systems will also lack water collection capacity in some districts.

### 3.1.2 Natural disaster risk

Armenia is at high risk of natural disasters. World Bank lists Armenia among 60 most disaster prone countries in the world<sup>16</sup>. The likelihood of a disaster event and the potential severity of such event are high. Seismic hazards are the primary threat, with storms, hails, floods and landslides as additional potential natural disaster risks. Multiple studies<sup>17</sup> have been carried out in the past analysing the primary causes of these risks as well as appropriate mitigation measures.

The 1988 Spitak earthquake<sup>18</sup> exposed the country's vulnerability to the seismic risk and Armenia has ever since been improving its emergency management capacities. As of 2008, there is a dedicated ministry, the Ministry of Emergency Situations (MoES) which is responsible for the management and coordination during large scale emergency situations and for the execution of emergency plans. The coordination body for Yerevan is the Yerevan Rescue Service which falls under the MoES and together with MoES develops a Disaster Risk Management Programme for the City of Yerevan. We note that since the establishment of the new emergency management body, the emergency plans and systems have not been tested yet.

<sup>14</sup> Source: R.A. Mkrtychyan, Mkrtychyan A.R. The Climate of Yerevan. Yerevan, 2016. (In Russian)

<sup>15</sup> Yerevan SEAP (2016), English version, p. 79

<sup>16</sup> Disaster management in Armenia, Armen Yeritsyan, Ministry of Emergency Situations, Republic of Armenia, 20 May 2013

<sup>17</sup> Disaster Risk Reduction and Emergency Management in Armenia, World Bank, 2009

VFL Armenia National Study; REC Caucasus Armenia National Office, 2013

Climate Risk Management in Armenia, Country Report, UNDP, 2013

United Nations Development Programme (UNDP) Report on reducing natural disaster risk (2004)

<sup>18</sup> The Spitak earthquake killed more than 25,000 and injured 19,000 people, damaged over 515,000 homes and caused about USD 15-20 bn in damages (Source: JIKA study, 2009)

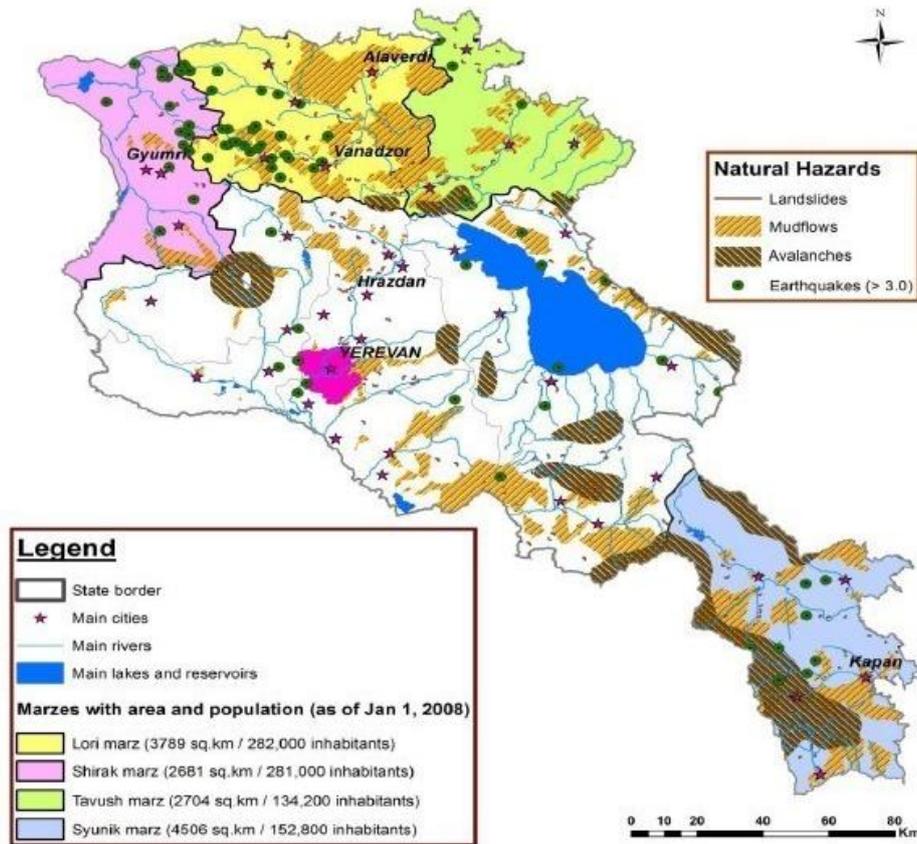


Figure 6: Natural disaster risk map of Armenia (Source: Ministry of Emergency Situations)

Natural disasters have had negative impact on the Armenian economy and the vulnerability remains high. According to a 2013 study on vulnerability mitigation<sup>19</sup>, there is a 20% chance, in any given year, of a major disaster resulting in losses of 12.7% GDP. Moreover, vulnerability is high also with regard to population as 80% of Armenians are at risk of exposure to catastrophic events.

Considering the high risk of natural disasters, all capital investment projects are bound to consider general resilience improvement. This is also ensured by the Strategic Environmental Assessment framework.

Considering the impact of natural disasters when they occur, resilience relates not only to the state and quality of the environmental assets<sup>20</sup> but also to accessibility of urban environment and social inclusion.

### 3.1.2.1 Landslides

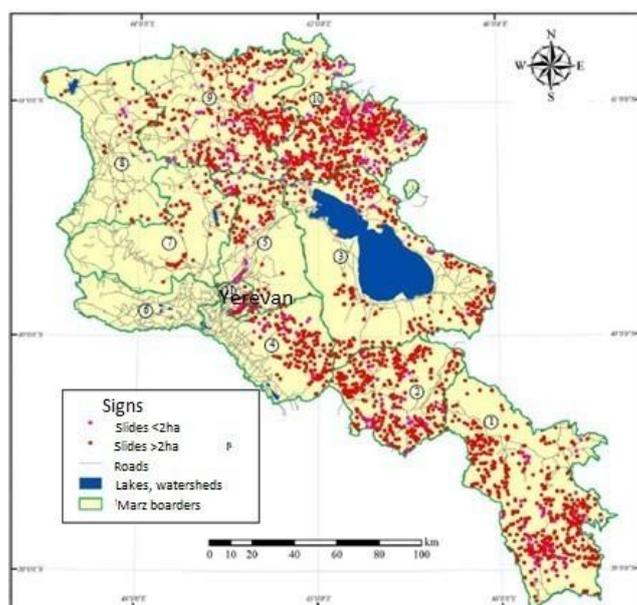
Landslides are quite common in Armenia and, in recent decades, their occurrence has grown in numbers and extent due to deforestation, improper organization of water management and irrigation works as well as changes in the water balance circulating within the landslides. Deforestation that occurred in the period of economic crisis and blockade (1990-2005) led to the loss of close to 20% of Armenia's forest cover (around 63,000 ha).

Landslide-prone area covers over 122,000 ha (around 4.1% of the area of Armenia) and 35% of settlements. A Japanese International Cooperation Agency (JICA) study on the management of landslide disasters (2004-2006) reported that 233 communities out of around 960 communities in Armenia are affected by landslides and more than 100 of them experience significant impact of landslides causing damage to houses, communication routes and other facilities, incl. approximately 3.2% of the total road network and approximately 0.5% of the total railway network.

<sup>19</sup> VFL Armenia National Study; REC Caucasus Armenia National Office, 2013

<sup>20</sup> Traditionally «Environmental asset» is the broader term for «natural resource», which not only includes receipt of material benefits, but also providence of environmental functions and services, including those which have no economic value, but have other benefits, alternatives and privileges or those which merely have advantage by their existence, regardless of their monetary expression. For a further explanation see, for example: <https://stats.oecd.org/glossary/detail.asp?ID=6421>:

Yerevan's territory has a low risk of landslides compared to other regions of Armenia but landslides do occur in about 6% of its territory (See Figure 7 below).



Landslide indicators for Yerevan		
Surface area		22,300 ha
Number of landslides		152
Total landslide-prone area		1,300 ha
Share of landslide-prone area		6%

Figure 7. Landslides in the Republic of Armenia, and landslide indicators for Yerevan

### 3.1.2.2 Seismic Risk

Seismic risk represents the greatest threat of all natural disasters. The distribution pattern for seismic risk in Armenia is shown below (Figure 8). The map illustrates that the maximum seismic risk is concentrated in the region of Yerevan and hence affects 40% of the total population of Armenia. According to RA law On Seismic Protection, earthquakes in Yerevan are now expected with the peak ground acceleration of 0.4g. Thanks to the GIS technology, seismic risk factors have been calculated for almost all Yerevan's buildings. The design level of the buildings' earthquake resistance is presented in Figure 8 below. The zones of high seismic risk cover about 2,600 ha (15% of the city territory) and 5,389 buildings; another 4,400 ha (24% of the city territory) should also be considered as a high seismic risk area taking into account the 34,143 private low-storied stone houses. The remaining 2,185 buildings have a moderate risk of destruction. Yerevan seismic activity has been studied by various international institutions and most agree that an earthquake with a magnitude of 7.0 or higher would destroy most buildings and lead to a very high number of fatalities.<sup>21</sup>

Data on natural and anthropogenic incidents during 2010-2016 in Yerevan City

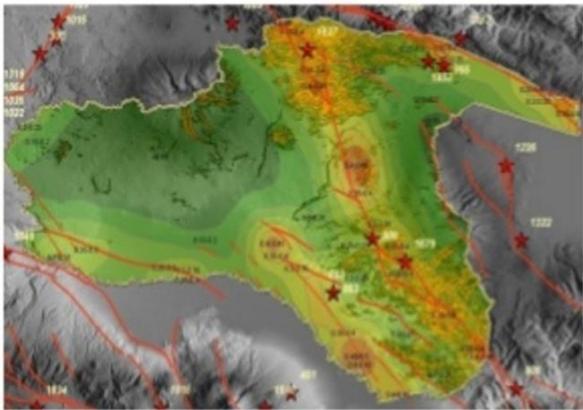
Year	Natural incidents						Anthropogenic incidents	
	landslide	landfall	stonefall	hail	wind	Fire in vegetation	Fire	explosion
2010	2	8	10	3	28	1,037		3
2011	3	5	3	4	13	1,068		2

<sup>21</sup> Source: UNDP, 2013; Final Report on Country Situation Review in the Context of National Disaster Risk Assessment and Management in Armenia

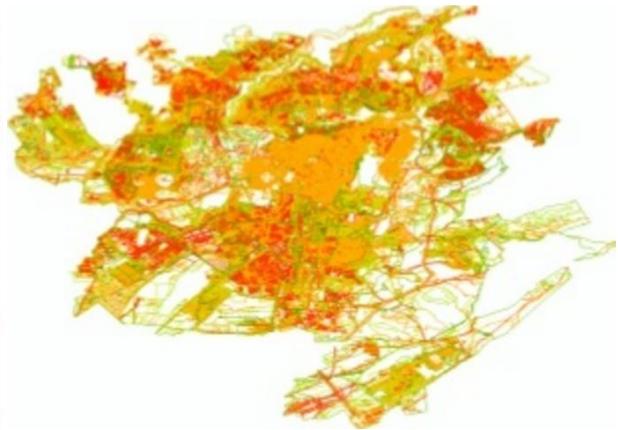
Yerevan's Green City Action Plan 2017

2012		4	10	1	31	317		8
2013		8	7	1	52	498	2 (Spayka and Grand Candy)	5
2014		7	6	2	65	354		4
2015		4	7		65	1,670		6
2016		6	14	7	46	536		2

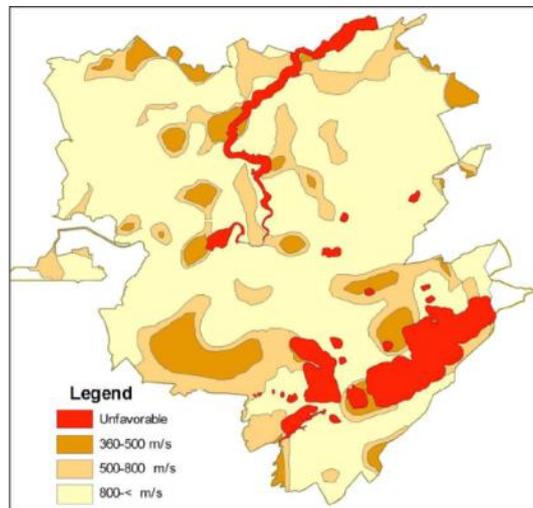
Table 2: Frequency of natural and anthropogenic incidents from 2010 to 2016 in Yerevan City (Source: Ministry of Emergency Situation (RoA))



PGA distribution



Building damage distribution



Hazard map

Figure 8. Probabilistic Seismic Hazard Maps of Yerevan

### 3.1.3 City layout

The city has a circular core, Kentron, which is the historical part of the city and the location many residences as well as business and government offices and major cultural venues. It is encircled by the other districts and connected by a road network. The further from the city core, the lower the density and accessibility of transport means. Seven (7) out of 12 of Yerevan districts—viz., Shengavit, Malatia-Sebastia, Nor Nork, Erebuni, Kentron, Arabkir and Adjapnyak—account for 82% of the city's population. The least populated areas of the city are districts of Nubarashen, Nork-Marash and Davidashen. Our city layout poses both opportunities and challenges for the sustainability of our transport network.

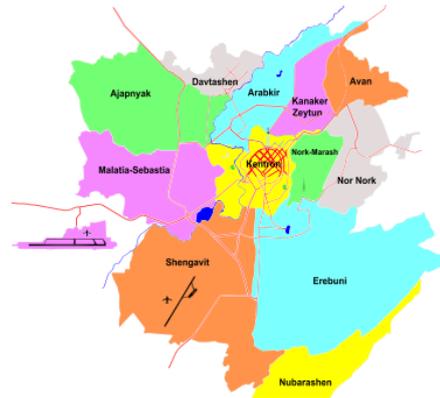


Figure 9: Layout of Yerevan

### 3.1.4 City demographics

In 2016 Yerevan had approximately 1.1 million inhabitants, which represents 36% of total population of Armenia and 56% of Armenian urban population. During 2016, 15,440 people were born and 8,270 died, thus ensuring natural population growth by 6,170 people.

Average life expectancy is 75.3 years, with 78.3 years for women and 71.9 years for men. The average population age is 35.9 years. People in productive age (15 to 64 years) represent 69.4% of population.<sup>22</sup>

The level of urban development and population has greatly evolved over the last 100 years. The rapid growth of the urban population reached its peak in the 1960s and continued at a slower pace till the 1990s. After the collapse of the Soviet Union, during which the largest portion of migration was observed. The emigration continued as a result of economic downturn, privatization of land in rural areas and war with Azerbaijan. The emigration continues today, it is however partly offset by the urbanization trend in Armenia.

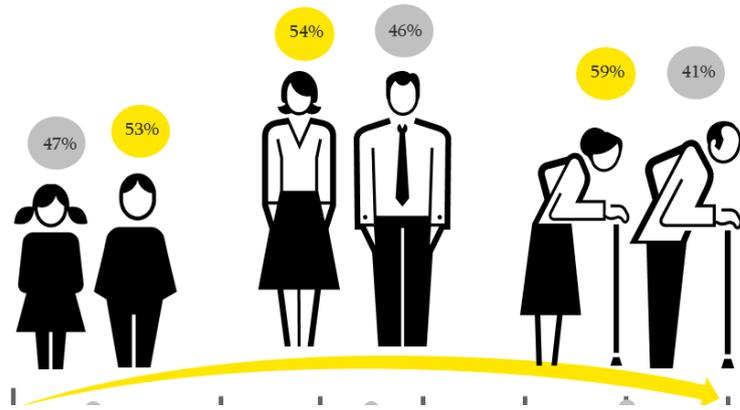


Figure 10: Demographic distribution of Yerevan population

The consistent flow of people from the regions into the city of Yerevan fuels demand for real estate and construction and also burdens the city with traffic load.

The consistent flow of people from the regions into the city of Yerevan fuels demand for real estate and construction and also burdens the city with traffic load.

<sup>22</sup> Source: National Statistical Service of Armenia , 2015

### 3.1.5 Economy

#### 3.1.5.1 General overview

Yerevan is the largest economic centre in Armenia and hence the overall economic prosperity of the country is very much dependent on Yerevan's economic development. Yerevan has 86% of service income in the country, 83% of retail trade, 54% share of construction, 42% share of industry but only 1% in agriculture. Additionally, 78% of new buildings are put into operation and 33% of the hotel business is located in Yerevan.<sup>23</sup>

Based on the official statistics, 50% of the population is employed and the rate of unemployment is 18.5%.

Yerevan is also the education centre of Armenia. 48 out of the total number of 60 higher education institutions are located there. There are 70,931 students in the city and nearly 50% of the students imagine their future perspectives to be realized abroad<sup>24</sup>, mostly due to economic and development factors.

According to the World Bank categorization, Armenia is a lower-middle income country, heavily dependent on agriculture, industry, trade and services with the last one becoming more important throughout the years. In contrast, construction, which used to have a major important role in the economy and in the city, is losing its share of GDP.

The economy is largely shaped by its political situation and remittances sent by Armenians working abroad. Russia is home to the largest portion of Armenian diaspora and this, in its turn, has a huge impact on the economy and the living standards of the Armenians. Therefore, Armenian economy is strongly affected by any development in the Russian economy. Large share of FDI comes from Russia, America and Iran.

Armenia has a passive foreign trade balance, where imports exceed exports more than twice. The largest import partners, which together account for 60% of total imports, are Russia, China, Germany, Iraq, Georgia and Canada. Armenia imports mineral fuels, mineral oils, products of their distillation, nuclear reactors, boilers, machinery and mechanical appliances, vehicles and machinery, pharmaceutical products, plastics and grains.

Six major export partners, which also account for 61% of the total exports, are Russia, China, Iran, Germany, Italy and Turkey. Main export articles are ores, slag, ash, natural or cultured pearls, precious or semi-precious stones, precious metals, tobacco, beverages, mineral fuels, aluminium, copper and iron.<sup>25</sup>

#### 3.1.5.2 Recent economic development and poverty issue

The economy of the country as a whole, as well as of the city itself has faced unequal territorial development since the 1990s. Nevertheless, throughout the years, the average living standard of the population in Armenia have constantly improved. If during the early 2000s nearly 53% of the urban population was regarded to be poor, in 2016 it was only 30%. Further reduction of poverty is considered a priority area according to Armenia Development Strategy for 2014-2025<sup>26</sup>. We strongly believe that actions defined in this GCAP to support environmental as well as economic and social sustainability will contribute to further reduction of poverty in Yerevan which was at 27% in 2015<sup>27 28</sup>.

<sup>23</sup> Source: National Statistical Service of Armenia, 2015 and Yerevan Municipality, 2016

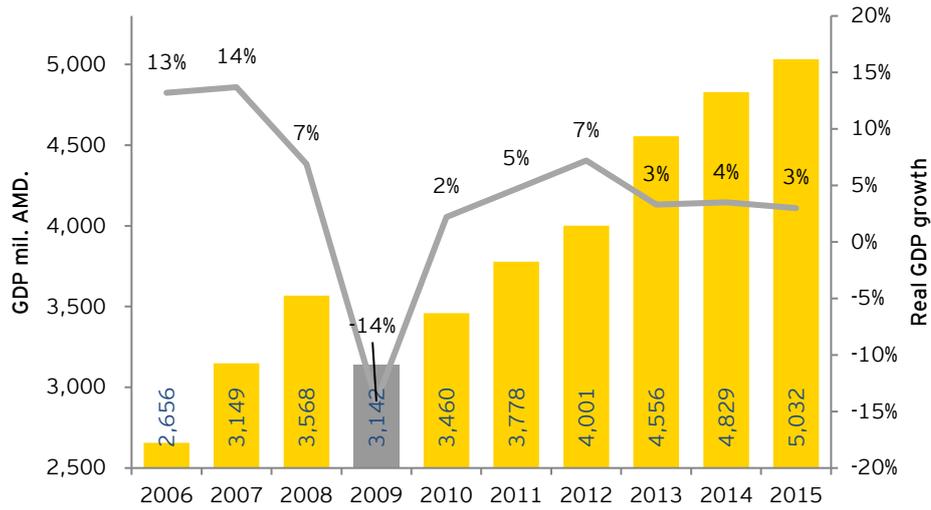
<sup>24</sup> Source: National Statistical Service of Armenia, 2015

<sup>25</sup> Source: UN Comtrade Database, 2015

<sup>26</sup> Source: [https://eeas.europa.eu/sites/eeas/files/armenia\\_development\\_strategy\\_for\\_2014-2025.pdf](https://eeas.europa.eu/sites/eeas/files/armenia_development_strategy_for_2014-2025.pdf)

<sup>27</sup> Source: National Statistical Service of Armenia, 2015

<sup>28</sup> Source: (National Statistical Service of Armenia, 2015



Source: Ministry of Economy of The Republic of Armenia, Macroeconomic Indicators

Figure 11: GDP development in Armenia

### 3.2 Governance framework

In order for the GCAP plan to be implemented, it should first be processed and approved by the Council of Elders with subsequent implementation of projects executed by the Municipality's respective divisions and overseen by the Mayor.

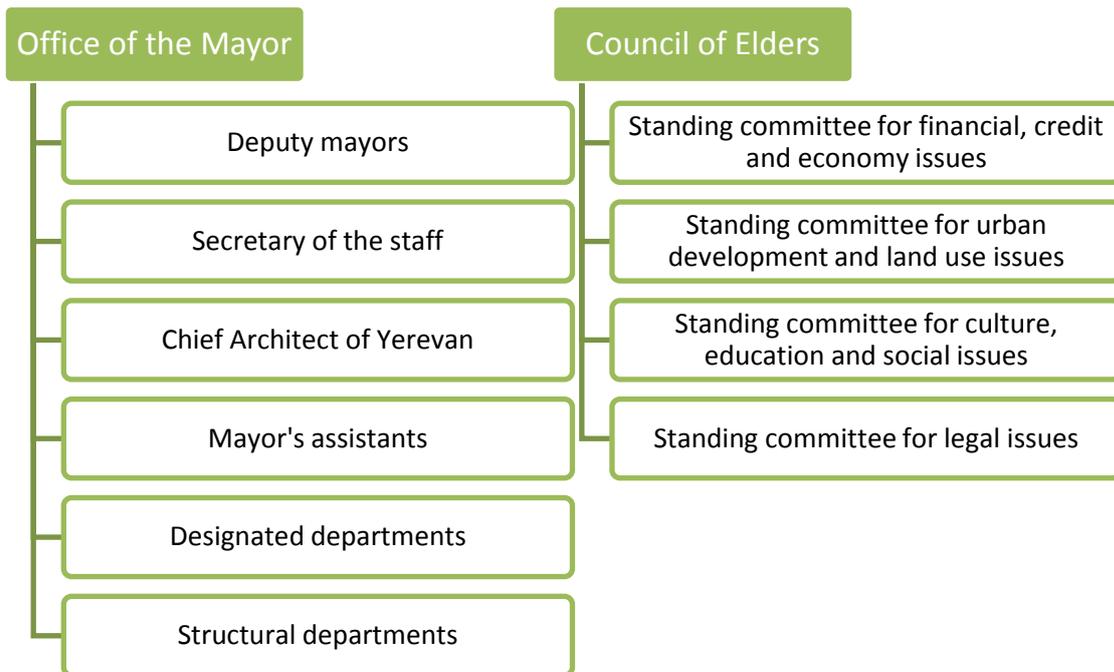


Figure 12: Organizational structure of Yerevan

The governance framework of the City of Yerevan<sup>29</sup> is established by the RoA “Law on Local Self-Government in the City of Yerevan” and is executed by two elective bodies, the Council of Elders and the Mayor. Figure 13 illustrates the governing framework.

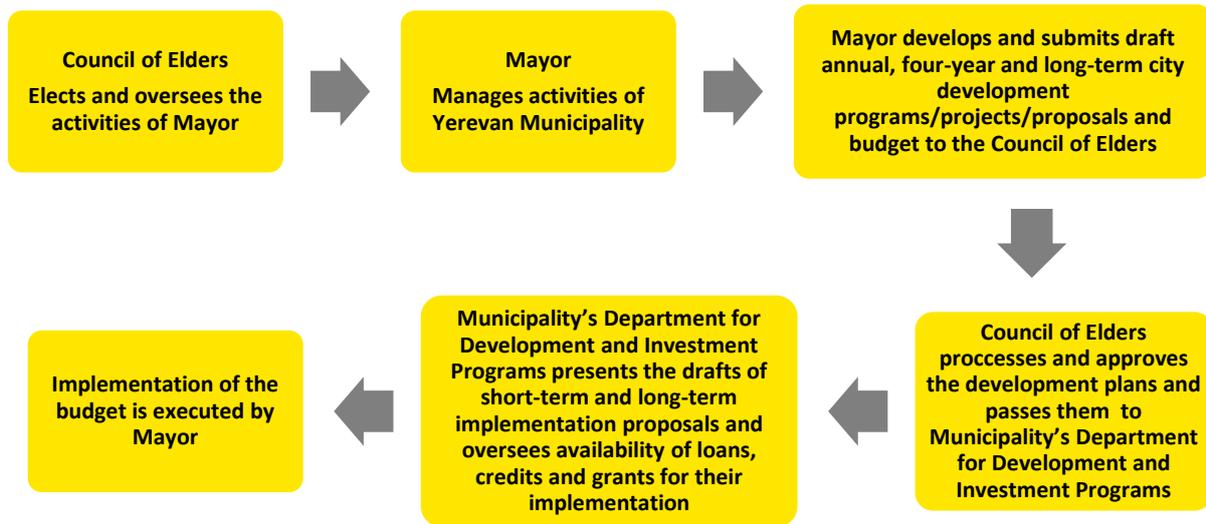


Figure 13: Schema of municipal approval mechanism

The Mayor of Yerevan is the highest representative of the local government body managing the activities of Yerevan Municipality. The Mayor of Yerevan develops and submits draft annual, four-year and long-term city development programmes/projects/proposals to the Council of Elders and this GCAP should support the Mayor in those tasks.

In order to increase the effectiveness of project implementation, Yerevan also established a project implementation unit (PIU) for Sustainable Urban Development Investment Program. The PIU executes projects related to urban infrastructure, institutional strengthening and programme management and capacity building. The PIU supervises the preparation and management of project contracts, quality of activities and deadlines.

The City budget is developed by the Mayor and adopted by the Council of Elders. After the approval of the budget by the Council, quarterly budget execution breakdowns are established by the Mayor. Mayor is responsible for managing Yerevan budget resources and their purposeful use and the Council of Elders takes decisions on the budget, its amendments, oversees budget execution and Mayor’s annual budget execution report.

The Council of Elders, with 65 members is the highest body of local self-government and has the authority to elect and oversee the activities of the Mayor. It approves the charter and human resource policies for the municipality, administrative districts and entities in their jurisdiction. Local taxes, duties and fees for services delivered by the community are also set by the Council of Elders. In addition, it has the power to approve one year, four-year, and longer-term and special plans of city development, make decisions regarding the conservation and use of the green land in Yerevan and execute liabilities regarding waste removal and sanitary cleaning.

The current four-year plan covers the period 2014-2017. The summary below presents the key focus areas as well as achievements stemming from the targets set for the preceding period 2009-2013.

### Construction and urban development

Main target:

- Improvement and renovation of existing roads as well as construction of new roads in Yerevan
- In 2009-2013, we have updated the Master Plan of Yerevan addressing the current needs of the city development. We also managed to improve the traffic load in the city by introducing new underground parking areas with a capacity of 500 cars in the city centre, as well as opening new roads connecting

<sup>29</sup> The City of Yerevan consists of 12 administrative districts: Adjapnyak, Arabkir, Avana, Davidashen, Erebuni, Kentron, Malatia-Sebastia, Nor Nork, Nork-Marash, Nubarashen, Shengavit and Kanaker-Zeytun

different parts of the city and bypassing the city centre, such as G. Nzhdeh overpass way, Tsitsernakaberd highway, David Bek, Leningradyan-Isakov, Isakov-Arshakunyats, Ulnetsi-Rubinyants and other streets. Nearly 20 new overpasses had eased transport for pedestrians.

In the framework of the 2014-2017 plan, the renovation and construction works continue. Specifically, we planned to finish the construction process of the "Cascade" monument and to renovate the "Victory" park. Additionally, we planned to reconstruct existing green areas and create new ones. It is expected that around 40 new overpasses for pedestrians will have been built during this period.

### **Water management**

Main target:

- Improvement and extension of the water and wastewater management system

In 2009-2013, we had had many of the 33 existing structures within the water management system renovated or rebuilt in order to meet the current requirements on the system operation. Overall, 40 km of water pipelines and around 5.4 km of sewer systems were reconstructed, 165 modern pumps and pumping stations and chlorination stations were reconstructed or installed. The aforementioned activities had resulted in a lower rate of water losses and approximately 62% of energy saving.

In 2014-2017, we planned to continue with reconstructions of the water system and to launch the Aeracia wastewater treatment plant renovation.

### **Waste management and sanitation**

Main targets:

- Improvement of the waste management and sanitary cleaning system to meet international standards
- Renewal and enlargement of the car fleet of waste management companies

During 2010-2013, 6,211 new trash bins were distributed around the city aiming to improve the waste collection system. We had also piloted equipping garbage trucks with the GPS system to monitor the waste management operations and improve their operational efficiency. Moreover, the Law on the "Garbage Disposal and Sanitation" was adopted on 23 June 2011 introducing some level of mandatory littering fees.

Further improvements to waste management are planned during the period of 2018-2021. As part of the improvements, the Nubarashen waste disposal site would be reconstructed and the construction justification of new waste recycling and sorting facilities will be considered through public-private partnership.

### **Transport**

Main targets:

- Enlargement of the bus and trolleybus fleet, as well as decrease of the number of minibuses
- Improvement of the underground transportation system
- Improvement of the conditions of the bus stops
- Implementation of an integrated ticketing system

During -2013-2017, the car fleet was enlarged with 390 buses while 750 minibuses were taken out of operation to reduce emissions and improve the sanitary aspects of transportation. 298 bus stops had been renovated and seven bus stops, situated on Mashtots avenue and Sayat-Nova street, had been completely replaced. Ten metro carriages had been renovated and 34.6 km of high-voltage cables had been replaced with new ones.

As part of the 2014-2017 plan, it was provided for the purchase of new buses and 40 new trolleybuses to the city fleet while simultaneously decreasing the number of existing minibuses. The public bus stop renovations would continue (10-15 bus stops annually) and be complemented by installations of

electronic timetables. The underground system should be further developed and two new stations should be added. We also considered introducing automated fare collection devices for the integrated ticketing system.

Generally, our activities have been defined based on sustainable economy principles and concerned improvements to the street lightning system, environment, enlargement of green spaces, city design and security and a number of other activities.

### 3.2.1 Annual budget

All actions proposed and agreed under the GCAP are subject to our strict budget rules.

The budget of Yerevan city is a community budget, developed by the mayor based on the planning of financial resources. The budget follows the principles established in the four-year program for community development. By July 1st of each year, revenues and expenditures of the Community budget are estimated in accordance with the standards defined by the Minister of Finance. By 15 August, the budget institutions, i.e. the legal entities which execute the powers of state and local governments submit their budget requests and the estimates of their personnel expenditures with corresponding justification. The mayor summarizes the submitted requests by October 1st and develops a draft decision on the community budget, which is then adopted by the Council of Elders. A summary report on the budgets of the communities is then submitted to the Republic of Armenia (RoA) Ministry of Finance.

The Ministry of Finance is responsible for servicing budget implementation in all communities, including Yerevan. The supervision over implementation of the city's budget is exercised by the Council of Elders, the RoA National Assembly and Prime Minister's Cabinet, within the framework of their statutory powers (Parliament, 2015).

The fiscal space of the Republic of Armenia has diminished over the past years. Currently, there is very limited possibility for integration of sovereign loans for further transfer to local governments. Municipalities are left only with direct borrowing, which has been unprecedented until now. The national legislation regulating the local government's ability to borrow is largely regulated by the Law on Local Self Governance.<sup>30</sup> The legislation is being revised by the Government of the Republic of Armenia. Until the legal reform is completed, we can only hold one loan, and borrow the following loan only after the full repayment of the prior obligations. This creates a significant barrier for our ability to attract financing for a diverse set of investment opportunities in various sectors. Under such circumstances, beyond our current budgeted initiatives, for any additional measures we need to prioritize a single sector and initiative where capital intensive improvements are necessary. From air quality, climate change and urban infrastructure improvement, the transport sector has been rated as primary priority, for which the city will seek to recruit external financing. When the legislation is amended, we will change our borrowing practice to fit within our financial borrowing capacity. We have recently received a Fitch rating of B+ (same as Republic of Armenia) and are currently undergoing an assessment of borrowing capacity to establish the limits to borrowing and annual debt service. We estimate that beyond the short-term actions, the Yerevan Municipality will be able to attract substantially more financing for GCAP measures.

### 3.2.2 2016 Budget

According to the "Mayor's Report on the main directions of development of Yerevan City in 2016" and based on the priority areas and available resources as per Yerevan City's four-year plan 2014-2017, as well as considering the effectiveness of programmes accomplished in 2015 and the requirement of

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<sup>30</sup> Informal translation of Article 59 of the Law on Local Self-Governance on Community Loans and Borrowings stipulates: "...Under the decision of the community council and duly agreed by the state authorized agency, the chief of community may conclude loan agreements for investments in social infrastructure of the community, or issue securities in accordance with legal requirements. Provided the consent of the state authorized agency, the community may conclude the loan agreement with the conditions that the annual repayments of such loans (total of the principal and interest) prescribed by the loan repayment schedule shall not exceed the value of 20% of the revenues collected to the capital budget of the community in the year in question. Community may contract any new loan agreement only further to complete repayment of the existing loan obligations. Such loan resources shall be necessarily channeled to the capital budget of the community..." retrieved from <http://www.parliament.am/legislation.php?sel=show&ID=1305&lang=eng>

keeping the City's actions aligned with its Master plan, the budgeted actions seek to achieve a number of objectives, including:

- proportionate and sustainable territorial development
- development of harmonious living space and equal territorial distribution of the population
- street lighting optimization plan as part of the City's energy saving systems
- improvement of buildings and yards, improvement of the City's environmental conditions
- projects aimed at enhanced public transportation mechanisms
- introduction of modern mechanisms for sanitary and waste disposal

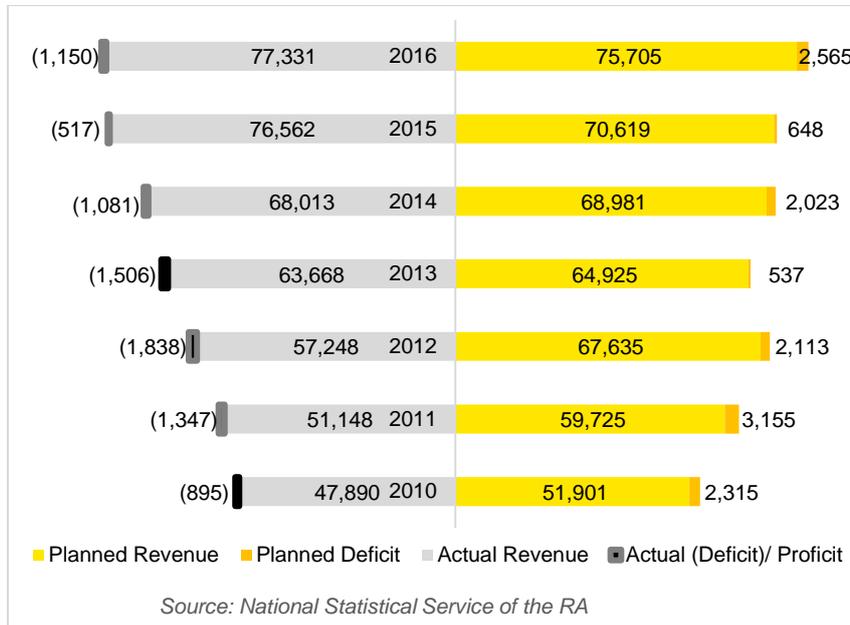


Figure 14: Actual vs. Planned Budget of Yerevan City, AMD mil.

In 2016, the City's actual revenues totalled AMD 77,331 mil. (USD 159 mil.), which represents a 1% increase from 2015 actual budget and is 7% of the Armenian national budget. The actual expenditures totalled AMD 78,481 mil, which is a 2% increase from the actual 2015 budget and represents 6% of the total budget expenditure in Armenia. As a result, there was a deficit of AMD 1,150 mil. Over the last years, the trend has however been towards lower budget deficits than before. In 2010 and 2013, the city's budget even enjoyed a surplus in contrast to the plan. There has also been a stable growth both in revenues and expenditures during the period 2010-2016. (Yerevan Municipality, 2010-2016)

In 2016, the AMD 77,331 mil. revenues were sourced from taxes and duties (AMD 14,220 mil.), official grants (AMD 19,268 mil.) and other income (AMD 43,842 mil.). Other income includes royalties, rent income, income from goods and services, administrative charges, income from fines and penalties, capital non-official grants, etc. Income from goods and services comprised 93% of other income in 2010 and 88% in 2016. (Figure 15)

It is noteworthy that the revenues increased by 59% throughout the years 2010-2016, which is due to an increase in tax and duties income (38%), an increase in official grants (22%) and an increase in other income (93%), which is mostly the financing from the state budget for the services delegated to the local self-government authorities and local fees collection. The increase in other income mainly occurred as a result of increase in income from delivery of goods and services (82%).

The smallest portion of the revenues is generated from taxes and duties, which are nevertheless a stable source of income and include such taxes as property tax on vehicles (7% of total revenues), land value tax, and parking fees.

The actual expenditures for 2016 were AMD 78,481 mil. The biggest budget item was education, followed by building construction and utilities, economic relations, including transport, agriculture, public services and environmental protection. Building construction and utilities cover water supply, building construction and utilities services, as well as street lighting. Environmental protection expenditures include waste removal, initiatives against air pollution and other initiatives aimed at protection of the environment and biodiversity are included.

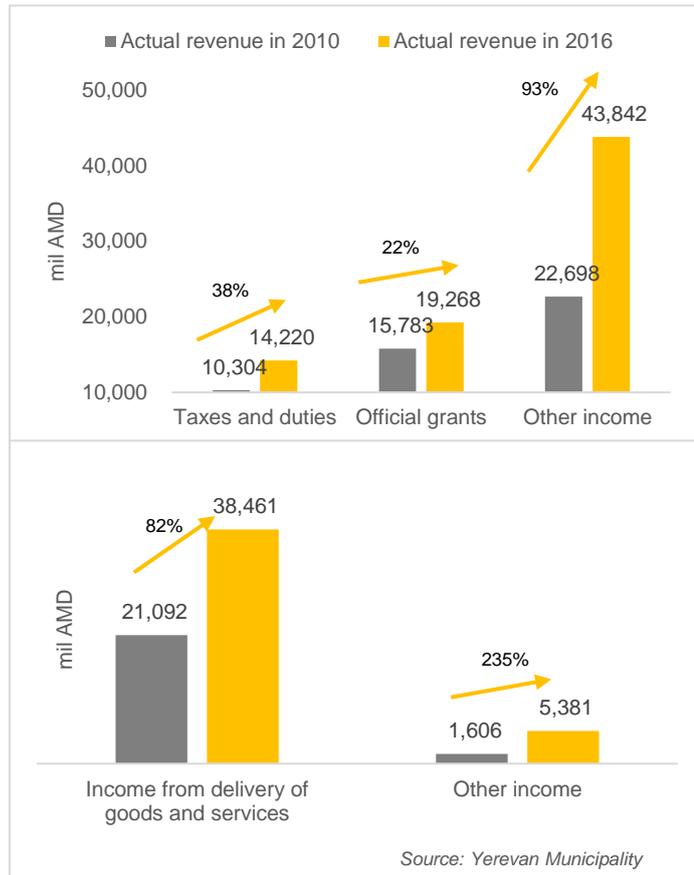


Figure 15: Municipal budget development

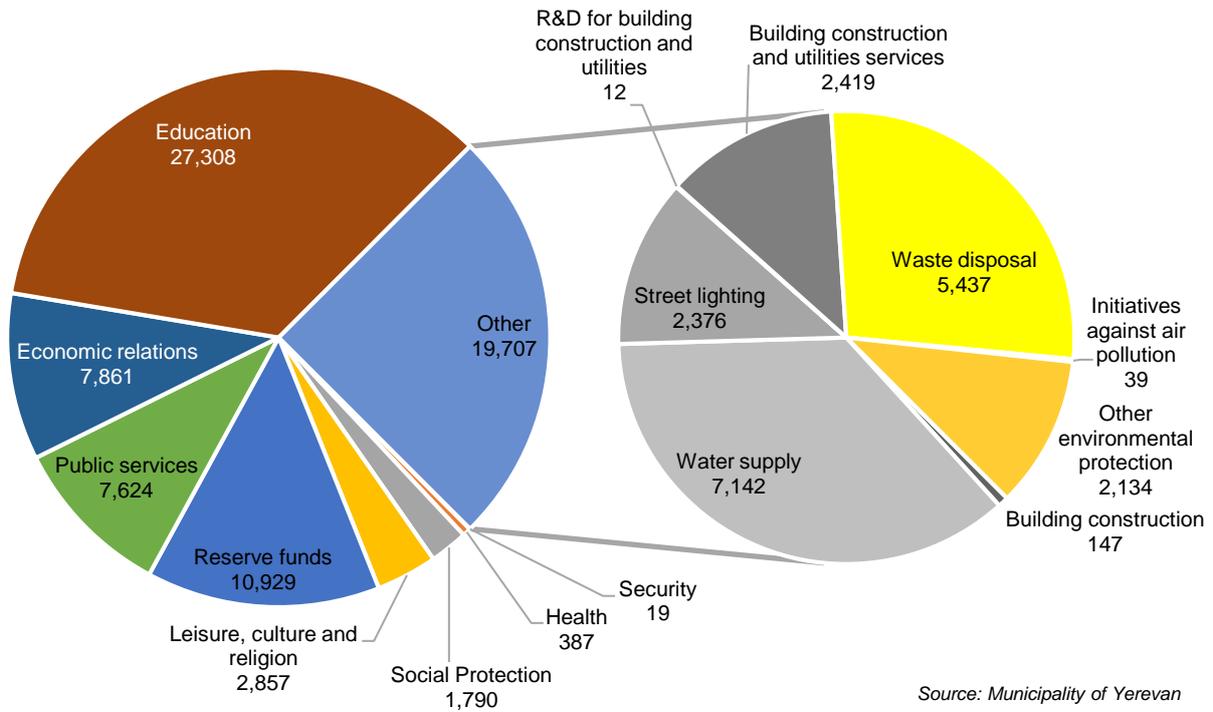


Figure 16: Composition of Yerevan budget expenditure in 2016

### 3.2.3 Annual Action Plans

As specified by the law, the Mayor is responsible for short-term and long-term development projects. Yerevan's annual development plan captures the socio-economic state of Yerevan and its development directions, and provides an analysis of the ongoing infrastructure development as well as an outlook for the future. It aims to reflect the interests of the population, development programmes and available resources.

Specific departments within the municipality are responsible for the implementation of corresponding actions. This will also apply to this GCAP implementation, which will be mostly in the competence of the transport, communal services, nature protection, architecture and urban development, as well as construction and improvement departments. The heads of the departments are accountable to the deputy mayors for each specific field. The deputy mayors, in their turn, report to the mayor regarding the progress of the project.

Yerevan's annual development programme for 2016 addressed the following GCAP related areas:

### Urban planning and architecture (Architecture and Urban Development Department)

- Activities linked to the targets set for urban planning and architecture as established by the 2005-2020 Master plan, incl. a perspective for development activities until 2025.
- Activities include the development of documents for the downtown building construction, development of an administrative zoning plan for Kanaker-Zeytun administrative district, development of roads and engineering networks for public zones, establishment of new recreational areas, restoration of parks and green areas, as well as a number of activities which continue from the prior years, incl. the construction of a number of strategic roads in cooperation with Asian Development Bank.

### Utilities (Communal Service Department)

- The activities include a water supply and drainage project with a total value of AMD 5,520 mil. and the automation of the water supply system through the SCADA system estimated to cost AMD 844,000. EBRD, EIB and EUN investment facility co-finance a project aimed at improvement of water supply system in Armenia valued at AMD 10,020 mil.. In cooperation with the Republic of France, another AMD 13,023 mil. is directed to the improvement of drinking water and rehabilitation of the waste water treatment plant in Aeracia. The Republic of France will provide 91% of the financing.
- The activities covered under this category also include projects on street lighting, buildings construction, energy efficiency of buildings, sanitation and waste disposal, as well as the destruction of expired pesticides and persistent organic pollutants in contaminated areas.

### Transport (Transport Department)

- The transport-related activities target the enhancement of the public transport, especially the operation of the bus network, and aim to decrease the number of mini-buses and increase the number of small and medium-size buses, as well as improve parking and bus stop areas.

### Construction and public space improvements (Construction and Improvement Department)

- Activities in 2016 are directed at asphaltting roads of the 12 administrative districts, crack filling and potholes repair work, headwall renovation, construction and renovation of overground and underground passages, ramps, repair of tiles for sidewalks, cleaning of facades and stones. They also include the creation of new recreational areas and improvement of yards, creation of mini football fields, reconstruction of sports facilities in educational centres, operation and maintenance of water facilities of the city and preservation of monuments.

### Environment (Nature Protection Department)

- Besides the general environmental activities, two major projects have been carried out in line with the 2016 plan. First the "Natural environment and I", which was an educational programme on environment developed through partnership with AUA Acopian Center for Environment and targeting middle and high schools. Second, the City of Yerevan has adopted its Sustainable Energy Action Plan (SEAP) in line with its commitments under the Covenant of Mayors to which Yerevan adhered on 9 September 2014.

Other areas (not directly related to GCAP activities) covered by the annual plan are:

External design and advertisement	Real estate management	Trade and service sectors	Elementary education
Health	Social security	Culture	Physical education and sports
Work with youth	Children' rights	International cooperation	Tourism

The cooperation with local universities is a prioritized activity from the GCAP point of view. We hope for an active engagement of academia in our actions to generate new ideas and concepts, generally support the involvement of the young generation in Yerevan's development and optimise the financial involvement of all stakeholders.

GCAP has also been developed in line with SEAP taking into account all analysis and defined actions and further building on its framework.

## 4 State of the Environment in Yerevan

State of the environment is directly linked to the health and wellbeing of our citizens. As such, good environmental conditions in our city are the key target in our efforts to improve the quality of life in Yerevan.

The state of environmental assets, including air, soil, water and biodiversity, is influenced by pressures of human activity – ranging from transport and industrial activity to energy and water supply and use and waste production. We mapped the current situation (baseline) through the GCAP methodology indicators of Pressure-State-Response, assessing the negative impact of human activities (Pressure indicators) on the state of environmental assets (State indicators) and identifying gaps in the governing framework (Response indicators). In order to examine the impact that the different pressures have on environmental assets, we begin with an assessment of the overall state of those environmental assets. This chapter hence presents the environmental assets one by one while identifying connections to the human activities exerting pressures on them. Those are covered in the subsequent chapters.

### 4.1 Air quality

The air quality in Yerevan is significantly worse than in other European cities of comparable size<sup>31</sup>. High concentrations of dust particles, due mainly to erosion caused by deforestation, is the leading cause of low air quality in our city.

Furthermore, SO<sub>2</sub> and NO<sub>x</sub> emissions occur in significant concentrations. Increased SO<sub>2</sub> concentrations are mostly attributable to molybdenum production in Yerevan. Furthermore, higher than declared content of sulphur in gasoline may contribute to emissions of sulphur oxides from the transportation sector.

Concentrations of NO<sub>x</sub> are related to the transportation sector and a gas power plant in the city. Concentration levels of pollutants and the number of days on which limits have been exceeded are above the standards set by WHO, the EU as well as above those set by RoA national guidelines.

Air quality has a direct impact on incidence of respiratory diseases and the general quality of environment. It is also the most comprehensible assessment of environmental quality for the inhabitants of our city.

#### 4.1.1 Key challenges

We have collected data on the key air pollutants from publicly available sources published by the Ecomonitoring Centre. The table below (Table 3) summarizes the results of this baseline mapping, incl. the assessment against international benchmarks as set in the GCAP methodology. This mapping was the basis for subsequent prioritisation of challenges.

State indicator	Indicator value
Average annual concentration of dust	162 µg/m <sup>3</sup> annual average
Number of daily exceedances of dust concentration limits*	43 days
Average daily concentration of SO <sub>2</sub>	28.8 µg/m <sup>3</sup> mean daily average
Number of daily exceedances of the daily SO <sub>2</sub> limit *	325 days
Average annual concentration of nitrogen dioxide	22 µg/m <sup>3</sup> annual average
Number of daily exceedances of the hourly NO <sub>2</sub> limit *	58 days
Annual CO <sub>2</sub> equivalent emissions per capita	3.08 t/capita

Table 3: Air quality indicators (\* indicators added based on stakeholders' consultation)

<sup>31</sup> Data for European cities of comparable size can be found at: [http://www.who.int/phe/health\\_topics/outdoorair/databases/cities/en/](http://www.who.int/phe/health_topics/outdoorair/databases/cities/en/)  
Although data for PM<sub>10</sub> pollution level are currently not available for Yerevan, we see from comparison of overall dust concentration levels of 162 µg/m<sup>3</sup> to average annual concentration of dust in other European cities, that the levels of dust concentrations in Yerevan are significantly greater than any levels measured in Europe.

The results were presented to stakeholders at a dedicated GCAP workshop to gauge the technical values against the perception of air quality issues by stakeholders. Main issues raised at the workshop concerned the credibility of the sharp decline in NO<sub>2</sub> concentrations in recent years, the threshold used for CO<sub>2</sub> emissions per capita and the categorisation of transport-related emissions by sources. The discussion led to the introduction of three additional indicators and their benchmarking against the respective EU framework. The introduction of dynamic daily assessment (number of exceedances and short measuring periods) resulted in relative worsening of the original indicators, however, these should not be overestimated.

As a result of the technical assessment and the stakeholders' engagement, we have the following two key areas of concern.



Figure 17: Air quality challenges

### Dust pollution concentration

The GCAP indicator assessment points to dust concentrations (including smaller particulate matter) as a priority issue. Furthermore, nitric oxides and sulphur oxides also present an issue for the air quality, particularly with negative development outlook in the future, due to increased motorization. Therefore, overall air quality is the most pressing challenge among the environmental issues of Yerevan.

The concentrations of particles equal to or smaller than PM<sub>10</sub> cannot be measured by devices used and are therefore not monitored. For this reason monitoring and evaluation of the concentrations of PM<sub>10</sub> and PM<sub>2.5</sub> are replaced in this report by the concentrations of overall dust. The primary sources for high concentrations of dust is the land surface as a natural source of dust, which is raised and brought into the city by wind, as well as stationary sources (most likely the chemical, metal and mining industrial sites) and transport.

### Limited air quality data

While nitrogen oxides are measured, the quality of the data is questionable. Measurements show rapid decline of concentrations since 2013, although this does not correlate with other reported emission values<sup>32</sup>.

The GCAP mapping demonstrated that a comprehensive monitoring of the pollutants of air is missing and there is a need to improve the data collection systems. The current systemic monitoring, reporting and verifying of air pollution governed by national institutions needs to be complemented by dedicated municipal monitoring and assessment of air pollution. This will further support the monitoring of projects whose benefit is closely linked to air quality. These projects are listed in the respective sectoral chapters.

## 4.1.2 Vision

Based on the assessment of key challenges for air quality in Yerevan and better understanding of the associated pressures, we offer the following vision for the City of 2030 where:

- a) The ambient air in the City of Yerevan will be of satisfactory quality, offering its citizens a good standard of living and limiting, to the extent possible, its negative impact on the population, ecosystems and the climate.
- b) We will continuously target air quality improvements based on good understanding of pollution sources.

<sup>32</sup> Ministry of Nature Protection of the Republic of Armenia, <http://www.mnp.am/?p=160>

Air-quality issues directly connected with individual sector activities covered by the GCAP such as transport, waste management, energy production and supply, and industry will be dealt with in the respective sectoral chapters.

The table below (Table 4) presents the strategic objectives, mid-term targets and short-term action reflecting our vision outlined above where these are beyond the scope of the respective sectors.

Yerevan's Green City Action Plan 2017

Visio n ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2022)	ST ID	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking <sup>33</sup>
AVa	AS 1	The levels of main pollutants (particles within respirable range, that is between PM <sub>10</sub> and PM <sub>0.1</sub> ; sulphur oxides (SO <sub>x</sub> ); nitrogen oxides (NO <sub>x</sub> ); tropospheric ozone (O <sub>3</sub> ); ammonia (NH <sub>3</sub> ); benzo[a]pyrene; toxic metals and carbon monoxide) will not exceed levels required by World Health Organization and its Air Quality Guidelines (AQG) or Clean Air Programme for Europe.  (See table 5 below)	AM1	Up to 2022, all national binding levels of pollution (expressed in Maximum Permissible Concentrations) will be met and ideally they will also be in line with EU limits as illustrated in the Table below.  (See table 5 below)	AA1	Support the national authorities to improve air quality policy and methodology, incl. through the development of Due diligence of the current system of air quality monitoring, reporting and verifying	2018-2022	25,000	na	Nature Protection dpt.	Due diligence  Developed air quality policies
	AS 2	All key sources of emissions will be identified and regulated	AM2	The City of Yerevan will have established an integrated Yerevan Air pollution model based on current meteorological data and calculated stationary and mobile source pollution, verified against air quality monitoring data and producing on-line interactive map of air pollution	AA2	Develop a municipal air quality monitoring system and cooperate with the Hydrometeorological Service for data processing and analysis <sup>34</sup>	2018-2022	1,000,000	30,000	Nature Protection dpt.	Time schedule of the project development  Number of municipal monitoring stations

<sup>33</sup> Wherever possible, measures for tracking are defined in such a way as to capture all contributions to achieving the mid-term target; where this is not possible or applicable, a percentage is given in brackets as to the contribution by the measured indicator to achieving the mid-term target. Additional measures for tracking aim to capture the improvement of quality of the associated environmental assets. Where possible, quantification is provided as to the extent of the improvement.

<sup>34</sup> As part of the SEA process, the Ministry of Emergency Situations requested that the monitoring system should comprise also automatic meteorological stations. The Ministry also requested a close cooperation with the Hydrometeorological Service regarding data processing and analysis.

Yerevan's Green City Action Plan 2017

Visio n ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2022)	ST ID	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking <sup>33</sup>
	AS 3	Integrated system of air quality monitoring and air pollution modelling as well as on-line interactive map of air pollution will be created	AM3	The City of Yerevan will have established regular reporting of polluter self-monitoring data. (Self-reporting of emission values by enterprises will ideally be set for short term periods, e.g. 10- and 20-minute values, hourly values so that they can be compared with MP emissions and EU/WHO values.)  The City of Yerevan will have a robust stationary/mobile monitoring system of air pollution.	AA3	Establish a corrective system for air quality	2019-2022	tbd	15,000	Nature Protection dpt.	Number of self-monitoring entities  Number and regularity of data sets  Number of stationary / mobile monitoring stations
	AS 4	MTT International (WHO) air quality standards will be regularly met	AM4	The City of Yerevan will have developed its 2 <sup>nd</sup> GCAP including targeted actions to further reduce air pollution	AA4	Monitor and assess regularly all GCAP actions targeting air-quality improvements	2018-2021				

Table 4: Strategic framework for air quality

For further information on all short-term actions, including their concrete benefits, you can consult Annex 5.

Approach to monitoring the implementation of short-term actions is outlined in chapter 12.

Yerevan's Green City Action Plan 2017

Pollutant	AQG short-term ug/m3	AQG annual ug/m3
NO <sub>2</sub>	200 (1-hour)	40
SO <sub>2</sub>	500 (10-minute) 20 (24-hour)	-
Dust	-	-
PM <sub>2.5</sub>	25	10
PM <sub>10</sub>	50	20

Table 5: EU limits for pollutant levels

Pollutant	RA MPC (mean 20 minutes) ug/m <sup>3</sup>	RA MPC (mean 24 hour) ug/m <sup>3</sup>	EU 1-hour mean ug/m <sup>3</sup> (number of days with exc. value)	EU 24-hour mean ug/m <sup>3</sup> (number of days with exc. value)	EU annual mean ug/m <sup>3</sup>
NO <sub>2</sub>	200	40	200 (18x)	-	40
SO <sub>2</sub>	500	50	350 (24x)	125 (3x)	-
Dust	500	150	-	-	-
PM <sub>2.5</sub>	160	35	-	-	20
PM <sub>10</sub>	300	60	-	50 (35x)	40

Table 6: EU limits for pollutant levels

## 4.2 Soil

Yerevan's landscapes and soil composition are varied comprising volcanic mountain chain, declivities, plains, and arable land. The soil is exposed to pressures caused by both human activities and natural forces such as erosion, salinization, chemical and biological pollution, which, if left uncontrolled, can lead to loss of biological productivity, desertification and biodiversity loss.

Concerning the anthropogenic factors, the following are considered the most damaging to the landscape and soil quality:

1. Engineering work that creates steep slopes and soil areas exposed to flooding and landslides.
2. Irrigation practices that erode soil.
3. Deforestation, tree cutting, and improper forest coverage of soil surfaces.
4. Use of artificial fertilizers and pesticides that contribute to soil pollution.
5. Municipal solid waste deposited in non-sanitary landfills.
6. Industrial solid and liquid waste as well as air emissions (particularly heavy metals).

### 4.2.1 Key challenges

The GCAP methodology captures many of the pressures highlighted above. They are covered in the sectoral chapters that follow, namely in industry, waste, water and land-use. As for the actual state of soil, the GCAP methodology focuses on the number of contaminated and potentially contaminated sites. Currently, there is no systematic monitoring of soil in Yerevan. Neither is there a parcel-by-parcel inventory of contaminated or potentially-contaminated sites in the city. There are, nevertheless, several studies that indicate unacceptable levels of pollutants of concern, such as lead, in soil found in different parts of the city. One large-scale study<sup>35</sup> of metals in soil shows some level of heavy metals contamination across all administrative districts of Yerevan. This is based on an indicator called "aggregate pollution factor" (APF) developed by the study's researchers.

Based on the information available and the GCAP team experts' experience, soil contamination of Yerevan was assessed as "amber" (See Table 7), that is requiring improvement while not being a critical priority.

State indicator	Indicator value
Number of contaminated and potentially contaminated sites	Expert estimate: 1 - 10 contaminated sites per 1,000 inhabitants of Yerevan

Table 7: Soil quality indicators

This technical assessment was presented at the GCAP stakeholders' workshop along with the assessment of the respective pressures. The discussion with stakeholders focused on how to reduce the pressures while the lack of information was also highlighted as an issue. Subsequently, we have defined the following key areas of concern. We prioritise the challenge of soil contamination over data availability as improvement of the environmental assets is at the core of this report. However, we acknowledge that improved data quality and wider monitoring is necessary for effective solutions to the soil contamination.

<sup>35</sup> Yerevan Functional Greening Plan with consideration of soil contamination, Econosphere Research Center, RA NAS



Figure 18: Soil quality challenges

### Soil contamination

Although up-to-date and detailed data are not available, based on Yerevan's industrial history and present as well as the general pressure from waste production, soil contamination has been assessed as an issue that requires action primarily on the side of the sectors that cause such contamination in the first place. In a second step, once the situation has been appropriately mapped and systematic monitoring of soil in and around Yerevan has been in place, further measures targeting improvement of soil quality should be adopted. Measures in sectors such as land use should additionally address pressures negatively effecting the quality of landscape, which in turn impacts the air quality (see above).

### Limited data availability

The lack of data is a cross-sectoral issue of this first GCAP cycle and needs to be addressed early on so that consecutive GCAP editions can define the most appropriate actions to deal with identified sources of problems. As for soil, there is currently no systematic monitoring of this environmental asset, neither is there an inventory of contaminated or potentially-contaminated sites in the city. Studies that had been carried out in the past will be a good starting point for more detailed mapping and monitoring activities, in particular the “Yerevan Functional Greening Plan with consideration of soil contamination” conducted by Econosphere Research Center.

## 4.2.2 Conclusions

Based on the results of our analysis outlined above, we see that soil contamination is an issue which deserves our attention even though more data need to be gathered and analysed to address the remediation of contaminated sites most effectively. In the first step, focus should be on current sources of contamination some of which are covered in the sectoral chapters. In parallel, we need to establish better mapping and monitoring tools. Attention will also need to be paid to landscaping.

Considering the links to the different sectors covered further on in this GCAP, **we address the challenges through the vision and strategic framework of the respective sectors, especially waste, land use and industry.**

## 4.3 Water

Water represents a key environmental asset for the society. Influence of water environment on the quality of life on a daily basis is indisputable. Water is used by people for different purposes such as consumption, irrigation, recreation, energy production, fishing, etc. Moreover, water provides a living environment for a huge spectrum of aquatic communities. Hence, extensive efforts towards protection of water environment and its proper management, with regard to human needs, are key for sustainable development of society in general.

The following sections describe the current state of water environment and water management in Yerevan.

### Surface water

The main surface water bodies in Yerevan are the Hrazdan River and Lake Yerevan (an artificial lake on the Hrazdan River). Water quality data provided by Ecomonitoring Center show that the Hrazdan already enters Yerevan with noticeable pollutant concentrations from anthropogenic activities upstream and the pollution levels increase significantly along the river flow through Yerevan, mainly due to insufficient treatment of wastewaters flowing into rivers. The following table (Table 8) provides a more extensive overview of the water quality. It compares the situation in European rivers with Lake Yerevan and the Hrazdan River at the inlet into Yerevan as well as the outlet.

	Annual average concentrations in European rivers in 2012 <sup>36,37</sup>	Annual average concentrations in the Hrazdan River in 2015 (entering the city)	Annual average concentrations in Lake Yerevan in 2015	Annual average concentrations in the Hrazdan River in 2015 (leaving the city)
<b>BOD<sub>5</sub> [mg/l]</b>	2.19	4.43	2.81	19.06
<b>NH<sub>4</sub> [µg/l]</b>	158	99	831	24,424
<b>PO<sub>4</sub> [mg/l]</b>	0.07	0.20	0.42	2.94

*Table 8: Comparison of water quality in European rivers with the Hrazdan River and Lake Yerevan*

The values show that the water entering Yerevan is of sufficient quality in terms of providing environment that enables the development of aquatic life according to local standards (N75 Directive), however, the concentration of BOD<sub>5</sub>, NH<sub>4</sub> and PO<sub>4</sub> indicates that the quality worsens as the water flows through the city. High values of BOD<sub>5</sub> (Biochemical Oxygen Demand) and a high concentration of NH<sub>4</sub> (Ammonium) indicate a high level of organic pollution in the river<sup>38</sup>. A higher concentration of PO<sub>4</sub> (Phosphates) in surface water in urban areas is usually caused by detergents present in wastewater.

Upon leaving the city, the Hrazdan River water quality is quite low with possible negative effects on human health and development of aquatic life. For example, high organic pollution in surface water creates a higher demand for dissolved oxygen needed for self-cleaning processes within the river. As a result, concentration of dissolved oxygen is decreased which has a negative influence on development of aquatic organisms and lowers their possible diversity. Moreover, disease-causing pathogens can be present in such polluted water. The presence of pathogens in a waterway can cause unpleasant odours and, more importantly, also diseases (e.g. hepatitis, viral gastroenteritis, cholera, etc.). Such pathogens may pose health risks to people fishing and swimming in the water body.

<sup>36</sup> Source: <http://www.eea.europa.eu/data-and-maps/indicators/oxygen-consuming-substances-in-rivers/oxygen-consuming-substances-in-rivers-7>

<sup>37</sup> Source: <http://www.eea.europa.eu/data-and-maps/indicators/nutrients-in-freshwater/nutrients-in-freshwater-assessment-published-6>

<sup>38</sup> High level of organic pollution in river reduces the biodiversity of aquatic communities and microbiological quality.

Indicators of a possible health risk from direct contact (i.e. occurrence of faecal coliforms) are not continuously monitored because microbiological tests are not listed in regular water quality tests.

### Groundwater

Groundwater is the only source for industrial and drinking water supply in the Republic of Armenia<sup>39</sup>. Yerevan's drinking water system is supplied by the Aparan aquifer<sup>40</sup>. In the territory of Yerevan there are sedimentary and volcanic rocks with both fracture and intergranular types of pores. Although the quality and quantity of drinking water resources for Yerevan is subject to the regular monitoring provided by the Hydrogeological Monitoring Centre SNCO under the Ministry of Nature Protection, since 1994 there has been no long-term systematic monitoring of the overall groundwater quality and quantity in Yerevan region.

Any economic activities in the territory of Yerevan dealing with water-affective substances can cause pollution of surface and ground water. It is namely waste management, industrial, energy, agricultural and transport sectors which can influence the quality of groundwater. Depending on the local geological conditions groundwater and surface water can communicate and contamination of one can result in contamination of the other. The quantity of water resources can be negatively influenced by activities such as inappropriate exploitation, various groundwater technical installations not respecting the local and regional hydrogeological conditions, wrong land-use management, and inappropriate construction works.

Solid waste management operations and facilities like waste disposal sites may become a source of groundwater pollution if not located in suitable areas and/or not constructed and managed according to standards aimed at adequate leachate control and collection<sup>41</sup>. Industrial activities also pose significant threat to ground water quality. If obligatory monitoring of the GW quality is not in place, there is a risk of uncontrolled damage of aquifer and soil. So far, the waste and industrial sectors have not put in place any appropriate ground water protection management in Yerevan. Protection measures in the proximity of solid waste management operations and industrial operations in Yerevan are missing.

Thus, at present, information on availability and quality of groundwater bodies in Yerevan (and in the country) is limited due to the lack of hydrogeological inventory of groundwater basins and subsequent lack of data on groundwater quality in the basins. Additionally, there is no comprehensive monitoring of the landfill sites to control the impact of leachate flows on surrounding aquifers.

### Drinking water

Yerevan receives drinking water from 10 principal water sources through boreholes and wells that are located in many communities outside the city, namely, Aparan, Gyumush, Arzni, Shor-shor, Arzakan, Katnaghbyur, Garni, Araratyan, Tsaravaghbyur, Dzoraghbyur-YerHEK. In general, the city receives about 7.5-8.0 m<sup>3</sup> of water per second from the water sources. This water is transported by more than 20 water mains with a total length of 700km. The city benefits from the high water quality of groundwater resources allowing water supply to the customers without additional treatment as the extracted water complies with national standards.

The water reaching Yerevan is distributed to the intra-urban distribution network directly or using 27 Daily Regulation Reservoirs (DRR). It reaches the customers by pipelines of about 1,900 km in length. Its operation is regulated through valves and pressure regulators. In places where hydraulic pressure is not high enough, the network makes use of 396 booster pumping stations. They work automatically and provide a stable water supply with sufficient pressure. However, not all consumers have a 24-hour access to water supply.<sup>42</sup>

<sup>39</sup> Aghinian A. (2009) Ground Water Vulnerability Assessment of the Aparan Aquifer, Republic of Armenia, and Its Representation in A 3-D Model. In: Jones J.A.A., Vardanian T.G., Hakopian C. (eds) Threats to Global Water Security. NATO Science for Peace and Security Series C: Environmental Security. Springer, Dordrecht

<sup>40</sup> Ibid

<sup>41</sup> Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste

<sup>42</sup> 84% of the population have 24-hour access to drinking water; for further information see chapter 9

In addition, almost 73% of the total water volume produced is lost before it reaches the consumers, and is not billed. These losses are caused by poor technical conditions of the water supply network and unauthorized consumption, which creates additional and unjustified requirements on the water resources.

### Wastewater collection and treatment

The local wastewater system consists of 220 km of out-of-city collectors and 950 km of intra-urban sewers. Historically, in some parts of the city, there were separate sewer systems (for sewage and storm water). These strictly separate systems were deformed by interconnections in the 1990s as part of emergency and unqualified repairs. Such interconnections are nevertheless considered illegal now and the water utility is bound to disconnect the systems and take appropriate remedy when such an interconnection is discovered. Considering the lack of data regarding the networks, there may however still be occurrences of the collected wastewater flowing through the stormwater system directly into the Hrazdan River without being treated at the Aeratsia wastewater plant, which has a negative impact on the surface water quality.

In addition, the network's capacity is not sufficient as localised flooding occurs in some parts of the city during heavy rains. Moreover, during such spells the wastewater pollution increases, which results in a short-term adverse effect on the water quality in the Hrazdan River too.

#### 4.3.1 Conclusion

Based on the results of our analysis outlined above, we see that our citizens have access to high-quality drinking water. However, the overall performance of the water supply system does not ensure a 24-hour access to water for all our citizens. In addition, poor technical conditions of the water supply network together with unauthorized consumption cause high losses of drinking water during its distribution. This inefficiency is in conflict with sustainable usage and preservation of water sources.

The status of our wastewater collection system does not allow collection of wastewaters from all city districts to the central wastewater treatment plant, "Aeratsia". Moreover, the treatment of wastewaters is currently insufficient and leads to the deterioration of surface water quality in the Hrazdan River. As a result, the water does not provide a beneficial environment for development of aquatic life (e.g. low concentration of dissolved oxygen which has a negative impact on the diversity of aquatic organisms). The occurrence of disease-causing pathogens may result in water-borne diseases and hence in a direct risk for the citizens.

Owing to the direct connection between water as an environmental asset and human activities related to water supply and water infrastructure management, **we define the vision and the related strategic framework under the respective sectoral chapter. Please go to Chapter 9 to see how we address the key challenges concluded above.**

## 4.4 Biodiversity and green spaces

*"The territory of [...] Armenia is part of one of the most important "hotspots" of the World biodiversity – Caucasus [and] shows very high biodiversity."* Yerevan outskirts including Erebuni reserve have been identified as an Important Plant Area which is *"a natural or semi-natural site exhibiting exceptional botanical richness and/or supporting an outstanding assemblage of rare, threatened and/or endemic plant species and/or vegetation of high botanical value"*. It also overlaps with areas of endemic beetle species and other rare invertebrates identified in the Red Book of Armenia.<sup>43</sup>

Biodiversity is closely linked with the quality of other environmental assets covered in this chapter as well as with the existence of green spaces. Yerevan's green areas officially cover about 6,760 ha (2015), which is about 30% of the total area of the city. This, nevertheless, includes both public and private spaces and covers all kinds of green vegetation, incl. flower beds and lawns. Moreover, the green

<sup>43</sup> Fayvush, G., Tamanyan, K., Kalashyan, M., & Vitek, E. (2013). "Biodiversity Hotspots" in Armenia. *Annalen Des Naturhistorischen Museums in Wien. Serie B Für Botanik Und Zoologie*, 115, 11-20. Retrieved from <http://www.jstor.org/stable/43922106>

spaces are not always well interconnected, which may create an additional obstacle for sustaining biodiversity.

It is also noteworthy that green areas have been recovering from a significant decrease that occurred particularly in the early 1990s during the energy crisis when 170,000 trees were cut down for heating purposes. It is only as of 2004 that we have seen a renewed increase in green areas in Yerevan. (See Figure 30 in Chapter 11 for more detail)). Some of the historical core green areas of Yerevan included the Nork forest, the Dalma Gardens, the gardens of Victory Monument and the adjacent Banjaranotsayin district. One of the city's most important green areas, Yerevan Botanical Garden, was established in 1935. With its 80 hectare area, during its 80-year history, it has introduced valuable and rare species of flora from different vegetation-geographical regions of the Earth, first of all from Armenia by creating demonstrational scientific collections. The Garden is one of the most favourite resorts in Yerevan. However, different parts of the Botanical Garden with a 50-55 ha green area need help. The Garden is not only one of the most important green areas of the city but nowadays, there is also an initiative to create a park and a recreation area within its borders. All these areas have been negatively impacted by the development. The Monument Park has maintained a good portion of its original coverage though a part of it has been taken up for development, the Dalma Gardens and the Nork forests have been gradually decreased and partially disappeared.

The partial disappearance of vegetation has also created pressure on air quality. Missing vegetation has led to increased levels of soil erosion and hence dust concentrations as the city lacks natural obstacles and green barriers within as well as outside of it.

We have started intensive tree-replanting and general revitalisation and expansion of green spaces in the city but the results will only be seen in many years to come. We also pay special attention to irrigation and aim to follow principles of sustainability as much as possible. Currently, irrigation water is supplied through a dedicated irrigation network of over 400km of length sourcing water from underground resources. Further information on measures taken so far is provided in the Land-use chapter. (See chapter 11)

#### 4.4.1 Key challenges

In line with the methodology, we collected data on the state of the resource and analysed the relationships between the states and pressures exerted by human activities.

To capture the state of biodiversity, the GCAP methodology uses the proxy of bird species abundance. Since birds are sensitive to structural changes of their habitats, the diversity of their communities can be considered as an appropriate biodiversity indicator reflecting environmental pressures created by human activities. The diversity of bird community was assessed through the Shannon index, a commonly used bio-diversity index.

The green spaces situation is represented through the standard ratio per inhabitant which currently stands at 7.6 m<sup>2</sup> and is below the recommended minimum value of 9m<sup>2</sup> promoted by the World Health Organisation.

The table below (Table 9) summarizes the results of the baseline mapping. The subsequent prioritisation of challenges was based on these results, while the trend of the recent years had also been taken into consideration. As with other state indicators, discussion with stakeholders focused on the related pressures and current gaps in responses.

State indicators	Indicator values
Open green space area ratio per inhabitant	7.6 m <sup>2</sup> /inhabitant
Diversity of breeding bird community	Shannon index value = 1.1147

Table 9: Biodiversity and green spaces indicators

Based on the analysis and stakeholders' feedback, we determined the following key areas of concern. Development of green areas is given higher priority than direct measures to support biodiversity as development of green areas supports multiple GCAP strategic objectives, most notably air quality and sustainable mobility, while also underpinning sustainable conditions for biodiversity.



Figure 19: Biodiversity and green spaces key challenges

### Low ratio of green areas

The green space areas of Yerevan had experienced a substantial decline in the 1990s which lasted until 2003. Despite significant efforts on our side in the past ten years, we have not yet been able to reach the green space area ratio registered back in 1990<sup>44</sup> and we are far away from the target of 17m<sup>2</sup>/inhabitant set by the 2006 Yerevan Master Plan. To achieve such an ambitious target, it will be key to integrate green spaces revitalisation and re-vegetation into all relevant projects across sectors. Such approach is in line with the relevance of green spaces for air quality, biodiversity, sustainable mobility and general well-being of citizens. (Further information is provided in chapter 11 on Land-use.)

### Loss of biodiversity

The Shannon index points to an unfavourable state of the bird community in Yerevan and implies challenges for biodiversity in general. Moreover, information available on the development of the bird community in the recent 20 years suggests a negative trend. Before the energy crisis, there were many nesting bird species in the city of Yerevan distributed across 4 categories: (1) very common (may-be thousands of pairs, so called eudominant<sup>45</sup> species, mostly typical synantropic birds), (2) common (hundreds of pairs, dominant species), (3) rare (recedent species) and (4) very rare (1-10 nesting pairs only). Currently, only two main categories seem to remain: thousands of (1) very common birds (crows, rooks, etc.) and many (4) rare-very rare bird species, mostly small passerine birds (tits, warblers).

Our vision for Yerevan is to become a green city, not only in name but also in appearance. We aim for the citizens of Yerevan to have an easy access to extensive green areas high in biodiversity and populated with local species of fauna and flora, environmentally connected with further large forest areas within the wider surroundings of our city.

## 4.4.2 Vision

Based on the assessment of key challenges for biodiversity and green spaces in Yerevan and better understanding of the associated pressures, we offer the following vision for 2030 where the City:

- a) Will consider biodiversity an integral part of its urban planning and aim to preserve the biodiversity richness that makes Armenia and Yerevan one of the world biodiversity hotspots.

<sup>44</sup> 8.47m<sup>2</sup> / inhabitant

<sup>45</sup> According to Tischler scale

The associated strategic objectives, mid-term targets and short-term actions are presented in the table below (Table 10).

Considering the links to the different sectors covered in this GCAP, we further address the challenges through the strategic frameworks of the respective sectors, especially land use, transport and energy.

Yerevan's Green City Action Plan 2017

Vision ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2022)	ST ID	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking <sup>46</sup>
BVa	BS1	Public will be aware of patterns and needs of city's sustainable biodiversity	BM 1	Public will be informed about patterns and involved in the city's sustainable biodiversity actions via regular awareness campaigns and education campaigns at least once per year	BA1	Set up a "Green City Awareness Centre"	2019-2020	20,000	50,000	Nature Protection dpt.	Time schedule for the establishment of the Green City Awareness Centre  Number of events organised by the Centre
BVa	BS2	Assessment of impact on biodiversity, based on scientific/survey data collected, will be an integral part of each EIA process the procedure of each EIA process will be traceable on public internet on-line database	BM 2	Capacity building of the relevant municipal staff on EIA process, biodiversity topics, scientific data collection methods, on-line database operation, etc. will be in place	BA2	Municipal Staff training courses	2018-2022	na	15,000	Nature Protection dpt.	Number of training courses  Number of trained personnel  Involvement of the trained personnel in the activities of the Green City Awareness centre
BVa	BS3	Cooperation between the academic institutions, NGOs and municipality will be developed	BM 3	Three common research and data collection projects between the municipality, academic institutions and NGOs will have been successfully completed or be running	BA3	The Green City Awareness Centre will establish cooperation between Municipality, NGOs, universities and	2020-2022	na	na	Nature Protection dpt.	Plan of cooperation  Number and topics for common research projects

<sup>46</sup> Wherever possible, measures for tracking are defined in such a way as to capture all contributions to achieving the mid-term target; where this is not possible or applicable, a percentage is given in brackets as to the contribution by the measured indicator to achieving the mid-term target. Additional measures for tracking aim to capture the improvement of quality of the associated environmental assets. Where possible, quantification is provided as to the extent of the improvement.

Yerevan's Green City Action Plan 2017

Vision ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2022)	ST ID	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking <sup>46</sup>
						research institutions on biodiversity data collection and evaluation.					
BVa	BS4	Systematic biodiversity data collection, their evaluation (comparable with EU and international indicators) will be in place, such data will be presented publically	BM 4	The database on specific biodiversity data available to the public will be in operation	BA4	The Green City Awareness Centre will set up a public database to publish the biodiversity and ecosystems data comparable to international indicators available.	2021-2022	4,000	na	Nature Protection dpt.	Biodiversity database project specifications Time schedule for the database implementation Number of data sets Frequency of updating

Table 10: Strategic framework for bio-diversity

For further information on all short-term actions, including their concrete benefits, you can consult Annex 5.

Approach to monitoring the implementation of short-term actions is outlined in chapter 12.

## 5 Environmental pressures

The state of environmental assets is influenced by the pressure of human activity – from transport and industrial activity to energy and water supply and waste production. When mapping the current situation (baseline) through the methodology indicators, we also considered the associated aspects of all the GCAP sectors to see respective relationships and understand the full picture. In this and the following sections we outline the key environmental challenges associated with the different pressures and how we plan to address these challenges. We define the strategic framework up until 2030 to acknowledge that many of the issues may take many years to solve. To help guide our thinking and to facilitate the dialogue with stakeholders with regard to what we want to achieve, we also define a 2030 vision for each sector covered. For that, we considered not only the current challenges of our city but we also looked at some other cities, especially in Europe, to see what their current issues are and how they approach them. This helps us anticipate what might be coming in for us too and address such issues in advance in our long-term strategy. We plan to use our partnerships with other cities more actively in the future to exchange information and best practices and we hope this will enable us to move forward faster and more efficiently.

In this document, we define in some detail short-term actions. This is important because these actions over the next 3 years lay the foundation for further measures in the future to meet the mid-term targets and strategic long-term objectives.

When prioritizing the short-term actions, we take into consideration the environmental benefits as well as potential for economic growth and social inclusion. Financial aspects are equally important and we keep in mind that our financial resources are limited and hence need to be spent effectively and efficiently.

## 6 Transport

We consider transport the key area for strategic development of our city. It has a significant impact on local air quality, economic growth as well as social inclusion. In the past ten years, a number of studies<sup>47</sup>, both at the municipality and national level, were carried out to assist us in defining strategic objectives and developing concepts to achieve them. We would hence like to take this opportunity to build on what has already been achieved in the past.

So far, we have focused mainly on developing the necessary road network to support effective transport within Yerevan as well as transit.<sup>48</sup> This includes a ring road around the city and the Yerevan segment of the North-South Highway connecting Iran to Georgia. Moreover, we consider construction of transport hubs on the following main roads: Arshakunyats-Lusavorich, Arshakunyats-Nzhdeh, Arshakunyats-Bagraturyats as well as reconstruction of Arshakunyats-Kristapor cross-roads. This should facilitate the traffic flow from the Gayi street out of the city and decrease the traffic load on the main city thoroughfares.

Public transport optimisation has been slow. An important project, however, is underway (launched in January 2017) and should deliver a new bus network model and its interaction with other modes of public transport<sup>49</sup>, an integrated tariff and ticketing service, and a concept for the establishment of a Public Transport Authority. The new model is to build on the already ongoing efforts to phase out minibuses replacing them with city buses. In addition, the SEAP foresees the implementation of renovation projects for the city's metro and trolleybuses. A due diligence report has hence been carried out on the renewal of Yerevan's trolleybus system analysing a number of options, incl. an assessment of affordability for the city's population. These are crucial developments on our way to a modern public transport system. We will, however, need to do more to maintain the public transport's share in commuting and make it grow in the future while also raising its green brand.

We see, indeed, rising environmental awareness among the public, especially through active involvement of environmental NGOs in different public consultations and discussions. We also recall our SEAP 2016 commitments to decrease CO<sub>2</sub> emissions. Public awareness of the interrelationships between our choice of transport mode and environmental impact is however still limited. We also have to account for an initial lack of willingness of public transport users to change lines when commuting<sup>50</sup> and the social status of car ownership and usage.

While this public transport culture should not be underestimated, we do not think it should create an artificial barrier for introducing a modern multi-modal public transport system aspiring to be the transport of choice for commuting. The transition should be gradual, especially in the setting of the routes and transport hubs<sup>51</sup>, based on pilots and offering a multiple of choices, including safe cycling and safe and convenient walking.

Private and commercial transport (logistics) will also need to be targeted accordingly so that they can contribute to our long-term green vision. We will have a unique opportunity to use our revamped road network to prioritise public transport, while supporting greening of the private and commercial fleets.

<sup>47</sup> Yerevan Urban transport project, World Bank (2008); Armenian Transport Sector Strategy 2020, ADB (2008), Armenia's Transport Outlook: Transport Sector Master Plan, ADB (2011), Yerevan Trolleybus Project, Due Diligence Report, EBRD (2017)

<sup>48</sup> Supported by ADB's Sustainable Urban Development Investment Program (SUDIP) Project 1 and 2 (2010)

<sup>49</sup> Yerevan public transport uses buses, minibuses, trolleybuses and metro.

<sup>50</sup> Current public transport system is very much based on a door-to-door service and its optimization, even if coupled with more physical comfort, is likely for many to lead to commuting with lines changing.

<sup>51</sup> Public transport hub means a place where passengers switch between different modes of transport. Public transport hubs include train stations, bus stations, rapid transit stations, metro stations, bus stops, tram stops, airports and ferry slips.

## 6.1 Key challenges

We have spent considerable effort quantifying the main environmental issues associated with our City's transport system. Our first step was to gather data and measure transport-related environmental indicators according to the GCAP methodology. A summary of the results of this analysis are shown in the tables below (Table 11). We first present the results of the pressure indicators mapping:

Pressure indicator	Pressure indicator value
Average age of car fleet (total and by type)	Cars: 16 years Buses: 15 years (Public transport buses: < 12 years) Special vehicles: 19 years Trucks: 18 years Tricycles etc.: 13 years Average all: 16 years
Percentage of diesel cars in vehicle fleet by type	Diesel cars: 1.3% (Petrol and converted CNG cars: 98.3%) Diesel buses: 19% (Petrol and converted CNG buses: 80%) Diesel trucks: 39% (Petrol and converted CNG trucks: 61%)
Public transport share run on fossil fuels	Diesel/Petrol/CNG: 89.5% (Bus: 36.5%, Microbus: 53%) Electricity: 10.5% (Trolleybus: 2.6%, Metro: 7.9%)
Motorisation rate	0.17
Kilometres of road dedicated exclusively to public transit per 100,000 population	0
Kilometres of bicycle path per 100,000 population	<15
Average travel speed on primary thoroughfares during peak hour	Bus – 20.2 km/hour Microbus- 20.8 km/hour Trolleybus – 14.8 km/hour Average – 18.6 - km/hour

Table 11: Transport pressure indicators

Below, we provide the assessment of the policy framework as mapped through the response indicators:

Response indicator	Response indicator assessment
Interruption of public transport systems in case of disaster	Emergency transport systems are able to run in case of disaster, but with limited efficiency / Emergency transport systems are not able to run properly in case of disaster (Qualitative assessment)
High-polluting vehicles are regulated / Energy-efficient vehicles are incentivised through fiscal instruments	Emissions standards <sup>52</sup> and a requirement to have a catalytic converter on imported cars exist <sup>53</sup> but are not fully and adequately implemented. While customs increase with age of a car <sup>54</sup> , no significant fiscal instruments are offered as incentive to own and operate energy efficient vehicles. Switching to CNG fuelled vehicles is supported through allocation of places for CNG stations in city districts and formulation of safety requirements. Technical data concerning the car fleet are insufficient for identifying further effective and efficient measures.
Extension and improvement of public and non-motorised transport is planned and supported through investment in place	Some investments have been made to purchase new buses and refurbish the metro system. Further investments are planned to upgrade the existing electric transport (metro, trolleybuses) A feasibility study has been launched for a new bus network and integrated tariff/ticketing. No investments have been planned in enabling non-motorised investments.
Public and non-motorised transport is promoted through Information and awareness campaigns	There has been little promotion of public or non-motorised transport in the last decade. Electronic displays for bus stops were piloted in 2012 but were later dismantled as the underlying infrastructure was missing and could not provide the necessary data support. There are plans to install electronic displays based on real-time information about the location of buses.
Traffic demand is managed (congestion charges, smart technologies)	No such solutions have been implemented.
Parking space is managed / Incentives for effective use of parking space are in place	There are designated and monitored areas for street parking in the centre of Yerevan. Their pricing, however, is not used to regulate driving behaviour.

Table 12: Transport response indicators

The assessment of the pressure and response indicators identified key challenges for us (i.e. those coloured 'red').

Our second step was to conduct extensive public consultation to present this data and challenges, and gauge the public's perception of the environmental issues connected with Yerevan's transport. The main issues discussed covered the state of public transport, alternative mobility, emissions from different fuels and type of transport, the average age of vehicle fleet, the number of registered vehicles compared to the number of vehicles in use and the non-existence of dedicated lanes for public transport. A summary of the stakeholders' feedback is provided in Annex 6.

As a result of the first and second steps, we have three key areas of concern as illustrated in Figure 20 below. The first two areas, transport infrastructure and management, are very interdependent and therefore we treat them as one in the sections below. High age of all vehicles (the whole fleet of the city) is the third

<sup>52</sup> RA Government Decision N965-N, June 22, 2006; (emission standards)

<sup>53</sup> RA Government Decision N902 of December 31, 2000. See section 2 paragraph "c"; (catalytic converters)

<sup>54</sup> RA Law on Rates of Environmental Protection Payment, December 20, 2006. See Chapter 1, section 4, last 3 rows of table; (customs)

area of concern which also has implications for the transport infrastructure and management but is dealt with separately due to our limitations to act on it.



Figure 20: Transport challenges

### Transport infrastructure and management

The results of the transport mapping regarding public/alternative transport infrastructure and transport management confirm results of previous studies mentioned in the introduction. Even though Yerevan's road network has been extensively developed in recent years and further extension and enhancements are planned, we still need to introduce a strategy regarding road use for public transport (as no dedicated lanes exist) and other alternative transport modes such as cycling. We will also need to consider walking and the respective infrastructure (pavements, green areas) in such planning. Traffic demand management will in general need to be enhanced to support these changes. Measures taken in this area will have a significant impact on the traffic flow as well as the public versus private transport shares.

We have started working on the integrated approach to public transport that is another aspect of the challenge. Public consultation and the Green City indicators highlighted the need to significantly upgrade the public transport system and do so in an environmentally friendly way. A green, efficient and effective transport management system will indeed lead to reduced emissions of pollutant gases and particulate matter and improve the air quality. In addition, such system will provide support in emergency situations and mitigate any related economic damage.

We also have to target the travel comfort of the users. If we can offer a high standard of commuting as seen in many European cities, we should also be able to attract more people to use the public transport instead of their own car. Moreover, if no action is taken, public transport is likely to lose further to private transport, which will worsen the air quality again.

Finally, it is worth reiterating that a key issue we also need to address is the transport data availability and quality. To develop tailor-made measures in the mid-term and long-term horizon, we will need to include measures focused on monitoring and regular situation assessments.

The challenges imply that we need to overhaul the public transport system as a whole to achieve the level of efficiencies, efficacy and comfort needed. We understand that implementation of these changes will need to go hand in hand with public awareness campaigns to illustrate the benefits our citizens can gain from choosing the public transport and other alternative ways of moving around the city.

### Age of fleet

Yerevan's vehicle fleet has been assessed as the second area of concern. The fleet is generally older than 16 years and often poorly maintained. This has a negative impact on the air quality in the city as, generally,

the older the vehicle, the higher the fuel consumption and the emissions. Poorly maintained vehicles further exacerbate the poor fuel efficiency, which in turn further increases the emissions. As poor air quality has negative impact on human health and biodiversity this represents a key challenge for us.

As for the private fleet, we have limited ability to act but are ready to make use of those measures that are available to us. Considering the positive effect of CNG for air quality, we already support private vehicles to switch to CNG fuel through allocation of plots for CNG stations in city districts and work on safety requirements relating to their operation as well as underground parking of CNG vehicles. Technical data concerning the private car fleet are insufficient for identifying further effective and efficient measures and this lack of information is targeted in the short-term actions. We only know that the fuel mix varies considerably across the different vehicle types with heavy-load vehicles having the largest share of diesel (39%). The share of petrol and CNG is difficult to assess as most cars with the CNG drive have been converted without any formal registration of the change. The high consumption of CNG in Yerevan (based on CNG sales) and the rising trend of such consumption in the recent years points to an increasing number of CNG cars at the expense of petrol cars<sup>55</sup>. To assess the impact on air quality of different types of fuels and how to mitigate it, better monitoring is however needed. We believe that technical inspections of vehicles are a good way to start. Besides providing data, we also hope they will support better vehicle maintenance. In the mid- to long-term we plan other city measures such as restricting the movement of most polluting vehicles, especially at times of increased city pollution.

Given that private vehicle modernisation depends on the economic situation of the country and is likely to take a long time, we believe our approach should focus on the efficiency and comfort of the public transport as identified under the first area of concern. The data show that the situation of the public transport fleet is unfortunately not much better than that of the overall fleet. Buses are an exception with an average age of 7 years, trolleybuses, on the other hand, reach an average age of 21 years. The modernisation of the trolleybus fleet is indeed one of the priorities identified under SEAP 2016. The age of the bus fleet will get reduced further as new city buses will continue replacing the minibus fleet. At the same time, we will strive to keep a large share of CNG buses in the renewed fleet. In parallel, we are also planning to promote electric mobility and acquire some electric vehicles into our municipal fleet while facilitating the development of respective charging infrastructure. We can hence contribute to the implementation of the national strategy for promotion of electric cars as outlined in the National Energy Efficiency Action Plan (NEEAP).

## 6.2 Vision for transport

The overall assessment of transport has helped us understand the weak points in our strategic framework for the transport sector development. We have hence defined a vision and strategic objectives for 2030 as well as mid-term targets for 2025 to close those gaps. Measures proposed as part of this GCAP build on the current initiatives and further enhance the framework so that the City can make use of the full potential of public transport on its path to sustainable development.

For 2030, we offer a vision of the City of Yerevan which:

- a) Will be served by a friendly, comfortable, efficient and well-connected intermodal public transport network. Public transport will make use of clean technologies as well as innovative mobility services. Public transport will be the transport of choice for both the city commuters as well as for tourists.
- b) Will have commercial transport managed so that its impact on traffic flow in the city and the environment are minimised, and where electric vehicles will be supported by a network of charging stations.
- c) Will offer its citizens a vibrant city centre where traffic is restricted promoting walking and cycling and other alternative forms of mobility.
- d) Will benefit from strong, collaborative partnerships with the City's stakeholders and its partner cities.

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<sup>55</sup> Considering small increments in the share of cars less than 5 year old.

### **6.3 Strategic objectives (2030) and mid-term targets (2025) and short-term actions (2017-2020)**

To achieve Yerevan's transport vision, we offer the following strategic objectives and mid-term targets defining the milestones on the way. The complementing short-term actions present the initiatives and programmes that we assessed as crucial to kick-start the necessary process or sustain the efforts already underway.

Yerevan's Green City Action Plan 2017

Visi on ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2025)	ST ID <sup>56</sup>	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking <sup>57</sup>
TVa	TS 1	There will be 3-4 key transport hub points in the City (main railway station, main bus station, plus possibly an additional one depending on the future public transport network model)	TM1	The public transport system will be integrated and offer a variety of tariff choices that promote its use.	TA1 Link ed to SEAP T.1	Implement a new bus network model, incl. dedicated bus lanes, and an integrated tariff and ticketing system (in line with the ongoing transport network project).	2018-2019	85,000,000	tbd	SUDIP PIU	GHG emission savings Fuel savings / OPEX savings Air quality improvements Share of public transport in commuting
TVa					TA2 SEAP T.2 and T.3	Upgrade electric public transport (trolleybuses and metro)	2017-2019	28,000,000	na	Transpo rt dpt.	GHG emission savings: Energy savings: OPEX savings
TVa					TA3	Integrate sidewalks and pedestrian paths as an integral part of the public transport system in the city.	2018-2020	tbd	tbd	Transpo rt dpt. / Urban develop ment	Share of public transport in commuting Satisfaction of commuters with public transport
TVa	ST 2	The City will provide transport-related information in a friendly way and using state-of-the-art technology and there will be an open data platform available to support all city-related data that are collected.	TM2	The City will have provided a city mobility application (possibly integrated into a wider city application) to transport users and have introduced an open data platform with key data sets related to the city in line with the best practices of other cities.	TA4	Organise a hackathon to support the creation of a public transport mobile application that will provide both the citizens and tourists with all transport-related information such as real-time route planner, schedules, transport stops identification, service interruption and offer them the possibility to	2018	5,000	10,000	Transpo rt dpt. / SUDIP	Share of public transport in commuting Satisfaction of commuters with public transport Number of data sets available to public Number of downloads of the application

<sup>56</sup> Wherever the events are related to the SEAP (transport, energy, land use), the starting date of the Action is set in accordance with the expected start date of the SEAP.

<sup>57</sup> Wherever possible, measures for tracking are defined in such a way as to capture all contributions to achieving the mid-term target; where this is not possible or applicable, a percentage is given in brackets as to the contribution by the measured indicator to achieving the mid-term target.

Yerevan's Green City Action Plan 2017

Visi on ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2025)	ST ID <sup>56</sup>	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking <sup>57</sup>
						pay for a ticket in real-time.					
TVa					TA5	Implement a pilot regarding the introduction of transport stops providing real-time information on the transport services.	2018	60,000	9,000	Transport dpt.	Share of public transport in commuting Satisfaction of commuters with public transport
TVa					TA6	Establish an open data platform which will serve as a data source for the citizens as well as support new business activities. The initial scope of data will at least reflect the GCAP short-term targets, further extensions will follow the European best practise.	2018-2020	75,000	tbd	Transport dpt.	Number of data sets available to public
TVa	TS3	The length of dedicated public transport lanes will have been extended compared to 2025. A concrete target will be set in accordance with the results of optimisation modelling of the transport model.	TM3	Dedicated lanes will have been introduced for the public transport. A concrete target will be set based on cooperation with the City of Paris or other partner cities and in accordance with the results of optimisation modelling of the transport model.	TA7 SEAP T.5	Develop road infrastructure (new, including bypass roads and road junctions)	2018-2022	79,000,000	tbd	SUDIP PIU	Length of dedicated lanes for public transport GHG emission savings Fuel savings / OPEX savings Air quality improvements Satisfaction of commuters with public transport

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Visi on ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2025)	ST ID <sup>56</sup>	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking <sup>57</sup>
TVa	TS 4	Public transport is regularly used by 75% of commuters.	TM4	Public transport is regularly used by 65% of commuters	TA8	Introduce regular monitoring of passenger satisfaction and quality of service of public transport. Quality indicators will be part of the service providers' performance assessment.	2018-2020	Na	(5,000)	Transpo rt dpt.	GHG emission savings Air quality improvements Share of public transport in commuting Satisfaction of commuters with public transport
TVa					TA9	Strengthen its awareness campaigns through e.g. the introduction of regular "Day without cars", "Biking weekends" etc.	2017-2020	na	50,000	Transpo rt dpt. / Information and Public Relations Department	Share of public transport in commuting Satisfaction of commuters with public transport Public feedback on awareness campaigns
TVa	TS 5	90% of public transport will run on alternative fuels such as CNG and electricity and hydrogen	TM5	70% of public transport will run on alternative fuels such as CNG, electricity and hydrogen.	TA10	Purchase up to 85% of all new buses as CNG-fuelled buses.	2018-2022	57,000,000	tbd	Transpo rt dpt.	GHG emission savings OPEX savings Air quality improvements Fuel savings s
TVa	TS 6	35% of public transport will be fuelled by electricity and hydrogen.	TM6	20% of public transport will be fuelled by electricity and hydrogen. This will include electric buses. The number of electric buses will reflect transport optimisation potential as well as financial capacities and		See TA18	2018-2020			Transpo rt dpt.	GHG emission savings Air quality improvements OPEX savings

Yerevan's Green City Action Plan 2017

Visi on ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2025)	ST ID <sup>56</sup>	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking <sup>57</sup>
				available charging infrastructure.							
TVb	TS 7	The City will have introduced specific rules on the movement of commercial transport around the city, particularly focusing on the transit of heavy-duty vehicles and supply of goods to areas of restricted traffic.	TM7	The City will have introduced a car-free centre and special rules for supply of goods into the area.		See TA17	2018-2022			Transport dpt.	GHG emission savings Air quality improvements
TVb			TM8	Technical inspections provide the City of Yerevan with quality data regarding the state of the overall fleet, incl. its characteristics. These data support the operation of the transport model and development of transport-related concepts for Yerevan.	TA11	Recommend to relevant bodies and endorse the creation of an integrated technical inspections system, incl. emissions, to achieve better maintenance on the part of the vehicle owners and targeted traffic-related actions on the part of the City owing to increased transparency on the fleet mix.	2018-2020	na	na	Transport dpt.	GHG emission savings Air quality improvements Technical data availability
TVb			TM9	The City will have prepared a concept for restricting the entrance of old vehicles into parts of the City depending on		See TA17	2018-2022	tbd	na	Transport dpt.	GHG emission savings Air quality improvements

Yerevan's Green City Action Plan 2017

Visi on ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2025)	ST ID <sup>56</sup>	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking <sup>57</sup>
				the current air quality situation.							
TVb					TA12 SEA P T.6	Optimise city transport, improve management efficiency (incl. waste disposal, sanitation and other machinery)	2018-2020	10,000,000 <sup>58</sup>	tbd		GHG emission savings Air quality improvements Fuel savings / OPEX savings
TVb	ST8	The City will have promoted alternative mobility and alternative fuels.	TM10	25% of the municipal car fleet will consist of electric vehicles.	TA13 Link ed to SEA P T.7	Introduce 10 electric vehicles in its fleet by the end of 2020 (). Synergies will be sought with action TA-16.	2018-2020	250,000	tbd	Transpo rt dpt.	GHG emission savings Air quality improvements OPEX savings Number of EVs registered in Yerevan and using the EVSE
TVc	ST9	The City will have put in place measures supporting e-mobility and enabled the creation of a network of charging stations (EVSE) e.g. through project-driven procurement.	TM11	There will be a number of public charging stations available. A concrete target will be set based on cooperation with the City of Paris or other partner cities and in accordance with the results of modelling of the transport model	TA14	Facilitate the development of charging infrastructure.	2018-2020	45,000	na	Transpo rt dpt.	Number of EVs registered in Yerevan and using the EVSE

<sup>58</sup> Implementation period 2014-2020

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Visi on ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2025)	ST ID <sup>56</sup>	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking <sup>57</sup>
TVc					TA15	Apply a zero tariff for parking of all electric vehicles within the City boundaries. <sup>59</sup>	2017	na	na		Number of EVs registered in Yerevan
TVc					TA16	Organise a public tender for a pilot project for electric car sharing system.	2018	na	5,000	Transport dpt.	Number of EVs registered in Yerevan and using the EVSE Use of the new service
TVc	ST 10	The City will aim to have 50km/100,000 inhabitants of bike lanes.	TM12	Yerevan will have 35km/100,000 inhabitants of bike lanes.		See TA17	2018-2022	tbd	na	Transport dpt.	Length of dedicated bike lanes Air quality improvements
TVd	TS 11	The City will have established key partnerships with local stakeholders to develop innovative solutions for transport. The cooperation has also contributed to increasing the technical capacities of the private sector.	TMT13	The City of Yerevan will have established long-term cooperation with the local universities or other partners aimed to develop a sustainable transport model for the city.	TA17	Establish a cooperation framework with the City's academic institutions, or, alternatively, seek a long-term partnership regarding transport topics:  a. To develop an all transport modelling tool which is used for both strategic and operational integrated planning.  b. To prepare the introduction of sensors around the city to provide relevant input for development of the transport model.	2018-2022	tbd	10,000	Transport dpt.	Long-term Partnership Agreement City Transport model in active use Feasibility studies

<sup>59</sup> A zero parking tariff for electric vehicles was sanctioned by decree N 675-Ն of the Elders' Council of Yerevan of 14 February 2017.

Yerevan's Green City Action Plan 2017

Visi on ID	SO ID	Strategic (2030)	Objective	MT ID	Mid-Term (2025)	Target	ST ID <sup>56</sup>	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking <sup>57</sup>
								<p>Sensors will collect data about traffic flow, air quality and weather conditions.</p> <p>c. To develop a concept for regulating heavy-load vehicles transit through the city.</p> <p>d. To develop transport sector performance indicators.</p> <p>e. To develop and implement public transport satisfaction and quality of service surveys.</p> <p>f. To develop a concept of car-free centre, incl. the regulation of supply of goods into such area.</p> <p>g. To develop a pre-feasibility study for expanding the biking lanes network in the city.</p> <p>h. To develop a pre-feasibility study to re-introduce a tram (light rail) service in the city using best practices from other cities. This study should further look into the feasibility of increasing the</p>					

Yerevan's Green City Action Plan 2017

Visi on ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2025)	ST ID <sup>60</sup>	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking <sup>57</sup>
						number of trolleybus routes. <sup>60</sup>  i. To identify opportunities to enhance intermodal connections for both intra- and inter-city transportation.  j. To track investments in general transport infrastructure vs. dedicated public transport infrastructure.					
TVd			TM14	The transport modelling tool will have been in place and used by the City for strategic and operational planning.		See TA17	2018-2022	tbd	na	Transport dpt.	City Transport model in active use  GHG emission savings  Air quality improvements
TVd	ST12	Have established long-term cooperation with a comparable EU city or a number of cities dealing with the same issues of greening its public transport.	TM5	The City of Yerevan will have established long-term cooperation with a comparable EU city dealing with the same issues of greening its public transport.	TA18	Use its partnership with the City of Paris to learn the best practices in greening public transport.	2018-2020	na	30,000	Transport dpt. / Foreign relations dpt.	Concrete actions for GCAP 2020

Table 13: Strategic framework for transportation

For detailed information on all short-term actions, including their concrete benefits, you can consult Annex 5.

Approach to monitoring the implementation of short-term actions is outlined in Chapter18.

<sup>60</sup> The importance of electrified public transport (trolleybuses, trams) was highlighted by the Ministry of Emergency Situations in their opinion on the draft GCAP and draft SEA. The original action that focused on the feasibility of re-introduction of trams in Yerevan was further expanded to also cover the extension of trolleybus services.

## 7 Energy supply, energy use efficiency in buildings and external lighting

We consider the city's energy and carbon footprint a high priority. We are a signatory to the Covenant of Mayors for Climate and Energy as well as a member of the ICLEI network of Local Governments for Sustainability. We adopted our Sustainable Energy Action Plan (SEAP) in June 2016 and committed to reduce energy consumption by 16% and greenhouse gas emissions by 21% until 2020 compared to the 2012 baseline. The Green City Action Plan allows to reinforce the short-term commitments of the SEAP, recalling its key recommended actions for the 2016-2020 period and further enhancing its objectives with a broader range of environmental, service quality, social and affordability indicators. This section further establishes the city's sustainable energy agenda until 2030, well beyond the SEAP scope of 2020.

### 7.1 Energy Supply Armenia and Yerevan

Yerevan is a city with a universal access to energy services. Access to electricity is generally available to the whole population while access to gas is not as wide but still available to a vast majority of Yerevan citizens (93%). The service reliability is high but the quality of electricity supply remains a concern as the electricity delivered to consumers does not meet the voltage requirements ¼ of the time.

After the collapse of the district heating systems<sup>61</sup> almost everywhere in the city, natural gas and to some extent also electricity have become the major heating solutions. Currently, there is only a group of buildings supplied by the district heating system which is connected to a combined heat and power (CHP) plant (ArmRusCogeneration, see Table 14 below). Despite the clear environmental benefits, the rehabilitation of district heating faced multiple market and regulatory constraints.<sup>62</sup> Consequently, the overarching heating option of choice is a decentralized, local, household-level heating with gas, and those with technological or financial limitations to installation of gas heating continue heating with electricity.

Yerevan hosts a number of gas-fired thermal and renewable energy power plants (See below). They are all part of Armenia's single integrated electricity system as there are no municipal energy services specific to Yerevan alone. Yerevan's electricity supply mix is hence the same as that of the rest of the country with 12% of electricity from renewable sources (excluding large hydro), compared to the GCAP methodology benchmark of 20%. Armenia's Scaling Up Renewable Programme Investment Plan targets 15.4% of renewables by 2020, and the National Least-Cost Energy Generation Investment Plan of 2013 targets 15.4% of the electricity generation will come from RES. The Least-Cost Energy Sector Development Pathways strategy until 2036 is less ambitious. By 2030, the share of RES electricity output (excluding large hydro) should be 10%, considering the forecasted demand growth by 3%, phase-out of obsolete thermal power plants and entry of 1,000MW new nuclear power plant in 2027.

Yerevan hosts four hydro power plants (HPP), of which, however, only one is a small HPP (Yerevan SHPP) with only 2.7 mil. kWh annual electricity output.

<sup>61</sup> District heating (DH) collapsed during the years of energy blockade in the mid-1990s when the gas supply was disrupted and the DH systems remained idle for a number of years. Some parts of the system became unrecoverable, in other parts of the system consumers had invested in own heating equipment and did not want to connect back to central heating.

<sup>62</sup> The Government of Armenia cooperated with donors in attempts to rehabilitate central heating on district level and on the level of individual building or small group of buildings. Unfortunately, the key barrier was the already evolved set of alternatives households have already invested in during the years of energy blockade, including individual gas-fired apartment heat and hot-water boilers, which were a more flexible and efficient alternative to district heating. The regulatory framework was not favorable either. The retail gas tariff for small consumers (<10,000m<sup>3</sup>) was nearly twice higher than the tariff for large consumers (>10,000m<sup>3</sup>). A small-scale heating system would usually stay within the "small consumer" category. Despite the multiple urges from various public groups to grant the centralized heating systems the favorable tariff, the regulator was not responsive. This has left centralized heat supply without any competitive advantages. With a few minor exceptions, the city evolved on the path of decentralized individual heating solutions in the residential sector. The public buildings have been slowly transitioned to building-level heat-only boiler supply.

Production facility	Production (mil. kWh)		
	2013	2014	2015
<b>Thermal Power Generation</b>			
Yerevan TPP	702.1	740.7	823.1
ArmRusCogeneration CHP	3.5	11.5	9.0
Yerevan Medical University CHP	4.0	14.5	12.3
<b>Renewable Energy Sources – Hydro Power</b>			
Kanaker HPP	104.5	106.0	101.2
Yerevan-1 HPP	42.6	43.2	41.3
Yerevan-3 HPP	5.0	5.1	4.8
Yerevan SHPP*	2.7	2.7	2.7
<b>Total</b>	<b>864.4</b>	<b>923.7</b>	<b>994.4</b>

Table 14: Electrical Power Generation from Gas-fired Thermal and Renewable Sources in Yerevan (\* Average annual production data)

Photovoltaic power generation has so far been installed with rather small capacities through demonstration modules. In Yerevan, medium-size solar PV systems are installed on roofs of three medical and educational institutions.

Site Location in Yerevan	PV capacity (kW)	SWH capacity (kW)
International Center for Agribusiness Teaching and Education (ICARE)	15	
American University of Armenia (AUA)	11	70
Armenian-American Wellness Center (AAHC)	9.8	
Tufenkian Traditional Hotel (announced in 2017)		80

Table 15: Installed Capacities of Selected Solar Rooftop Systems in Yerevan

There are also some small-scale solar water heating (SWH) and photovoltaic (PV) installations on the roofs of public and private buildings, such as kindergartens, houses, medical centres, hotels, commercial buildings, etc. These were assessed based on an informal survey of the solar technology vendors. Based on the survey findings, the small-scale solar PV systems of Yerevan have the cumulative capacity to produce 101 MWh electricity per year, while the SWH systems generate up to 13,500 MWh of thermal energy per year.

It is also noteworthy, that the Yerevan municipal landfill has been part of a clean development mechanism (CDM) project originally designed to produce electricity through methane capture. Currently, the captured methane is only flared for climate mitigation, however, as we are rethinking our municipal solid waste management (see chapter 8 on Waste Management), it is critical that we push forward with the original plan and use the captured methane for sustainable electricity generation.

Incentive programmes to support further expansion of renewables had been scarce; however, recently, several policy tools aimed at developing the market have been introduced and are slowly entering the implementation phase. The amendments to the Law on Energy Saving and Renewable Energy in May 2016 allowed implementation of provisions for net metering for autonomous solar electricity producers with installed capacity of up to 150 kW. PV systems installed under this scheme need no license and are exempt from taxes. The owners of the PV systems are entitled to sell their power surplus to local utility Electric Networks within Armenia at 50% of the retail tariff. Furthermore, the regulatory framework has been enhanced by the introduction of a feed-in tariff (42.645 AMD per kWh without VAT, comparable to wind power tariff) for solar PV electricity generation for systems within the capacity range from 150kW up to 1 MW.<sup>63</sup> Armenia is also moving forward with the implementation of its Scaling-Up Renewable Energy

<sup>63</sup> Decision of the Public Services Regulatory Commission N 128-N dated 25 May, 2016 the tariff for solar energy amounts 42, 645 ARMD / kWh excluding VAT.

Programme (SREP). As part of SREP implementation, in addition to the small-scale solar systems, Armenia will not only start a local production of PV panels, but also attract investments for utility-scale solar and geothermal plants to meet the declared target of covering up to 30% of domestic electricity demand with RES, greening thus also the electricity supply of Yerevan.<sup>64</sup>

Commercial financing of the small-scale renewable electricity production is possible through various green loans for sustainable energy investments provided by the banking sector, with the support from IFIs (EBRD, IFC, GGF, AFD, KFW). These financial instruments; however, remain unaffordable to wider population.

## 7.2 Efficiency of Energy Use in Buildings

Energy consumption in the territory of Yerevan comprises roughly 42% of all energy consumed in Armenia. While there is no local accounting of energy use, expert estimates indicate that in 2012 the total energy consumption in all sectors of Yerevan's economy, including population, comprised nearly 55 million MWh. Furthermore, between 2012 and 2015 this consumption had grown by 50-55%. The structure of energy consumption in the city is presented below.

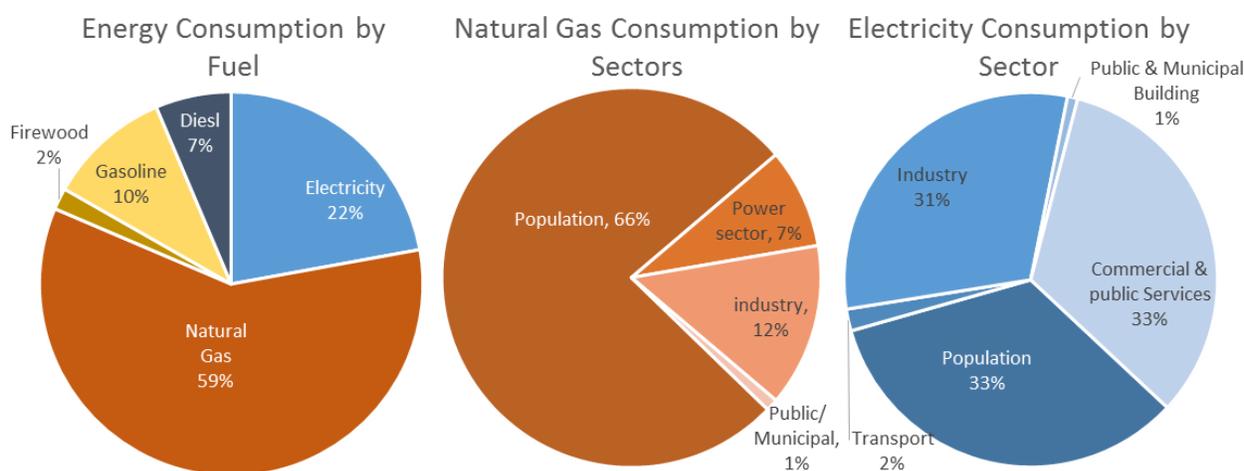


Figure 21: Structure of energy consumption in Yerevan (2012)

The municipal sector of Yerevan is not a large energy consumer. Energy consumed in public buildings under our oversight account for around 250 GWh/year (2012<sup>65</sup>) distributed between gas consumption (about 61% share) and electricity consumption (about 39% share). This amounts to about 10% of the total municipal energy consumption in Yerevan and 1% of the overall city-wide energy use. The energy efficiency in most public buildings is very low, which is largely due to the age of the buildings, usually built with no insulation in the building envelope, as well as the lack of proper energy management. Generally, such buildings have 10-70% energy saving potential. Energy costs of the majority of public institutions make up 5-20% of current expenditures.

The public buildings have also a low level of thermal and lighting comfort, which is a result of reduced heated or lit area, reduced hours of heat supply and lowered temperatures. When normalized for comfort, the public buildings have very high energy consumption rates. The internal lighting systems in the administrative buildings normally consume 27-30% of the total electricity. A recent study of the lighting systems enabled to identify the types of luminaires used, their energy efficiency and the illumination level of the structure surfaces. In general, the electricity consumption of lamps per each 1m<sup>2</sup> of those surfaces

<sup>64</sup> Exploratory drilling is currently underway in Karkar region of Armenia's Suiyiq Marz, and three 1MW plants under development in different parts of Armenia, with preliminary announcement of an upcoming tendering of utility-scale solar PV plant. Solar energy flow over horizontal surface is about 1,720 kWh/m<sup>2</sup>, which is 25% higher than the average EU level. The first utility scale plant tender will be announced for Masrik area for a minimal capacity of 55MW.

<sup>65</sup> 2012 is the latest year for which the official detailed energy balance was developed, and expert estimates for electricity

is 6-8 W/m<sup>2</sup>. This is quite low both by the national norms (20-30W/m<sup>2</sup>)<sup>66</sup> and indicates reduced lighting comfort considering that 40% of luminaires used in public buildings rely on incandescent light bulbs, the remaining are fluorescent (not LED). The situation is worse in preschool institutions. Incandescent bulbs dominate in the interior lighting systems of kindergartens where they reach about 70%, totalling over 17,000 incandescent light bulbs.<sup>67</sup>

Residential buildings are responsible for the majority of electricity and gas consumption in Yerevan (gas consumption by population is 66% of all natural gas consumed in Yerevan, and electricity consumption by population is 33% of city-wide electricity consumption, see Figure 21 above)<sup>68</sup> as they represent 75% of the area of all buildings in the city. The buildings performance indicators studied under this GCAP point to low energy performance relative to benchmarks and thus significant energy inefficiencies. This is again coupled with a low level of comfort.

The latest policy developments at the national level have created the legislative framework to promote energy efficiency in buildings and utilization of renewable energy sources. These include the Government Resolution 1405 of December 2015 introducing mandatory requirements for the integration of energy efficiency technologies in new construction and capital renovation in state-funded projects, and the amendments to the Law on Energy Saving and Renewable Energy of May 2016 making energy efficiency mandatory in all new construction and capital reconstruction. The enforcement mechanisms are still to be put in place.

It is also noteworthy, that the building sector has been subject to new requirements<sup>69</sup> related to the enhanced seismic resilience of buildings and to urban planning (e.g. accessibility of public spaces and limits to density of construction) and handicapped accessibility, which have been high on the policy agenda. These legislative provisions still require time, awareness, institutional capacities, procurement procedures, and investment mechanisms to ensure the enforcement. Both the public and residential sectors lack financing resources and they will require different tailor-made solutions to address their building energy efficiency (EE) potential.

The public sector is a relatively well-established owner and borrower. The Energy Saving Programme, supported by the World Bank, and the Renewable Resources and Energy Efficiency Fund<sup>70</sup> offer loans to public buildings for energy performance-based contracting covering quick pay-back EE measures. We will, however, need external financial resources with substantially softer terms compared to the current market lending rates (3% compared to the 12-18% in other commercial lending) and additional technical capacities to be able to finance more system-wide, cost-intensive and long pay-back EE retrofits, which do not only improve the heating systems and replace fenestration and lighting, but also insulate the building façades and integrate roof-top RES systems, while also providing seismic reinforcement and accessibility upgrades. We are currently negotiating the possibility to develop such a large scale investment programme with donors and IFIs.

The financing options for the residential sector differ and may not be easily accessible to all. The private, stand-alone houses, which comprise approximately 50% of all housing in Yerevan, generally have comparatively better energy performance and can directly access financing for EE retrofits through multiple green credit lines based on individual creditworthiness. The remaining multi-apartment buildings, however, face a serious challenge when attracting investments due to limited budgets, a low social condition of the population, a lack of loan risk security mechanisms, legislative barriers and poor institutional capacities in multi-apartment building management. With the exception of a small-scale pilot initiative by Habitat for Humanity – Armenia, which offers condominium associations loans for common space EE retrofits and immense technical assistance to orchestrate the lending process, there is no financial mechanism for multi-apartment building EE retrofitting which can offer affordable financing, risk guarantees, effective management of lending to multiple households (multiple decision makers) within the same building, outreach and capacity building of both PFIs and households.

<sup>66</sup> Construction Norm: RACN II-8.03-96 (ICN 04-05-95) Artificial and Natural Lighting

<sup>67</sup> Exception are Avan and Arabkir administrative districts, which have a lower share of incandescent bulbs.

<sup>68</sup> This does not include transportation fuels

<sup>69</sup> RoA Construction Norm II-6.02-2006 Seismically Resilient Construction. Design Norms.

<sup>70</sup> Official URL [www.r2e2.am](http://www.r2e2.am)

We have also worked with the UNDP to develop a demonstration case for a comprehensive thermal modernization of a typical panel building with complete insulation of the building envelope. The measures resulted in reduction of energy consumption from 178kWh/m<sup>2</sup> to 74kWh/m<sup>2</sup>, which was rated as “C-“ under Armenia’s building certification standard and ensured a building energy label. This represents the minimal energy performance requirement by the construction norm on thermal protection of buildings. Yerevan still hosts about 4,000 such panel multi-apartment buildings, and a replication scheme is necessary to allow for the demonstrated technical solution to be scaled up with an adequate financing scheme and implementation capacity.

The above issues have been articulated in the Yerevan Sustainable Energy Action Plan (SEAP 2016). Nevertheless, the SEAP has a limited sectoral scope and does not include any hard commitments for the residential sector. Additionally, SEAP only focuses on energy and GHG emission reduction objectives. Moreover, many of the actions included in the SEAP still require financing solutions. SEAP is also limited in its timeframe targeting primarily the year 2020. If we continue on our path towards the new Covenant of Mayors for Climate and Energy, the future step will require transitioning from a SEAP to a Sustainable Energy and Climate Action Plan where adaption will also need to be built in. The GCAP, with its broader scope, longer timeframe, more diverse environmental objectives, can help build the ground for the further development of Yerevan’s sustainable energy agenda up to 2030.

### 7.3 Efficiency of Energy Use in External lighting

Urban lighting is another major power consumer in the municipal economy. It is responsible for over 25% of electricity consumed by all municipal buildings and services and hence has a substantial carbon footprint. Urban lighting is also a significant budget item, total costs<sup>71</sup> of this service for all Armenian municipalities amount to more than USD 5 million per annum with Yerevan accounting for approximately 80% of those costs.

Yerevan’s external lighting system holds a total of 65,149 luminaires<sup>72</sup> and has an installed capacity of 15 MW. The inefficient compact sodium lamps comprise nearly 94% of all bulbs, while mercury bulbs and LED bulbs both comprise 3%.<sup>73</sup>

As a result, the system uses a relatively large amount of energy for ensuring the lighting standards are met, and the city dwellers feel safe and comfortable during the dark hours, while service sector work later hours and the city has enhanced its tourism appeal.

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<sup>71</sup> Power costs and maintenance

<sup>72</sup> As of 2011 there are no no incandescent light bulbs used in Yerevan’s street lighting

<sup>73</sup> All LED bulbs have the light efficacy of 109 lumen/watt but have a different capacity

The GCAP benchmarking allowed us to compare Yerevan against other cities in terms of electricity used per kilometre of lit road (see Figure 22 below) indicating potential for efficiency upgrades.

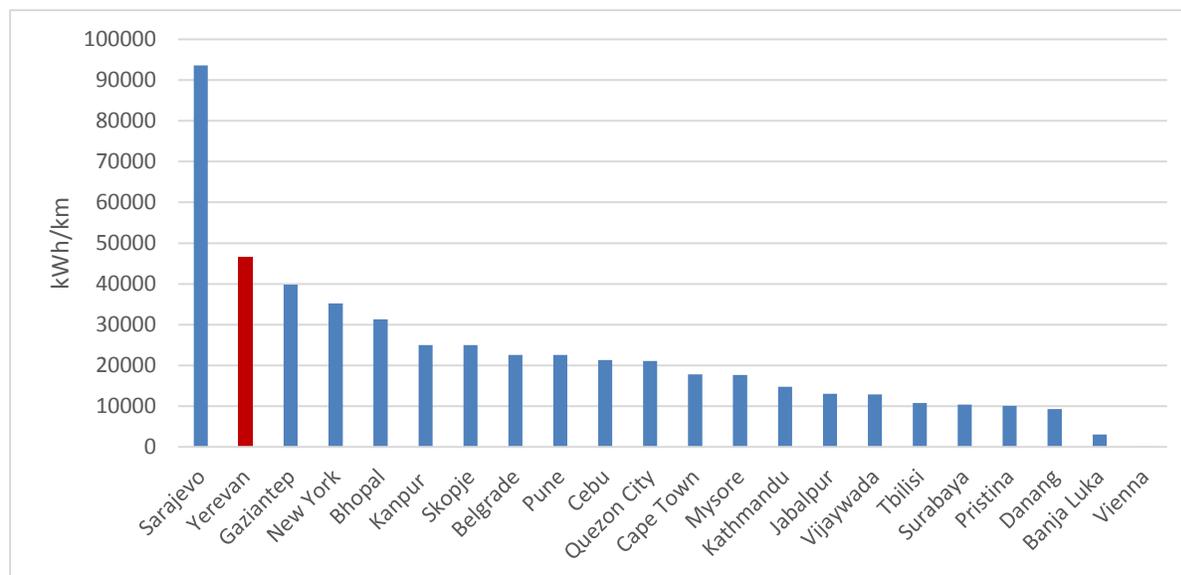


Figure 22: Electricity consumed per km of lit roads (Source: TRACE database)

Yerevan has already started working in this direction. During the last 5-6 years, the outdoor lighting system of Yerevan underwent significant qualitative and quantitative changes. Inefficient mercury light bulbs have been phased out, and after 2012 the lighting systems in a number of streets have been equipped with modern energy-efficient luminaires, under various grant and credit programmes.

For example, the UNDP-GEF Green Urban Lighting Project, implemented in cooperation with the Yerevan Municipality, has introduced about 500 LED lights to Isakov Avenue, Tairov street, as well as Yerevan Zoo. The initiative, which has been carried out in partnership with the Ministry of Nature Protection, allows energy savings of 63%, reduction of costs by USD 45,000, and carbon emissions by 220 tons per year. The project launched in 2013 and will continue until 2017<sup>74</sup>. An additional feature of the project was the requirement to accrue all financial savings from reduced energy consumption to establish a revolving fund which will further be used to expand the street-lighting retrofits. The first achievements are a great success..

The Order #2354-A of the Mayor of Yerevan dated 30.07.2015 approved the EE measures in Yerevan external lighting based on the “Utilization Procedures for the Designated Revolving Fund for Yerevan External Lighting EE Retrofitting”, which allowed establishment of a revolving fund which is perpetually replenished from the financial savings accrued as a result of reduced O&M costs resulting from the original investment in the pilot project financed by the joint initiative of the Yerevan Municipality and UNDP-GEF Green Urban Lighting (GUL) Project. Within the framework of this project the lighting retrofits have started by enhancing the efficiency and replacement of light-bulbs with LEDs with the Isakov Avenue joining the Yerevan centre with the airport, followed by the Victory Bridge, Mashtots Avenue, Athens Street, Brazil Square, Tsitsernakaberd Drive, and the road leading to the Genocide Victims’ Memorial, and the Arshakunyats Avenue.

In addition, in 2015, EBRD signed a Yerevan Municipal Street lighting loan with the Armenian Government for 28 pilot streets for EUR 6 million of which EUR 2 million will be covered from the Eastern European Energy Efficiency and Environmental Partnership (E5P) grant facility. The project will help bring new energy-efficient LED lighting to almost 10% of the existing luminaires in the city, a control and monitoring system,

<sup>74</sup> Source: <http://www.am.undp.org/content/armenia/en/home/presscenter/pressreleases/2015/03/27/almost-500-new-energy-efficient-leds-installed-along-isakov-avenue-and-tairov-street/> and data provided by Project team.

pole replacement and renovation, as well as power cable replacement. This will result in better service quality and improved environmental standards due to reduced energy consumption and the minimisation of operating and maintenance costs. Better-lit streets will also be safer for pedestrians and motorists alike. The new LED lighting supported by UNDP and EBRD/E5P is expected to cut the cost of energy consumption by 64% and hence result in annual electricity cost savings.

## 7.4 Key challenges

The GCAP's scope regarding energy generation and use is closely connected to the issues covered in the SEAP (2016). The preparation of the latter generated a database on Yerevan's municipal and residential energy uses and hence significantly facilitated assessing the GCAP indicators for energy generation, efficiency of energy use in buildings as well as street lighting.

The Table 16 below summarizes the results of baseline mapping which was the basis for subsequent challenges prioritisation.

Pressure indicator	Indicator value
Share of population with an authorised connection to electricity	100% (considering unauthorized consumption 91.2%)
Share of population with access to heating	100%
Proportion of total energy derived from RES as a share of total city energy consumption <sup>75</sup>	12.6%
Average duration of per consumer disruption of electricity supply per year in case of force majeure*	3.5 hours/consumer
Hours of voltage deviation per customer during the year due to technical and natural reasons*	2148 hours/consumer per year
Electricity consumption in residential buildings	36.2 kWh/m <sup>2</sup>
Electricity consumption in public buildings	46.8 kWh/m <sup>2</sup> , corrected for comfort
Heating / cooling consumption in residential buildings, fossil fuels	174 kWh/m <sup>2</sup>
Heating / cooling consumption in non-residential buildings, fossil fuels	284 kWh/m <sup>2</sup>
Percentage of total streets lit*	97%
Electricity consumption per kilometre of lit road*	46,542 kWh/km per year
Electricity consumed per light pole	537 kWh/lighting pole/year

Table 16. Pressure indicators for energy supply, energy use efficiency in buildings and external lighting

Below, we provide the assessment of the policy framework as mapped through the response indicators

Response indicator	Response indicator Assessment
Green building is promoted through standards and fiscal incentives	Not existing

<sup>75</sup> According to the energy balance as of 2015, the primary energy generated from RER was 391.8, and the primary energy supply was only 3,100, equivalent to 12.6%.

Energy efficiency building is promoted through standards	New building code, passportization, auditing and certification standards adopted recently, enforcement still lags, capacities lack
Public and private investment in energy efficiency in buildings	Promoted by latest amendment to Energy Saving & Renewable Energy Law requiring EE technologies' application in all new construction and capital reconstruction. Government decree (Decree No 1504 from 25 December 2014 on Mandatory EE Provisions in Public procurement in building (re)construction) and the May 2016 amendment to the ESRE Law on mandatory compliance with EE requirements in state investment projects and residential construction has no provisions for enforcement
Metering and billing for personal energy use is regulated	100% - The electricity and gas (heat) billing is consumption-based on the level of each individual consumer/household, market-based pricing, disconnection possibility. Electric meters have been partially replaced to digital, allowing for application of dual tariff (night and day tariffs vary by 25%).
Coverage and quality of electricity and heat supply is improved through investment	While coverage of electricity improving, the quality still remains an issue. As to the quality of heat provision, the efforts to rehabilitate district heating in Yerevan only succeeded in 36 buildings. Some of the newly constructed multi-apartment buildings have heat /hot water supply based on building-level boiler houses. The remainder of the market is covered by individual heating solutions, which are elaborate and efficient only to extent of technologies' affordability to individual consumers.
Renewable energy facilities in private buildings are incentivised through fiscal instruments	Net metering legislation adopted incentivizing solar panels for autonomous electricity producers with capacity under 150 kW. <sup>76</sup> Feed-in tariff established for solar PV for under 1 MW electricity producers. Several IFI green credit lines offer grant co-financing for EE & RES investments (10-20% grant for qualifying investment loans) and leasing on below-market terms. More support is necessary to push the market and enhance the private investments in this direction, including public sector taking the lead, private sector receiving more affordable financing, etc.
Renewable energy technologies are developed and supported through public and private investment	Private financing available in the banking sector, but terms remain high for massive uptake.
Renewable energy facilities are incentivised through awareness campaigns	Not existing
The resilience of electricity networks in case of disaster is tested and enhanced through investment	Yerevan emergency service established but electricity network resilience not assessed or enhanced

Table 17: Response indicators for energy supply, energy use efficiency in buildings and external lighting

The findings of the analysis (the areas in red and amber in the above tables) were discussed at length with the stakeholders from the municipality, key experts and NGOs, representatives of academia and donor/IFI implementing partners operating in this field. With the quality and reliability of electricity supply and

<sup>76</sup> The net metering provision allows the autonomous producers to supply the generated electricity excess to the electric networks and retrieve energy back when needed based on a reversible meter. The annual excess supply, if any, is purchased by the Armenian Electric Networks at 50% of the retail tariff.

emergency services being outside the scope of local government activities and a designated state function (being addressed as part of national policies and plans), the stakeholders strongly advocated for the GCAP to focus on challenges that can be addressed within the powers of local government. During the bilateral consultations and organized group public discussions the participants emphasized the poor condition of public and residential buildings, the low affordability of utilities leading to under-heating and under-lighting and the low comfort levels consequently reducing the quality of life and quality of municipal services. The discussions also addressed the limited ability of the municipality to finance major energy efficiency retrofits from own funds and the need to integrate borrowed investment funds, bearing in mind municipality's need to prioritize its borrowing for only a small number of top priorities. Among the nearly 500 buildings under oversight, if the municipality needs to prioritize, the kindergartens (161) and polyclinics (160) are considered above other categories of buildings.

The key findings included:

- Public buildings are municipality's third highest priority for sustainable energy interventions, following transport and municipal solid waste,
- The buildings have a high energy consumption (e.g. kWh/m<sup>2</sup>/year) relative to the GCAP methodology thresholds and Armenia's national standard on energy performance in buildings (comparable to class 'F') largely due to inefficient heating or indoor lighting technology, age of buildings, poor maintenance, a lack of systemic energy management, and a limited investment capacity. Despite the low efficiency of energy end use, in some public and residential buildings the energy consumption remains low due to suppressed demand driven by budget and affordability constraints.
- The external lighting infrastructure has a high energy consumption rate as well as high installed capacity (per km of lit road),
- The share of renewables was rated as lower than commonly accepted for relative energy sustainability level as well as the announced national RES targets.
- The residential buildings consume more than half of all energy resources consumed in the territory of Yerevan, but the city authorities have neither direct jurisdiction nor the necessary resources to support EE investments in this sector. Private housing sector cannot be viewed as a priority for the municipal borrowing until all municipal sectors have been adequately supported with EE and RE solutions. Nonetheless, should a financing scheme be proposed, which will support EE/RE investments in multi-apartment buildings without creating financial burden for the municipality, the city authorities will support such an undertaking.

Hence, priorities were defined based on the importance attributed to given issues by the consulted stakeholders, by the available potential for EE and RE interventions, the expected impacts of resolving the existing challenges and their potential benefits, including improved quality of environment, climate change mitigation, reduced energy bills, improved comfort levels, capacity and jurisdiction of the city administration to address given issues, etc. The key findings revealed the following priorities:

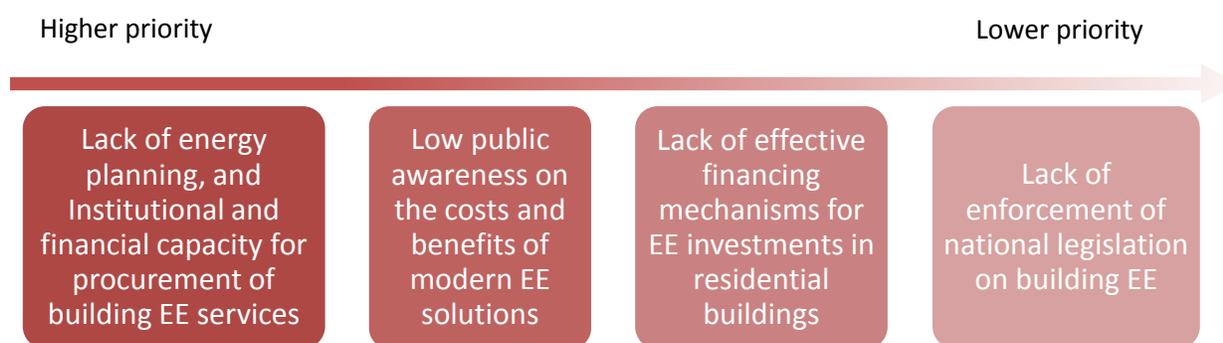


Figure 23: Challenges related to low energy efficiency in buildings



Figure 24: Challenges related to low energy efficiency in external lighting



Figure 25: Challenges related to low share of renewable energy sourcesLow Energy Efficiency in Buildings

### 7.4.1 Low Energy Efficiency in Buildings

The energy efficiency in most public and residential buildings is very low, which is largely due to the age of the buildings (most of which were designed and built without any energy efficiency in mind), poor condition of the building envelope, as well as the lack of proper property and energy management.

The public and residential buildings also have a low level of thermal and lighting comfort due to restricted consumption driven by the growing energy prices. When normalized for comfort, both residential and public buildings have very high specific energy consumption rates.

#### **Lack of Energy Planning, and Institutional and financial capacity for procurement of building EE services**

Yerevan has already taken ambitious steps in assessing own energy consumption and costs for assessing the City's ability to deliver the committed energy savings and greenhouse gas emission reduction. However, to create a basis for EE investment in municipal infrastructure and buildings sector, the energy information gathering, planning and management must be systematized and potentially automated, with integrated benchmarking of specific energy consumption, established low-energy, low-carbon and green building thresholds for all new construction and reconstruction initiatives.

The energy saving potential of public buildings has been estimated and documented both in Yerevan and other parts of Armenia. EE retrofits of public buildings implemented under the energy saving agreements of the R2E2 Fund framework program have delivered an average of 52% energy saving with EE measures ensuring repayment of investments in seven years. While these retrofits were not aimed at building energy code compliance, the investments provided empirical evidence of the savings potential. Nonetheless, the

municipality does not have adequate capacity to design, finance and implement a comprehensive energy efficiency retrofitting campaign due to the lack of technical and financial capacity. The national building EE legislation provides no detailed guidelines or instruction on how to comply with the rules, and furthermore – how to organize the public procurement of EE in buildings. The Municipality will need additional capacity and technical assistance for adequately organizing the procurement of energy auditing services, technical design of EE (re)construction and surveillance of thermal modernization projects, followed by respective monitoring, evaluation, certification and labelling of EE.

Considering the financial constraints in municipal budget, the investments need to be repaid from savings. If a scheme is effectively designed, the generated savings could feed into a sustainable and replicable financing scheme which would allow streamlining of the savings towards more investments through a revolving/multiplier mechanism. As noted above, there is a limited potential for sovereign borrowing by the Republic of Armenia for investments in municipal projects. The non-sovereign borrowing, in turn, is an unexplored path which is now being actively pursued by IFIs, including for Yerevan. The local government legislation makes municipal borrowing cumbersome, and is undergoing legal reform and the municipalities will be open to borrow with less limitations. We have worked with partners to assess our own borrowing capacity through getting a “B+” Fitch rating<sup>77</sup>, and initiating an assessment of borrowing capacity. Nonetheless, we will still need approval to borrow from the Ministry of Finance and Ministry of Territorial Administration and Development, which, in turn, are tasked to ensure that no loans are borrowed which run a financial risk or may create financial or credit risks for the city or the state. This situation creates the need to identify and attract financial resources which (a) have very attractive financial terms; (b) have significant grant co-financing to reduce the repayment demands; (c) have a sound built-in repayment mechanism; and (d) minimal repayment risks.

The Municipality of Yerevan is currently carrying out negotiations for attracting external financing for implementing a rehabilitation programme involving energy efficiency (EE) and integration of renewable energy (RE) measures in public buildings of Yerevan. These measures will lead to substantial reduction of GHG emissions and will result in significant climate change mitigation.

In addition to the other benefits, the above EE AND RES investments will contribute to the local and regional economic activity especially in the construction sector and will contribute to the private sector development and promotion of the small and medium enterprises.

The proposed financing scheme of the project entails pooling of several sources including a EUR 7 million loan from the European Investment Bank (EIB) potentially to be lent to the Yerevan Municipality, UNDP Green Climate Fund (GCF) grant for technical assistance, expected EUR 10 million grant from the Eastern European Energy Efficiency and Environment Partnership (E5P) and Municipality's own funds in the amount of EUR 2 million. The completion of project negotiations is expected by the 3rd quarter of 2017.

The following activities focused on Demand Side Measures are included in the project:

- Thermal refurbishment of buildings focusing on building envelope and inherent works related to heat distribution within those buildings. These works include also structural works to secure earthquake resilience and accessibility for disabled people, also Modernization of heat generation/distribution system, including boiler replacement;
- Lighting systems;
- Integration of renewable energy sources and energy management systems;
- Solar heat and/or solar power generation;
- Others: geothermal heat generation, heat pumps, small cogeneration, and also new ventilation systems and equipment etc.

To comply with the Armenian Government strategy, all comprehensive interventions will be accompanied by seismic reinforcement, handicapped accessibility and capacity building.

According to preliminary estimates, short payback EE/RE measures will be implemented to a larger target group of 190 buildings (kindergartens, polyclinics/hospitals, cultural and athletic buildings) totalling approximately 400,000 m<sup>2</sup>, whilst 66 buildings, mainly kindergartens, are expected to undergo

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<sup>77</sup> Source: “Fitch Rates Armenia's City of Yerevan 'B+'; Outlook Stable” retrieved from <http://www.reuters.com/article/idUSFit981280> on 12 April 2017.

comprehensive thermal rehabilitation, upgrading of HVAC systems, installation of RES systems, etc. As a result of the project, an estimated primary energy saving amount of more than 36 GWh/year, CO<sub>2</sub> saving of over 7 thousand tons/year and cost saving of 1.4 million EUR/year will be realized. To comply with the Armenian Government strategy, all comprehensive interventions will be accompanied by seismic reinforcement, handicapped accessibility and capacity building.

Despite the above initiative, the resources to be attracted from external sources will remain insufficient to address all needs of the sector and it will hence be crucial to attract private investments and create a self-sustained market for commercial financing of energy efficiency. Using experience of EU cities, Energy Performance Contracting can become a very useful business model to create such market. EPC provides for energy savings without capital requirement from the building owners and at the same time guarantees the energy savings and technical maintenance.

In order to successfully develop the EPC market for local companies, bring private sector participation in the municipal sector and take advantage of private sector knowledge and skills, we will need to support both the EPC demand and supply side. To establish the EPC demand, Energy Performance Contracting should be integrated into municipal procurement related to building renovations. We will need to train EPC facilitators and municipality representatives with focus on the contractual and operational arrangements related to EPC and the Energy Service Companies (ESCO) business. This will raise awareness about the added value of EPC compared to in-house implementation of energy savings underpinned by the outsourcing of technical and economic risks to the ESCO and through the provision of guarantees.

To create the EPC supply side, we will facilitate capacity building for ESCOs as well as the establishment of special financial mechanism to co-finance EPC pilot projects. Under the financial mechanism, EPC facilitators will be employed to prepare pilot projects and, through their implementation, get the experience and references needed.

#### **Low public awareness on the costs and benefits of modern EE solutions**

The population is still insufficiently informed about the benefits of insulation of external walls, utilizing solar water heating for hot water preparation, benefits of modern lighting solutions, the magnitude of energy losses in the common spaces and the potential energy and cost savings from energy efficiency improvements of common areas and façade insulation, etc. People rarely see the linkage of the open entrance door or a broken stairwell window glass and the indoor air temperature and household energy bill. Consequently, the uptake of modern energy efficiency technologies remains low, the residential building renovations almost never include energy efficiency of the building envelope, common space or EE-integrated renewables.

While raising awareness on energy conservation and systemic energy management can help identify and implement low-cost energy efficiency measures, more intensive energy efficiency measures require large capital investments. These are particularly cost-intensive due to the need to integrate capital EE retrofits with seismic reinforcement and accessibility of the buildings into any capital reconstruction project. We will need additional capacity and technical assistance for adequately organizing the procurement of energy auditing services, technical design of EE (re)construction and surveillance of thermal modernization projects, followed by respective monitoring, evaluation, certification and labelling of EE.

Additionally, as the section on green spaces indicates, Yerevan has limited green space per capita and constrained ability to enhance this indicator, whereas green walls and green roofs are a well-known solution to enhancing building energy performance while also contributing to the green landscape of the city. While there are no building requirements for this, vertical greening and green roofs can be promoted through voluntary initiatives to set the example and promote green building culture.

#### **Lack of effective financing mechanisms for EE investments in residential buildings**

The energy saving potential being documented by pilot projects. The UNDP experience showed comprehensive thermal modernization of building envelope can reduce specific energy consumption of typical panel buildings in Yerevan by 58%. And yet, with the exception of the small grant co-financing

scheme that the Yerevan Municipality has with the Habitat for Humanity – Armenia loan scheme for residential EE retrofits for multi-apartment building common areas, that have addressed ten buildings until now, the municipality of Yerevan has no resources or jurisdiction to leverage extensive financial resources for the private buildings' sector. Unless an innovative financing scheme is put in place which could pool the resources of the residents, some municipal support, grant co-financing and potential scheme for soft commercial lending, the residential sector will remain underserved by the EE lending market for common-space EE rehabilitation.

If we manage to create the EPC market as outlined above, this could also boost energy efficiency action on the part of residential building owners

### Lack of enforcement of national legislation on building EE

In addition to the age and poor maintenance of old buildings, the new buildings also have a low level of thermal energy performance and high energy consumption due to the poor enforcement of energy efficiency codes and standards in construction. The building sector consequently remains a high energy user and building energy use remains one of the significant contributors to national greenhouse gas emissions.

Building certification for energy performance is voluntary and still very rare, while green building certification, ISO 50001 and EMAS are not commonly practiced. A number of laws, regulations, construction norms and standards have been adopted in Armenia recently that introduced some energy performance requirements for new construction and capital renovation, including provisions on energy efficiency and energy-saving regulation in the construction sector, construction climatology, building energy passportisation, energy efficiency standards, standard energy audit methodology, thermal protection of buildings and minimum energy performance requirements for all new and renovated buildings.<sup>78</sup> The enforcement of the above regulatory framework is still not in place due to missing procedural guidelines, but will remain a challenge due to the lack of institutional capacity to enforce energy efficiency standards and technologies in Yerevan's routine operations, particularly the maintenance and procurement procedures. The current lack of regular energy monitoring and information gathering, regular analysis of energy consumption data and lack of energy management result in lost opportunities in energy efficiency.



Figure 26: Residential Building Common Space EE Retrofits by Yerevan Municipality and HFHA

### 7.4.2 Low energy efficiency of External Lighting

Street and outdoor lighting have high energy intensity which is a major pressure on the local government budget while also creating unnecessary greenhouse gas emissions. The challenges in external lighting have been identified based on consultations with the municipal street-lighting company, experts in the field and implementing partners currently involved in Yerevan street-lighting retrofits. Yerevan has further been compared against comparable benchmarks in key indicator areas.

Even though our outdoor lighting system has been undergoing significant improvements in the recent years, further action is needed to make use of the efficiency potential. The recent pilot efforts have successfully

<sup>78</sup> The amended Law on Energy Saving and Renewable Energy, Government Decision N225-N, 14.03.2013, Government Decision N1504-N, 25.01.2014; RACN II-7.01-2011; CN II-7-01-2011; AST 362-2013; AST 371-2016; Government Decision N120-N from 24.01.2016; other relevant national standards, EN, ISOs, etc.

showed the potential for energy savings and the cost-effectiveness of investments in the urban lighting systems.

### **Need for holistic conceptual approach to external lighting**

While the short-term goal is to reduce the energy consumption of Yerevan's external lighting in its current setting, it is also important to rethink the conceptual approach to external lighting, its safety, reliability, other added features and the evolving objectives it can serve. In addition to the replacement of light-bulbs with the high-efficient alternatives, we will also need to invest in increased safety and reliability of old light poles (and replace, where necessary), change luminaires to be compatible with the new light-bulb technologies, minimize visibility of electric wiring, and optimise operation and management procedures, such as lighting hours, variable intensity through dimming, elimination of light pollution, etc.

We will work on a long-term holistic conceptual approach to external lighting. Rethinking urban lighting will be necessary to adequately assess and calibrate the street-lighting service, while integrating the concept of multi-functional light poles, which would allow urban street-lighting infrastructure to host other urban street applications on a single pole rather than installing a series of poles with individual applications. Utilization of the street lighting infrastructure for additional cross-sectoral equipment, such as traffic monitoring and management cameras, Wi-Fi transmission devices, charging stations for electric vehicles, environmental quality monitoring sensors can free up space and improve the environment visually and operationally, while reducing the cost of the infrastructure and utilizing synergies between various municipal services.

### **Lack of municipal funds for EE lighting retrofits**

We still need to identify the necessary volume of investments which will be sufficient to cover the energy efficiency measures for the whole street lighting infrastructure. Moreover, the street-lighting system needs to expand to cover the parts of the city which are currently not so equipped. Based on the costs of ongoing efforts the volume of required investments in the municipal street-lighting is beyond the city's financial possibilities. Simply transitioning all luminaires to LED lighting could be done with around EUR 100 mil. investment, while redesigning the external lighting infrastructure for higher safety, reliability, renewed infrastructure and added features will cost 2-2.5 times more. An investment of this magnitude is not affordable for the municipal budget. The small-scale revolving fund that has been generated by the several streets supported with UNDP grant funding allowed to create the seed funding for continued flow of funds in further EE retrofits. Nonetheless, the generated financial savings do not provide sufficient funds to allow full retrofitting of the city lighting systems in the next 10-15 years. External financing will need to be leveraged to cover such investments.

### **City's limited borrowing capacity**

As discussed above, the City's ability to borrow is not only constrained by its creditworthiness and cash flows, but also the national policy and stakeholder ministries' concurrence on non-sovereign borrowing. To address the standing need for investments the city will need to be more creative in the ways it attracts financing in municipal infrastructure projects, including street-lighting. The city must explore opportunities offered by third party financing, public-private partnerships, energy performance contracting, vendor credits, and other similar arrangements to spare the limited fiscal space and leverage alternative financing arrangements to the extent feasible. PPPs have successfully worked in the water utility and municipal garbage collection services. Considering the city's limited experience in energy performance contracting and energy sector PPPs, it may require technical assistance in designing an effective scheme for the uptake of PPP in street-lighting.

### 7.4.3 Low Share of Renewable Energy Sources

The utilization of renewable energy remains low (12%) both in Yerevan and country-wide compared to the national target of 30% for 2025. Yerevan declared its commitment to the use of renewable energy sources in the 2016 SEAP. These include photovoltaic and solar thermal energy, municipal solid and liquid waste, and biomass pruning of trees in recreation and walk areas. The EIB and GCP co-financing pending for Yerevan public building EE project will also significantly increase the utilization of energy from RES in this sector. Concurrently, another pending project focusing on the Nubarashen landfill considers producing electricity from the methane captured from the landfill.

#### **Lack of funds**

Under the conditions of tight budget limitations identified above, the investments need to be prioritized not only according to the environmental objectives, but also according to the economic attractiveness of various investment opportunities. The investments in RES require large upfront capital investments and have a relatively longer repayment period.

#### **Lack of PP solutions to leverage RES investments**

Similar to street-lighting investments we need to develop an investment environment, in which we can also promote the use of RES through public-private partnerships. At the same time we will seek to attract green funds to help soften the RES investments due to their marked environmental benefits. These, combined with a favourable regulatory environment, can help the energy used in the city be more sustainable in the future.

#### **Limited experience in procurement of RES systems**

With all the financial arrangements in place, we will still need to develop the capacity to adequately organize the procurement of complex RES systems. This will require building capacity across multiple areas such as identification of the best sites and parts of the municipal economy for RES integration, establishment of minimal technical and performance requirements based on realistic capacity needs, assessment of contractual arrangements, incl. the quality of guarantees, monitoring requirements and eligibility criteria for vendors, and determination of the investment needs.. We will seek technical assistance to develop the necessary RES procurement guidelines covering all the elements outlined above.

## 7.5 Vision

Assessment of the current energy mix and of the efficiencies of thermal and electric energy use in public and residential buildings, and in external lighting, as well as assessment of the recent policy and programme initiatives allowed us to draw conclusions about the current development trends and the remaining gaps for a sustainable energy future. We propose to enhance the ongoing efforts in the direction identified by the SEAP (2016) while defining a vision beyond the SEAP timeframe. To accelerate the adoption of efficiency improvements and sustainability initiatives, and build on the policy reform momentum, we have defined the following vision and strategic objectives for 2030 as well as mid-term targets for 2022.

For 2030, we offer a vision of the City of Yerevan which:

- a. Will have a low energy and carbon footprint and contribute to the enhanced national energy security. The energy consumption will be closely monitored, planned and managed to allow informed decisions and use of innovative energy efficiency solutions.
- b. Will apply the principles of near-zero energy, low-carbon footprint and green architecture in all new construction and reconstruction initiatives. In residential sector, the City will have an effective

mechanism for promoting energy efficiency deep retrofits in multi-apartment residential buildings and improving its citizens' energy utility affordability.

- c. The City will foster and feature green building solutions and renewable technologies in its built environment, incl. 'smart' technologies for energy systems, focusing on the improvement of the quality of life of its citizens.

## 7.6 Strategic objectives (2030) and mid-term targets (2022) and short-term actions (2017-2020)

To achieve Yerevan's energy supply and end-use efficiency vision, we offer the following strategic objectives and mid-term targets defining the milestones on the way. The complementing short-term actions present the initiatives and programmes that we assessed as crucial to kick-start the necessary process or sustain the efforts already underway. Some strategic objectives and mid-term targets are cross-cutting for most measures such as those related to reduction of greenhouse gas emissions, enhanced use of renewable energy and reduced use of conventional energy. While the GCAP is relying on a range of short-term measures already approved in the Yerevan SEAP, the GCAP addresses the energy consuming sectors with a higher level of commitment and a more elaborate set of environmental objectives as illustrated by Table 18 below.

	SEAP Scope	GCAP Scope
<b>Timeframe</b>	2017-2020	2017-2020- 2030
<b>Objective</b>	CO <sub>2</sub> emission reduction	Full list of environmental indicators, including air quality,
<b>Targets</b>		
<b>Climate Change</b>	21% reduction of GHG emissions from BAU scenario by 2020	30% reduction of GHG emission from BAU by 2030
<b>Public Building EE</b>	None	20% reduction of average energy consumption in public buildings
<b>Residential Building EE</b>	None, a section on residential buildings included "for information"	No quantitative benchmark, commitment to promote residential EE through public outreach and small-scale demonstration projects
<b>Renewable Energy</b>	None, minor objectives for EE-integrated renewables	20% of RES share in the city's energy consumption by 2030

Table 18: SEAP and GCAP scopes comparison

Yerevan's Green City Action Plan 2017

Vision ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2022)	Action ID <sup>79</sup>	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking <sup>80</sup>
EVa EVb	ES1	Reach <30%> CO2 emission reduction compared to the baseline year of 2012 in accordance with the updated Covenant of Mayors for Climate and Energy.	EM1	Will have established and ensured capability and functionality of a state-of-the-art municipal energy planning and management system including all sectors of municipal energy use.	EA1  SEAP H.1, H.2. P.1.	Introduce the energy management in municipal institutions and capacity building for municipal energy managers	2018-2020	34,000	300,000	Development and investment programmes department	Energy manager appointed and trained in all municipal institutions
EVa EVb	ES2	Reach <20%> reduction of average energy consumption in public buildings	EM2	Regular and substantive allocations in the municipal budget for EE financing in public buildings, incl. a payment-from-savings scheme with revolving for further energy efficiency investments.	EA2  SEAP P.2, P.4, P.5, P.6	Invest in construction repair works within energy efficiency activities in municipal buildings, thermal rehabilitation of public buildings, in accordance with Yerevan SEAP. Installation of solar water heaters in administrative buildings, pre-schools, sports schools and complex sports schools for children	2018-2021	21,000,000	Operational costs to update and provide information tools.	Development and investment programmes department other sectoral departments (depending on intervention)	Reduction in specific energy consumption (kWh/m2/year) and comfort levels in targeted buildings
			EM3	Mandatory enforcement of building EE standards in new construction and capital reconstruction, integration of green building technologies.							

<sup>79</sup> A reference to SEAP (2016) actions is provided where applicable

<sup>80</sup> Wherever possible, measures for tracking are defined in such a way as to capture all contributions to achieving the mid-term target; where this is not possible or applicable, a percentage is given in brackets as to the contribution by the measured indicator to achieving the mid-term target.

Yerevan's Green City Action Plan 2017

						and teenagers where there is a demand for hot water					
EVa EVb					EA3 SEAP P.8	Modernise electric appliances in kindergartens (electric cook stoves, water heaters, etc.)	2018-2020	400,000	Operational costs to update and provide information tools.	Development and investment programmes department, education department	Reduction in electricity bills (%) in targeted buildings compared to baseline consumption, energy saved (kWh)
EVc					EA4 SEAP P.3	Use energy efficient luminaires in the internal lighting systems of administrative buildings	2018-2020	70,000	Operational costs to update and provide information tools.	Development and investment programmes department, YerQaghLuys llc	Reduced electric bills , (%),energy saved (kWh)increased level of lighting comfort and lit areas in targeted buildings compared to baseline
EVa EVb EVc			EM4	Integrating Energy Performance Contracting (EPC) into the municipal procurement, initiating EPC projects and capacity building	EA5	Develop a conceptual framework for integrating Energy Performance Contracting (EPC) into municipal procurement	2018-2020		10,000	Development and investment programmes department	Number of EPCs initiated, energy saved
EVb	ES3	Will have established a continuous promotion programme to support	EM5	Establishment of partnerships with donors, IFIs and private sector for offering a flexible and favourable financing scheme for large-scale	EA6 SEAP H.3-H.7	Carry out public outreach campaigns promoting energy efficiency in	2018-2020	3,000	20,000	Development and investment programmes department, relevant	Number of events and reached citizens

Yerevan's Green City Action Plan 2017

		residential EE through public outreach and small-scale demonstration projects		residential EE investments. Lead-by-example by co-financing small-scale EE retrofits in multi-apartment housing.		residential and public sector				sectoral depts. (depending on the intervention)	
EVa EVb					EA7 SEAP R.5	Develop a charitable campaign for LED lamps to socially vulnerable households, leverage external financing	2018-2020	645,000	Operational costs to update and provide information tools.	Development and investment programmes department, communal dept	Number of households converting to LED lighting, LED bulbs received, energy saved
EVa EVb					EA8 SEAP R.2	Cofinance small-scale common space EE retrofits in MAB sector by attracting commercial loans	2018-2019	440,000	Operational costs to update and provide information tools.	Development and investment programmes department, communal dept	Number of multi-apartment buildings implementing common-space EE retrofits, Percent energy saving
EVa EVb	ES4	Will have established a scalable mechanism for leveraging investments in residential EE and will utilize public-private partnerships for energy efficiency investments.		See EM4	EA9 SEAP R.3	Promote and get guarantees in residential buildings by reducing risks in EE investments	2020-2022	4,500,000	Operational costs to update and provide information tools.	Development and investment programmes department, communal dept, relevant sectoral depts. (depending on the intervention)	Number of multi-apartment buildings implementing common-space EE retrofits, Percent energy saving

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EVa EVb	ES5	Utilize PPPs for EE investments in public sector.	EM6	Will have integrated Energy Performance Contracting (EPC) into municipal procurement, initiating EPC projects and capacity building	EA10	Develop market for local companies providing energy services based on energy performance contracting (EPC)	2020-2025	X (x) cost of energy saving measures	operation costs are reduced by amount of energy saved	Development and investment programmes department	Number of EPC contracts / buildings targeted, % energy saving, private investments leverage
EVa EVc	ES6	Reach <20%> of RES share in the city's energy consumption	EM7	<75%> of public buildings will make use of renewable energy sources, such as solar energy, municipal solid and liquid waste, biomass from sanitary pruning of public green spaces	EA11 SEAP P.5	Use renewable energy, municipal solid and liquid waste, in municipal buildings. Installation of solar water heaters in administrative buildings, pre-schools, sports schools and complex sports schools for children and teenagers where there is a demand for hot water.	2018-2020	(combined with EA2)	Operational costs to develop the financing scheme and procurement procedures	Development and investment programmes department, relevant sectoral depts. (depending on the intervention).	Number of installations, installed capacity (kW), amount of annual RE generated (KWh) or m <sup>3</sup> of hot water
EVa EVc					EA12 SEAP L.3	Use solar PVs for external lighting facilities of yard areas and entrances of multi-apartment buildings	2018-2020	4,650,000	Operational costs to develop the financing scheme and procurement procedures	Development and investment programmes department	Installed capacity (kW), amount of annual RE generated (KWh)
EVa EVc					EA13 SEAP R.4	Promote installation of solar water heaters and PV systems in private housing areas through private investments	2018-2020	5,700,000	Operational costs to develop the financing scheme and procurement procedures	Development and investment programmes department	Number of installations, installed capacity (kW), amount of annual RE generated (KWh) or m <sup>3</sup> of hot water

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EVa EVc			EM8	Electricity is generated from the methane collected at Nubarashen municipal solid waste landfill	EA14 SEAP M.1	Utilise methane for electricity generation at Nubarashen municipal solid waste landfill	2018-2020	293,000	Operational costs to develop the financing scheme and procurement procedures	Development and investment programmes department, communal dept	Amount of methane captured, RE generated
EVa EVb	ES7	Will have established a scalable mechanism for leveraging investments in residential EE	EM9	Regular and substantive allocations in the municipal budget for financing EE investments in public buildings with payment-from-savings scheme and revolving mechanism	EA15 SEAP P.5 R.3	Develop a replicable financing scheme for residential and public building energy efficiency with built in repayment, revolving and credit guarantee features	2019-2020		20,000	Development and investment programmes department, communal department	Number of EPCs, energy saved
	ES8	Will have completed the modernisation of Yerevan's street lighting system, including lighting of high-ways, avenues, streets, historic monuments, landscapes, courtyards, parks, etc. The network is fully automated and remotely operable.	EM10	The street-lighting efficiency will have increased while expanding the lighting network and number of objects lit. This should allow to maintain or reduce the energy consumption of the overall service while enhancing the quality of lighting and comfort to the citizens.	EA16 SEAP L.1	Gradually replace inefficient lights throughout Yerevan using the savings for a built-in repayment mechanism to allow for loans as well as a revolving mechanism for reinvesting any further savings into further street lighting upgrades	2018-2021	110,000		Development and investment programmes department YerQaghLuys llc	Reduced energy per kilometre lit, total energy saved, reduced energy used per pole, lighting quality improvement
EVa EVc	ES9	Will have integrated smart technologies in the street lighting network.		See EM10	EA17	Develop a database and capacity assessment for introducing external lighting infrastructure smart	2020-2021		10,000/year	Development and investment programmes department	Database developed on Yerevan street-lighting infrastructure ,

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						networking (to allow the operator to exercise remote access, dimming, runtime scheduling, outage detection, etc.)					
EVa EVc					EA18 SEAP L.2 follow-up	Develop logistical framework and assessment for enhancing the efficient lighting revolving fund with energy saving proceeds accumulating from both UNDP and EBRD/E5P funded projects (after EBRD loan repayment) to generate sufficient resources to scale up the street-lighting retrofits for the remaining streets	2020-2021		5,000/year	Development and investment programmes department	
EVa EVc	ES10	Will have used the street lighting network to install sensors assisting the City's traffic control centre		See EM10		See TA18 (Transport)	2018-2022			Transport dpt. / Development and investment programmes department	
EVa EVc	ES11	Will have used the street lighting network to install sensors monitoring the air quality in areas with high		See EM10		See TA18 (Transport)	2018-2022			Transport dpt. / Development and investment programmes department	

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	emission exceedances to inform the City's traffic control centre for mitigating actions.									
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*Table 19: Strategic framework for energy*

For detailed information on all non-SEAP short-term actions, including their concrete benefits, you can consult Annex 5. Approach to monitoring the implementation of short-term actions is outlined in chapter 18.

## 8 Industries

Yerevan is the largest economic centre of Armenia. Its share in the annual total industrial product of Armenia is 41%. The industry of Yerevan is quite diversified and includes chemicals, rubber products, plastics, primary metals and steel products, building materials and stone-processing, wood products and furniture, rugs and carpets, textiles, clothing and footwear, jewellery, alcoholic beverages, mineral water, dairy product and processed food.

Table 20 illustrates the industrial output growth of Yerevan and Armenia over the period 2011-2015 and provides the structure of the industrial output by types of industrial activity for the last year of that period.

Industrial output by RA and Yerevan city at current prices (mil. AMD)					
	2011	2012	2013	2014	2015
RA	998 963	1 121 906	1 242 070	1 291 274	1 342 700
Yerevan	423 435	450 104	507 541	543 868	552 818
% share	42.4 %	40.1 %	40.9 %	42.1 %	41.2 %

Structure of industrial output of RA and Yerevan city by types of economic activity in 2015 (mil. AMD)				
	Mining and quarrying	Manufacturing	Electricity, gas steam and air conditioning supply	Water supply, sewerage, waste management and remediation activities
RA	220 666	839 473	261 879	20 680
Yerevan	1 986	440 032	97 706	13 092
% share	0.9 %	52.4 %	37.3 %	63.3 %

*Table 20: Industrial output and structure of industrial output in Armenia and Yerevan*

Before the 1990s, Armenia's economy was based largely on chemicals, electronic products, machinery, processed food, synthetic rubber and textile industries, and it was highly dependent on outside resources.

After gaining independence, Armenia "inherited" an unviable economy from the Soviet system and found itself in the most troublesome situation of all countries of Transcaucasia. Being an agrarian-industrial country with developed metal working, mechanical engineering, chemical, light, and food-processing industries Armenia felt the sudden isolation and its lack of rich natural resources, favourable geographical position and fertile soils.

In the transition period of the 1990s, the economic and energy crisis and transport blockade resulted in failure of the industrial sector, including Yerevan. This had a negative impact also on the transport and engineering infrastructures and green areas.

In 1994, after the conclusion of armistice with Azerbaijan and obtaining funds from IMF and the World Bank, the national economy gradually stabilized, the inflation rate decreased and GDP started growing.

It is also worth noting that the 1990s saw most industrial enterprises privatised.

Now, the leading industries are mechanical engineering, metal working, chemical and petrochemical, nonferrous metallurgy, manufacture of building materials, food products and beverages (including alcoholic) and light industries. Building materials (including those based on the deposits of tuffs, pearlites, limestones, granites and marbles) mainly include travertine, crushed stones, asphalt and asphalt concrete. Food products include processed meat, all types of canneries, wheat and flour, sweets and chocolate, dried fruits.

Major plants in the city include the Nairit chemical and rubber plant, Rusal Armenal aluminium foil mill, Grand Candy Armenian-Canadian confectionery manufacturers, Arcolad chocolate factory, Marianna factory for dairy products, Talgrig Group for wheat and flour products, Shant ice cream factory, Crown Chemicals for paints, ATMC travertine mining company, Yerevan Watch Factory AWI watches, Yerevan Jewellery Plant, and the mineral water factories of Arzni, Sil, and Dilijan Frolova. Furthermore, there are two molybdenum manufacturing factories located in the south part of Yerevan (e.g. Maqur Erkat).

The industry's impact on the local environment is undisputable, the oversight and regulatory competencies over industrial facilities in Yerevan nevertheless lie with the Ministry of Nature Protection and we have limited direct tools to influence the different industrial sectors.

Over the past two decades government's approach to private sector was based on minimal regulation to motivate investment and help spur economic growth. Recently, there have however been multiple legislative initiatives aimed to improve efficiency of operation and processes as well as to promote renewable energy sources in the industrial sector.

The 2016 amendment of the Law on Energy Saving and Renewable Energy stipulates development of a ranking system which will categorize economic entities as large, medium or small energy consumers by February 2018. The large energy consumers will be expected to undergo energy audits and comply with the existing voluntary standards on mandatory basis.

In addition, the Ministry of Nature Protection is currently in the process of developing a legislative proposal on the introduction of the EU Best Available Techniques, including the development of indicators. Once in place, this will have a positive impact on different industrial sectors, including those located in Yerevan. However, this process is likely to take years before the rules enter into force and are applicable.

There are no state initiatives directly addressing resource efficiency or pollution in the industrial sector. The UN Industrial Development Organization (UNIDO) has been working on an EC-funded Resource Efficiency and Clean Production (RECP) programme since 2013, in collaboration with OECD, UNECE and UNEP as part of the "Greening Economies in the Eastern Neighbourhood" programme (EaP Green). The RECP covers the whole country and has provided for the training and accreditation of a dozen of RECP experts. The programme also supported enterprises throughout Armenia, including two in Yerevan, to identify cost-effective solutions for improved resource efficiency and minimized ecological footprint of these enterprises. The enterprises in Yerevan included the Ararat food factory, Elbat starting battery and Kashy OJSC leather factory. In both cases the identified potential for improvement was large and the companies were advised on potential improvements in minimizing environmental contamination while reducing raw material input and reducing energy use by 10-12%. Consequently, the Regional Environmental Centre and UNIDO are aiming to establish a Green Economy Promotion Centre in Yerevan to serve as the centre of excellence and advocate for RECP principles in local businesses.

It is also noteworthy that private enterprises have been covered by the commercial lending market, which is underpinned by the international green credit lines and supported by EBRD, GGF, IFC and KfW. These financial institutions offer competitive lending, in some cases with subsidized energy audits, for any investments which reduce energy consumption and environmental footprint of production processes.

## 8.1 Key challenges

It was not an easy task to assess the situation and identify the challenges of the industrial sector in our city, mostly due to the lack of systematised and readily available information and statistical data to compare industry-related environmental indicators in line with the GCAP methodology. Some data refer to earlier years and may hence not reflect the most up-to-date situation, some indicators represent informed expert assessment.

The table below (Table 21) summarizes the results of baseline mapping which was the basis for subsequent prioritisation of the City's industrial challenges. The pressure indicators for industry focus on energy use and industrial waste.

It is worth noting that some of the industries also have a significant impact on the air quality situation as captured by the air quality indicators in Chapter 4. This is true especially with regard to SO<sub>2</sub> emissions, where local molybdenum manufacturing factories are responsible for 98% of the Yerevan's SO<sub>2</sub> pollution. Even if moderately high (marked with amber colour), these emissions are still in accordance with the EU Best Available Techniques (BAT).

Pressure Indicator	Pressure Indicator value
Electricity consumption in industries, per unit of industrial GDP	0.29 kWh/2010 USD
Heat consumption in industries, per unit of industrial GDP	12.26 kJ / 2014 USD
Heavy metals emission intensity of manufacturing industries	2.91 kg of heavy metals equivalent released per million USD GVA
Fossil fuel combustion in industrial processes, per unit of industrial GDP	3.46 MJ/USD
Share of industrial energy consumption from renewable energy	<1%
Share of industrial waste recycled as a share of total industrial waste produced	5%

Table 21: Industry pressure indicators

In the table below (Table 22), we provide the assessment of the policy framework as mapped through the response indicators. As noted above, these reflect the general situation at the national level.

Response Indicators	Response indicators assessment
Electricity and heat consumption / energy efficient industrial processes: Energy efficient industrial machinery is regulated and incentivised through fiscal instruments (electricity, heat, industrial processes)	There are no fiscal instruments targeted at energy efficient industrial machinery
Electricity and heat consumption / energy efficient industrial processes: Energy efficient industrial technologies (electricity, heat, industrial processes) is supported through private investment	There are a number of green credit lines that lend at relatively favourable terms (compared to average market rates) for energy efficiency investments in MSMEs and large industries, including the EBRD Energocredit, the IFC SEF, KfW MSME EE.
Industrial waste / material consumption: Material efficiency of new built industrial facilities and waste recycling is regulated and incentivised through fiscal instruments	No specific mechanisms or regulations developed within national legislation,
Industrial wastewater treatment / reuse / recycle is promoted through regulations and fiscal incentives	Not addressed within national legislation

Table 22: Industry response indicators

Evaluation of the pressure and response indicators helped identify key challenges. Furthermore, we conducted a public consultation<sup>81</sup> to present these challenges and the underlying data to gauge the public's perception of Yerevan's industrial sector and its impact on the environment. Stakeholders generally agreed with the results echoing the lack of data as a key issue to correctly assess the situation. Moreover, according to Armenia's legislation, the local government does not have any delegated authority or jurisdiction over the industrial sector. Consequently, local government plans, strategies and even the organizational structure do not have any elements, which can or have agenda to take any concrete mitigation action in industry.

<sup>81</sup> GCAP public consultation events on 8 and 19 December 2016

As a result we have defined three key areas of concern as illustrated in Figure 27 below.



Figure 27: Industry challenges

While the low efficiency of resource use and heavy waste and pollution load from the industrial sector in Yerevan is a major challenge, we do not have any formal power to take action in this regard. According to RoA policy framework, the regulation of the economy is a state function, including the regulation of the environmental footprint and the technical and fiscal framework, in which industries operate. Consequently, the local government structure in all Armenian communities, including Yerevan, has not provided for any human resources, institutional capacity, budget allocation or action items in any of the strategic plans related to the industrial sector. Owing to this situation, we currently lack data, experience as well as a conceptual framework for the green city actions in the industrial sector. We note, however, that a recent amendment of the Law on Local Self-Governance, in particularly the Article 12(2), foresees greater involvement of municipalities in promoting favourable and sustainable environment for businesses. The directions outlined in this GCAP take account of this changing framework.

### **Lack of information and cooperation platform between the City and the industry**

The limited scope of municipal competences resulted in limited in-house statistics on Yerevan-based industry, making collection of reliable up-to-date data on the environmental performance of Yerevan's industrial sector a difficult task. Given the limited involvement of the state government in the industrial sector as well, we realise that a dialogue can be voluntarily initiated between the City Administration and the industrial companies given industry's impact on the state of Yerevan's environmental assets.

Considering the other key challenges described further down and our limited involvement within the sector, we propose a strategic cooperation framework mostly aimed to motivate and attract the industrial sector to adopt efficient processes. We will seek to support such initiatives through different cooperation platforms. Key programmes to address the challenges will, however, need to be adopted at the national level.

Given the limited functional scope of our operations, the following initiatives can be implemented to help the introduction of industrial best practices, minimize the industrial footprint on the city environment as well as support green economic growth:

- Developing a public-private dialogue platform (e.g. "Yerevan Chamber of Green Businesses") for streamlining any initiatives and programmes aimed at communication of best practices and targeting green-minded businesses located in Yerevan
- The desired material and energy efficiency should be supported through increasing SME access to information, and developing voluntary partnerships and certifications (ISO 50001, RECP, BAT, benchmarking) as well as local green business award competitions
- Through construction permitting and land allocation procedures, we can further promote adequate zoning of industrial activities and establish requirements for waste management, pollution control, sustainable energy solutions, and development of new business parks and premises to meet green business needs
- Supporting green business incubators to spur green economic growth and job creation
- Seeking partnerships with international networks and programmes which promote success stories in local government partnerships with local economic players such as the new EC Mayors for Economic Growth (M4EG) Initiative
- Seeking opportunities for engaging local "green" businesses in public procurement with preference granted to local "green" business suppliers that meet all technical specifications and are cost-competitive, and/or offer innovative sustainable energy solutions.

### Low industrial material efficiency and high levels of waste and pollution

Yerevan's share of industrial waste recycled as a share of total industrial waste produced is only 5%, well below best practice levels of beyond 90% in OECD countries<sup>82</sup>. This indicator is illustrative of the low material efficiency that characterises Yerevan's industrial sector. The current regulatory framework does not motivate industrial companies to address the issue. The RoA Law on Waste (2004) foresees the provision of economic incentives allowing for privileges to those enterprises that recycle and utilize waste. There are, however, no specific mechanisms or regulations developed to offer and deliver these incentives. There are a few companies in Yerevan that use municipal solid waste fractions, mainly plastics, as input for their products and operations. This is occurring in the absence of incentives and may increase if proper incentives are introduced. Since the waste recycling is purely voluntary and not required by legislation, most industrial enterprises chose to discard waste. Companies with measures on waste minimization, reduction or reuse of on-site waste are still an exception. The Yerevan-based "EIBat" factory producing car batteries is currently considering construction of a battery treatment facility which would give them a more affordable secondary source for lead and cover 40% of their demand for raw material as well as reduce the discharge of a substantial share of hazardous pollutant car battery acid into the sewage or directly into ecosystems on daily basis.<sup>83</sup> We hope that projects like this will be more common in the future. Given the plans for the development of the new landfill and a treatment facility, it may be timely to also introduce specific requirements for industrial waste separation, recovery, treatment and recycling, further discussed in chapter 8 on waste.

As far as SO<sub>2</sub> emissions are concerned, the values of emission per kilowatt hour of electricity generated are only a moderate risk due to a relatively clean mix of fuels used in the electricity sector. Moreover, the industrial enterprises that have been assessed for resource efficiency and clean production appear to be in line with the EU best available technologies (BAT) from the perspective of industrial pollution by SO<sub>2</sub> compared to the unit of output. Still, aiming at long-term pollution reduction, measures supporting gradual improvement of the energy efficiency of the technology process and the reduction of SO<sub>2</sub> and other emissions of polluting substances by industrial firms should be welcome.

### Industrial energy efficiency + Industrial energy system sustainability

The energy consumption analysis of Yerevan's industrial sector indicates that the energy use is largely related to heating of industrial spaces (share of electricity use is quite low, seasonal variation shows a gas consumption spike in heating season). Industrial Energy Audits are, however, not common and industry representatives are frequently not familiar with the areas and processes where potential exists to conserve energy. Limited experience with industrial enterprise audits suggests that most industrial spaces utilize inefficient heating technologies, oversized facilities, and poor management of process heat and steam systems, and have outdated and oversized technological equipment. Very few energy audits are conducted as part of the lending precondition for the operating IFI-supported green credit lines. In some cases, the IFIs even subsidize the cost of the energy audits. Energy audits are required by IFIs (KfW, GGF, EBRD, KfW) via local participating financial institutions, to comply with Energy Efficiency and CO<sub>2</sub> emission reductions thresholds (e.g. around 15-20% of energy efficiency). If the energy audit confirms the loan application meets the set threshold, the client is considered eligible for the green loan. The green loans have thus created a market for energy audit services which provide basis for the assessment of cost-effectiveness and pay-back on EE investments. EE financing facilities include:

- ACBA Leasing, Ineco, Ararat and ACBA Banks have received multi-million credit lines for EE loans for individuals and legal entities from the Green for Growth Fund.
- International Finance Corporation (IFC) is working, in the framework of its Sustainable Energy Finance Project, with Byblos Bank on EE lending for households and with HSBC for EE in SMEs.
- EBRD Armenia Sustainable Energy Financing Facility has set up the EnergoCredit facility which provides energy efficiency loans for business clients.
- Ameria Bank's SME EE loan product is supported with own financial resources.
- National Mortgage Company (by means of KfW and French development agency) provides EE&RE credit line for SMEs and farms through its French partners

<sup>82</sup> GCAP methodology ranks waste treatment of all industrial waste below 80% as "red" and hence a matter of concern.

<sup>83</sup> Dead car batteries are accepted by specialized services empty of battery acid. Considering there is no organized way of safe disposal of battery fluid, the battery owners dispose them randomly either into sewage or on the "side of the road".

These loans are usually available under more competitive terms than regular commercial loans, and many enterprises tend to utilize the green loans for common business development and modernization investments. 17% of all green lending is utilized by industrial enterprises for EE, and the lending for renewable energy investments is 20% of the overall sustainable energy portfolio. The cumulative lending by the IFIs and local financial institution is within the range of EUR 90 mil. annually in Yerevan and other parts of Armenia. The share of industrial energy consumption from renewable energy shows the weak links between the call for action and integrated energy policies.

The latest legislative developments facilitated the installation of photovoltaic (PV) systems at industrial sites, by not requiring a license for installations up to 150 kW and permitting simultaneous operation with the existing network and by attractive purchase price for sites with up to 1 MW. While this has resulted in an increase in renewable energy generation for industrial facilities, few installations have been put in place so far. We need to promote awareness and better understanding of the current favourable environment for RES investments and the offered benefits since the legal incentives are fairly new (introduced in 2016).

The regulatory framework for heat consumption and fossil fuel combustion in industrial processes does not currently provide for sufficient incentivisation either. There are no built-in energy efficiency incentives in energy tariffs. The natural gas tariff even has an adverse incentive with the tariff being lower for larger consumers (over 10,000m<sup>3</sup> per month) than the regular retail tariff. The 2<sup>nd</sup> National Energy Efficiency Action Plan adopted by the Government of RoA in February 2017 emphasizes the need to raise public awareness in energy efficiency and energy saving.

## 8.2 Vision for industry

Our vision for industry focuses on the general environment of cooperation and mutual support we would like to achieve. It aims to increase energy and material efficiency to reduce waste, energy consumption and related polluting substances.

For 2030, we offer a vision of the City of Yerevan which:

- a. Will host industries that pursue cleaner production and resource efficiency as part of their business models
- b. Will be an attractive place for R&D activities and research institutions to develop GHG mitigation and resource efficiency technologies.
- c. Will see the emissions from the industry (including SO<sub>2</sub>) in accordance with the EU Best Available Techniques (BAT).

## 8.3 Strategic objectives (2030), mid-term targets (2022) and short-term actions (2017-2020)

To achieve Yerevan's vision for the industrial sector, we offer the following strategic objectives and mid-term targets defining the milestones on the way. The complementing short-term actions present the initiatives and programmes that we assessed as crucial to kick-start the necessary process.

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Vision ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2022)	ST ID	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking <sup>84</sup>
IVa	IS1	Industrial enterprises of Yerevan will have started applying cleaner production and resource efficiency solutions through benchmarking, corporate energy management (ISO), and tools such as BATs and RECP	IM1	Set up a Programme for incentivising energy and material efficiency and cleaner production in the industrial sector to attract state-of-art industrial technologies, services and waste processing businesses to invest and operate in Yerevan.	IA1	Develop a public-private dialogue platform and local green business development action plan to streamline any initiatives for incentivising material efficiency in the industrial sector and to attract new waste processing businesses to invest and operate in Yerevan.	2018-2023	50,000	20,000	tbd	Incentivisation programme
IVa	IS2	Industrial pollution, waste generation and energy use will have decreased		The local green business support platform will promote local economic activity, job creation and minimized environmental footprint of local production. Through green procurement, we will have created a market incentivising industries to engage with voluntary green certification programmes.		Incorporate green business support into public procurement procedures for local vendors with proven achievements in material efficiency, clean production and energy efficiency innovation.	2018-2023	na			Number of procurement procedures targeting green businesses and services

<sup>84</sup> Wherever possible, measures for tracking are defined in such a way as to capture all contributions to achieving the mid-term target; where this is not possible or applicable, a percentage is given in brackets as to the contribution by the measured indicator to achieving the mid-term target.

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Vision ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2022)	ST ID	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking <sup>84</sup>
IVb	IS3	Utilise the potential of sister-city networks, regional partnerships and partnership with academic institutions to promote local sustainable economic growth and R&D development.	IM2	We will have identified potential models of cooperation with the existing industrial facilities of Yerevan, as well as identified opportunities to attract new green businesses within the region to invest and operate in Yerevan through establishing favourable green business zones.	IA2	Organise an annual expo oriented on energy and material efficiency and GHG emission reduction in the industrial sector.	2018-2020	-	60,000	tbd	Annual expo event (33%)
					IA3	Implement and introduce a voluntary rating system for green production/Eco friendly industry.	2019-2020	40,000	20,000	tbd	Green production rating system (50%)
					IA4	Introduce an annual Green Business of the Year Award by the City of Yerevan.	2019-2020	-	20,000	tbd	Green Business of the Year Award (17%)
	IS4	The Centre of Excellence for Clean Production will have established itself as a major knowledge hub for the industry on the green circular economy, clean production, efficient operational management and optimization of resource use. Its services will be in high demand.	IM3	We will have established the Centre of Excellence for Clean Production and it has become the expert centre that industrial entities approach when they want to embark on clean production path.	IA5	Seek donor support for the establishment of Centre of Excellence for Clean Production	2020-2022	na	tbd	tbd	Time schedule for the project (25%)

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Vision ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2022)	ST ID	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking <sup>84</sup>
	IS5				IA6	Establish voluntary agreements on energy audits in industry to motivate companies (e.g. via small grants) to increase energy efficiency through conducting energy audits and implementing recommended energy efficiency measures.	2020-2022	600,000	-	tbd	Heat consumption in industries per unit of industrial GDP  Heavy metals emission intensity of manufacturing industries  Number of voluntary agreements  Funds allocated to the programme (75%)
IVc	IS6	SO <sub>2</sub> emissions will have decreased and reduced local SO <sub>2</sub> concentrations and daily emission levels	IM4	The molybdenum-producing companies will have voluntarily committed to apply measures to improve efficiency of their	IA7	Introduce voluntary agreements with the molybdenum industrial companies on energy audits. <sup>85</sup> The municipality will seek international financial	2018-2020	80,000	na	tbd	Monitoring system of the measures applied as a part of the

<sup>85</sup> The municipality will negotiate voluntary agreements with the industrial companies that commit the companies to conduct energy audits including an environmental impact assessment. The target is to identify measures to improve efficiency of the technology processes and thus reduce energy consumption and emissions of SO<sub>2</sub>, GHG and other polluting substances. Some of the measures identified by the energy audits will be possible to implement by the companies as the payback of the investments from the cost saved will be up to 3-4 years. For some other measures to be implemented, the municipality will seek international financial support to cover part of the investment costs.

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Vision ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2022)	ST ID	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking <sup>84</sup>
				technology processes and thus decrease energy consumption and related emissions of SO <sub>2</sub> , GHG and other polluting substances.		support to cover part of the costs.					grant programme

Table 23: Strategic framework for industry

For detailed information on all short-term actions, including their concrete benefits and timing, you can consult Annex 5. Approach to monitoring the implementation of short-term actions is outlined in chapter 12.

## 9 Waste management

Waste management is a key sector for transitioning to a green city. It is an area where we have made significant efforts in recent years setting up a framework for environmentally sound solutions.

Today, the municipal solid waste (MSW) management in our city includes the daily inspection and cleaning of public areas (streets, squares, courtyards, etc.), including snow cleaning, as well as collection and disposal of household waste from 4,865 multi-family buildings and 55,000 single family homes across the 12 districts of the city.<sup>86</sup> In addition, services are provided for collection of construction waste and garbage-chute cleaning, repair, and disinfection. As of 1 May 2016, this has included removal of 7,500 cubic meters of construction waste, clearing of 1,800 blockages in chutes, repairing of 250 chutes, and 8,800 disinfections of chutes.<sup>87</sup>

We have started reforming the collection of municipal solid waste in recent years. We formed a public-private partnership (PPP)<sup>88</sup>, signing agreements on the collection of MSW with two companies identified through an international bidding process. The new collection system has been operating since December 2014 and complies with EU standards (collection trucks and garbage bins). The agreement will be in force until 2025. The PPP agreement specifies investment obligations as well as targets on key performance indicators that obligate all parties. The current formal system of MSW collection and disposal does not however include separate collection, sorting or any type of waste treatment. Waste sorting for recycling is still a matter of rather informal activities both in Yerevan and the whole of Armenia.

The waste generated in the territory of Yerevan is currently disposed of on official controlled dumping sites which do not yet ensure proper technical security measures. No MSW, hazardous waste (HW) or other waste is disposed of in EU-compliant sanitary landfills. In addition to reforms in collection, we are therefore planning a key change to the MSW disposal. With a EUR 16 mil. loan from EBRD and EIB (each EUR 8 mil.) and EUR 8 mil. EU grant, a new sanitary landfill is scheduled to be built in Yerevan starting in 2018. The supplier of works to replace the existing managed dumps, the largest of which is the Nubarashen landfill, will be selected through a public tender. Closure of Nubarashen and Ajapnyak dumpsites is envisaged to be implemented with an EUR 2 mil. grant from E5P, which is in addition to the EUR 24 mil. and falls under the whole project. A tender is expected to be announced for building the new sanitary landfill. It is envisaged that this project will be delivered as a Public-Private-Partnership.

The current Nubarashen landfill entered into operation in the 1960s and handles the bulk of Yerevan's MSW. With an average of 850-900 tons a day, it receives an upward of 325 thousand tons of MSW a year. In 2009, we signed an agreement with the Japanese company, Shimizu<sup>89</sup>, to harvest the Nubarashen landfill's methane. The original plans called for generation of electricity from burning the methane, currently methane is nevertheless only flared. SEAP<sup>90</sup> foresees utilisation of the methane for electricity generation after 2020, which is also reflected in the GCAP strategic framework for energy (See Chapter 7). We recall that MSW's management was identified in SEAP as the second largest sector in terms of climate change mitigation potential.

The strategic planning of the municipal solid waste management of Yerevan follows the national solid waste management strategy adopted by the RoA government in 2014. This strategy envisages a system of regional landfills covering the whole country where the future sanitary landfill in Nubarashen will effectively serve as a regional disposal facility.

Concrete measures are planned in five-year cycles and detailed annually within our annual development plan. We are happy that, as part of this GCAP development, we received additional insight into the waste management issues by an international team of experts and outlined together a strategic framework up to 2030. This framework and short-term actions build on our ongoing efforts and complement them with current trends applied by cities in waste management. We understand that transparency is an important element across all sectors, including waste production and management, as it raises public awareness and opens new business opportunities. This aspect is thus reflected in the future initiatives as well. We

<sup>86</sup> Source: <https://www.yerevan.am/am/communal-services/>

<sup>87</sup> Source: Ibid

<sup>88</sup> Based on outcomes of a project financed by the World Bank through a grant from the Public-Private Infrastructure Advisory Facility (PPIAF) and executed in, 2008-2009

<sup>89</sup> The contract with Shimizu will last until 2023.

<sup>90</sup> Yerevan Sustainable Energy Action Plan, 2016

note nevertheless that we already report and publish basic information on communal waste generation and management.

## 9.1 Key challenges

In order to identify the pressures that the existing waste production and management system of Yerevan exerts on the city's environment we analysed relevant input data in accordance with the EBRD methodology. The pressure and response indicators concerning the waste production and management were mapped and evaluated according to pre-defined benchmarks. Summary of the evaluation process is shown in the following tables. The first two tables (Table 24 and Table 25) provides an overview of the state and pressure indicators and their values, the following table illustrates the current status of sectoral regulation through the response indicators (Table 26). Steadily improving performance of some of waste management indicators shown below (namely waste collection practice) is a result of a systematic long-term planning.. Based on the sector's potential of benefits as also described above waste management has become the second highest priority for us in terms of improvement and investment.

State indicator	Pressure indicator value
Number of contaminated sites	1 - 10 contaminated sites and potentially contaminated sites per 1,000 inhabitants

Table 24: Waste-related state indicators

Pressure indicator	Pressure indicator value
Total solid waste generation per capita	300 – 340 Kg/person/year
Share of the population with regular municipal solid waste collection	>95 %
Percentage of MSW and other waste (including HW) landfilled is disposed of in EU-compliant sanitary landfills	0%
Proportion of MSW that is sorted and recycled	< 5%
The remaining life of current landfill(s)	5 – 8 years

Table 25: Waste-related pressure indicators

Response indicator	Response indicator assessment
Reduction of material consumption / solid waste generation is promoted through awareness campaigns	Some activities aimed at reduction of material consumption occurred, but existing measures are not sufficient to reduce material consumption and waste generation
Coverage of solid waste collection system is improved through plans and investment	Yerevan Municipality has developed MSW collection and disposal strategy and investment plan and is implementing them step-by-step.
Littering and non-compliance to sorting systems is disincentivised through fines and penalties	There are littering fines established and collected in Yerevan. Individual offence is penalised. There is no official municipal solid waste sorting system and sorting incentivising system in Yerevan yet.
Composting, recycling, and waste-to-energy facilities are developed through plans and investment	Plans considering self-paying investments in sorting and recycling facilities with international tender are expected in 2017-2018
Solid waste reuse, sorting and recycling is promoted through information and awareness campaigns	No information or awareness campaigns in place.
Overcapacity issues in waste disposal sites are tackled through plans and investment	Only plans and investments for municipal solid waste disposal sites are in place, other waste disposal sites are not.

Table 26: Waste-related response indicators

We presented the results of our technical analysis at a dedicated GCAP public workshop highlighting the identified challenges. The results were considered a good reflection of the current situation of waste

production and management and no further challenges were suggested. Based on the technical analysis and stakeholders' feedback, we have hence identified two key areas of concern which we present below in more detail. As illustrated also in Figure 28, the first area of concern is the waste disposal practice, the second area of concern regards the low material efficiency.

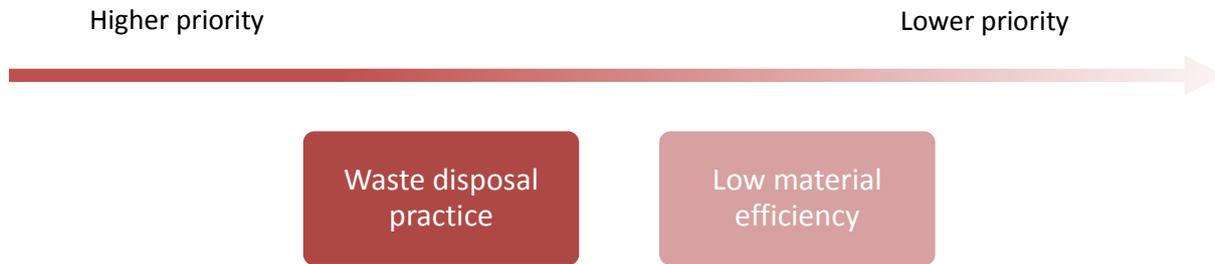


Figure 28: Waste challenges

### Waste Disposal Practice

We have already adopted policy measures and embarked on the path to change the existing MSW disposal practice towards international standards. To address the urgent need for sanitary landfills for MSW disposal, we have developed a MSW collection and disposal strategy and are implementing it step by step. In the close future, we plan to call an international tender for construction of a new MSW sanitary landfill in Yerevan. This policy fully covers the existing MSW disposal gap to meet EU standards. Complementary to the new sanitary landfill construction the existing dumpsites of Nubarashen and Ajapnyak will be properly closed following the international technical and environmental standards. What refers to the sorting and recycling process, the Yerevan community considers garbage sorting and recycling as a business plan and envisages organizing this process within the framework of communal-private partnerships which will be based on the reduction of garbage and negative environmental impact, as well as leaving the possibility of choosing technological solutions and output products to the investor's discretion for achieving the potential maximum income (community budget)<sup>91</sup>. Yerevan municipality will announce an international tender for construction of a sorting and processing plant for 2017-2018, the purpose of which is to select a private company that will offer a technical solution for the sorting and recycling of waste water, which will satisfy the environmental requirements and will operate according to the self-paying principle under Communal-Private Partnership. For reclamation of mining waste disposal sites, financial reserves allocated for this purpose should be effectively used to ensure adequate environmental protection including monitoring of environmental assets<sup>92</sup>.

We will, however, still need to deal with the consequences of the current waste disposal practice, which will continue until the new sanitary landfill has been built and is operational. The dumping of the vast majority of waste in existing controlled dumpsites has a negative effect on the quality of the environment as it decreases biodiversity (i.e. bird community) in the city and causes contamination of surface water and soil on waste disposal sites and their vicinity. This applies to both active dumpsites and those already abandoned.

The GCAP team experts also pointed out the negative environmental impact of the industrial sector as a whole as it generates major amounts of waste (both hazardous and non-hazardous) within the territory of Yerevan. Obsolete industrial waste disposal as well as absence of hazardous waste sanitary landfill capacities for Yerevan increase the risk of environmental contamination significantly.

Although the existing policy measures plan for EU-standards-compliant MSW collection and disposal, other waste management aspects, such as capacities for other waste, including hazardous waste, have not been part of long-term planning yet. In the future planning, we will hence focus more on the evaluation of trends in production of all individual waste types and respective forecasts, identification of the waste management options, plans for future waste treatment, and utilisation and disposal capacities. As one of the functional measures verified on international level (EU) we see the policy of granting permission for operation (for future and existing enterprises) under the condition that the waste disposal/treatment of individual enterprise is ensured in accordance with environmental standards

<sup>91</sup> Source: SUDIP

<sup>92</sup> This requirement results from the 3rd SEA public hearing.

applicable in the EU. The waste could be disposed of either at facility owned by the enterprise or the waste disposal services could be outsourced. Fulfilling this condition should be monitored and, in case of noncompliance, sanctions should be applied. In the extreme case the permission to operation could be suspended.<sup>93</sup>

This effort will result in a comprehensive waste management plan covering a period of ten years and aiming to approach the EU standards<sup>94</sup> in the waste management sector covering both MSW and other waste. Cooperation with the Ministry of Territorial Administration and Development and the Ministry of Nature Protection will be crucial in addressing this challenge.

### **Low Material Efficiency**

The second area of concern is linked to limited recycling of waste. From the experience of other cities, high material efficiency of a city's economy can bring substantial and tangible benefits for its citizens as well as for the community's budget. We can contribute to the process directly by introducing an effective recycling system of municipal solid waste commodities and incentivising high material efficiency in the industrial and service sector.

We have already begun implementing the necessary policy measures by preparing the introduction of MSW sorting for a recycling system. In 2017, the municipality launched the non-binding request for expression of interest aiming at companies interested in sustainable solid waste pre-treatment investment project via a Public Private Partnership.

The GCAP team of experts has recommended further measures, in particular awareness campaigns concerning solid waste generation prevention, solid waste reuse, sorting and at source and recycling. Based on their experience, such information and awareness campaign must be intensive and long-term. Main focus on and cooperation with schools on various levels of education is also recommended. We expect the situation in municipal waste sector to improve soon with the MSW sorting for recycling facility of the new Nubarashen landfill. However, as also noted above, we will need to pay attention to industrial, agricultural and service sectors present in the territory of Yerevan. These sectors can also benefit from high material efficiency, which would in turn benefit Yerevan, esp. regarding the potential for new business opportunities. To reach high standards in these sectors we will aim to systematically incentivise and motivate them on their way to close the loop of the material consumption via tailor-made policy measures and awareness raising.

Based on the overall assessment of the waste sector and on our deeper understanding of the challenges and trends in waste management, we present below the strategic framework until 2030. As with other sectors, it is complemented with short-term actions for the next three years. It takes account of the ongoing activities and builds upon them.

## **9.2 Vision**

For 2030, we offer a vision of the City of Yerevan, which

- a) Will be served by a modern integrated waste-management system employing international standards, directing Yerevan towards a materially efficient economy.
- b) Will make Yerevan attractive for state-of-the-art waste management and technological companies as well as affiliated service sectors.

## **9.3 Strategic objectives (2030), mid-term targets (2025) and short-term actions (2017-2020)**

To achieve Yerevan's vision for the waste sector, we offer the following strategic objectives and mid-term targets defining the milestones on the way. The complementing short-term actions present the initiatives and programmes that we assessed as crucial to kick-start the necessary process or sustain the efforts already underway.

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<sup>93</sup> This policy measure recommendation results from the 3rd SEA public hearing.

<sup>94</sup> EU Directive 98/2008 EC and European Commission, Directorate General - Environment: Preparing a Waste Management Plan - A Methodological Guidance Note, 2012

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Visio n ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2025)	ST ID	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a )	Action owner	Key measures for tracking <sup>95</sup>
Wsv a	Wss 1	100% of MSW as well as other waste generated will be handled in appropriate waste disposal or waste treatment facilities and managed both according to EU standards.	Wsm 1	100% of MSW and 50% of other waste generated will be handled in appropriate waste disposal or treatment facilities. These facilities will be designed, built and operated according to EU (or other international) standards.	Wsa1	Construction of the new sanitary landfill for MSW <sup>96</sup> , and operation of the facility (PPP Project). Closure <sup>97</sup> and reclamation <sup>98</sup> of existing dumpsites in Nubarashen and Ajapnyak.	2018-2022 <sup>99</sup>	26,000,000	220,000 <sup>100</sup>	Communal services dpt.	EU standards for landfilling Weight of MSW delivered to the new sanitary landfill Weight of waste sorted out of the MSW Surface water quality improvement GHG emissions reduction (expected GHG emission reduction for Nubarashen: ca 45 kt CO2 eq. p.a.) <sup>101</sup>
					Wsa2	Consider possibility of constructing a new MSW sorting and recycling plant in the framework of public-private partnership	2018-2019	Subject to evaluation	15,000	Communal services dpt.	Public-private partnership agreement

<sup>95</sup> Wherever possible, measures for tracking are defined in such a way as to capture all contributions to achieving the mid-term target; where this is not possible or applicable, a percentage is given in brackets as to the contribution by the measured indicator to achieving the mid-term target. Additional measures for tracking aim to capture the improvement of quality of the associated environmental assets. Where possible, quantification is provided as to the extent of the improvement.

<sup>96</sup> The EBRD-EIB-EU financed project concerning the new sanitary landfill construction and operation as well as the MSW sorting and recycling facility is to be implemented in the coming years. In addition, the two existing waste disposal facilities should be closed as part of the project. These projects completely match with the green city strategy and serve as an example of progress made in the waste management sector.

<sup>97</sup> E5P

<sup>98</sup> Nubarashen and Ajapnyak landfill closures, ENVIROPLAN S.A. - CMD SMITH Europe GmbH - ICP mbH - COCKS Consult GmbH - LOUIS BERGER (2016): Yerevan Solid Waste Task, Landfill Concept Announcement.

<sup>99</sup> The period of 2018-2022 is assumed to cover the procurement period and construction of the first phase of the landfill.

<sup>100</sup> HYDRO INGENIEURE, RCE, KPC TRANSPROJECT (2012): Yerevan Solid Waste Project – Technical Feasibility Study, Preliminary Design, Technical Report.

<sup>101</sup> Yerevan Sustainable Energy Action Plan, 2016

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Visio n ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2025)	ST ID	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a )	Action owner	Key measures for tracking <sup>95</sup>
			WsM 2	The city of Yerevan will have adopted a Ten-Year Waste Management Plan	WsA3	Development of the Ten-Year Waste Management Plan for Yerevan	2018-2019	na	15,000 <sup>102</sup>	Communal services dpt.	Percentage of MSW and other waste (including HW) landfilled is disposed of in EU-compliant sanitary landfills Share of the population with regular municipal solid waste collection Proportion of MSW that is sorted and recycled Total solid waste generation per capita Overcapacity issues in waste disposal sites are tackled through plans and investment
Wsv a	Wss 2	More than 99% of producers of MSW and other waste will pay an appropriate obligatory fee for its collection and disposal.	WsM 3	More than 95% of producers of MSW and other waste will pay an appropriate obligatory fee for its collection and disposal.	WsA4	Delivery of regular awareness campaigns focused on the waste-disposal fee and littering in cooperation with the Green city awareness centre	2018 on		55,000	Communal services dpt.	Share of citizens covered by awareness campaigns Increase of the success rate of the waste collection and disposal fee Decrease in littering
					WsA5	Best international practice in pricing MSW sorting and recycling facility <sup>103</sup>	2020	na	16,000	Communal services dpt.	Considering alternatives for fee formula of MSW collection and disposal by citizens, and if there is attractive alternative awareness and its acceptance by public

<sup>102</sup>OPEX per Waste management plan.

<sup>103</sup> This strategy complements the Ten-Year Waste Management Plan but is a stand-alone document.

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Visio n ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2025)	ST ID	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a )	Action owner	Key measures for tracking <sup>95</sup>
Wsv a	Wss 3	The recycling rate for MSW will be more than 30%, for other waste it is more than 60%.	Wsm	The recycling rate of MSW will be more than 15%, for other waste it is 30%.	Wsa6	See Wsa1					Decrease in the amount of MSW Increase in MSW utilization and material efficiency Increase in employment Decrease of MSW waste management costs (10-20%)
					Wsa7	Pilot project on biodegradable waste composting in Yerevan	2018-2020	30,000	30,000	Communal services dpt.	Decrease of MSW disposed of on the landfill Decrease in GHG emissions Satisfaction of participants in the project
Wsv a	Wss 4	The integrated sorting and recycling system will bring revenues back to the MSW management system (more than 20 % of MSW management costs p.a.).	Wsm 5	The integrated sorting and recycling system will be in place bringing revenues back to the MSW management system (> 10 % of MSW management costs p.a.).	Wsa8	See Wsa1				Communal services dpt.	Monitoring of the waste disposal (and collection) fee Income from sorted commodities placed on market Monitoring of the waste recycling market
Wsv	Wss 5	A publicly available database of MSW and other waste generated, treated and disposed in accordance with the	Wsm 6	A publicly available database of MSW generated, treated and disposed in accordance with the national waste coding system will be in place.	Wsa9	Creation of database of MSW generated, treated and disposed of in accordance with the national waste coding system, the same action for the other waste on a voluntary base.	2018-2020	100,000	20,000	Communal services dpt.	Number of other waste generators reporting on their waste to the municipality Number of visits of the database

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Visio n ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2025)	ST ID	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR/a )	Action owner	Key measures for tracking <sup>95</sup>
		national waste coding system will be in place.									
WsV	WsS 6	Frequent information and awareness campaigns on developments and accomplishments of the waste management sector as well as reduction in waste generation will be delivered to citizens.	WsM 7	Green City Awareness Centre will be delivering regular awareness campaigns and capacity building.	WsA10	See BA1 (Establishment of Green City Awareness Centre)	2019-2020	na	na	Communal services dpt./ Nature Protection dpt.	Frequency of campaigns Efficiency of campaigns <sup>104</sup> Availability of waste management information to the public Rate of volunteering Number of participating partners from the private and R&D sector

Table 27: Strategic framework for waste

For detailed information on all short-term actions, including their concrete benefits and timing, you can consult Annex 5.

Approach to monitoring the implementation of short-term actions is outlined in Section 12.

<sup>104</sup> Efficiency of campaigns will be assessed based on the combined development of quantitative indicators used for other mid-term targets such as Weight of MSW delivered to the new sanitary landfill and Weight of waste sorted out of the MSW

## 10 Water

In this chapter we follow-up on the information provided in section 4.3 and present a more detailed analysis of water quality and the state of supply and water infrastructure.

The municipal water infrastructure underpins the drinking water supply, drainage and treatment of wastewaters and is hence crucial for satisfying the basic citizens' needs as well as enabling good water management. It should be noted that this system is under the community's authority and is not financed from the community budget.

Our analyses showed that Yerevan citizens enjoy a high quality of drinking water thanks to the high water quality of groundwater resources. However, the analysis also showed that the surface water quality of the Hrazdan River is low due to the negative impact of the sewage water that is discharged into the river on its way through the city and partly also due to the industrial wastewater. High values of BOD<sub>5</sub> (Biochemical Oxygen Demand) and a high concentration of ammonium (NH<sub>4</sub>) indicate a high level of organic pollution in the river.<sup>105</sup>

Although there are regulatory policies in place such as water permits issued by the Water Use Permitting Department under the Water Resources Management Agency and subsequent monitoring of compliance with the water use permit conditions by State Environmental Inspectorate, implementation is slow, in particular, due to insufficient financial resources.

The local water and wastewater utility system had been operated by Yerevan DJUR (operated by Veolia Group) over the last 10 years<sup>106</sup>. During this time considerable improvements of the utility system operation have been achieved, in particular in the level of continuity of water supply. These improvements followed long-term plans that had been agreed between the city of Yerevan and the water utility and targeted a gradual increase of the level of continuity of water supply to all customers.

The state of the sewerage system is, however, quite critical. Although 90% of inhabitants are connected to the sewerage system, a part of the wastewaters network are discharged to the storm water network and then discharged directly into the river without being treated in Yerevan's Aeratsia WWTP. Most of these cases are connected to previous emergency and unqualified repairs in the 1990s.

Moreover, the wastewater that does flow through the wastewater treatment plant undergoes mechanical treatment only, as no biological treatment technology has been installed yet due to insufficient financial resources. As a result, the treated water does not comply with the requirements given by the water use permit and negatively impacts the water quality in the Hrazdan River. This creates a potential health risk from water contact caused by presence of faecal bacteria (e.g. E. coli and enterococci) and a risk of water-borne diseases.

There is currently no concrete long-term plan for the renewal of the city's extensive water supply and sewerage systems. Yerevan DJUR had annually submitted the Enhanced Maintenance and Repair Programme, it however represents a short-term maintenance plan rather than a long-term strategy. A conceptual and sustainable development plan for the water infrastructure including potential Green Infrastructure solutions is also lacking.

Moreover, as of 1 January 2017, the governance framework of the water sector changed and the authority for the development of Yerevan's water infrastructure is now exclusively with the State Committee of Water Economy (Committee), a government body under the Ministry of Energy Infrastructure and Natural Resources (Ministry). The city of Yerevan can originate proposals for the development and investment into the water infrastructure within Yerevan, the ultimate decision and responsibility for investment, however, lies with the Committee. The Water Supply and Sanitation Sector and Financing Plan Strategy of Armenia includes a pledge by the Ministry to implement a AMD 300 bn<sup>107</sup> water infrastructure investment programme by 2030. This provides an opportunity for the development of water infrastructure in Yerevan too. Cooperation with the Committee will hence be crucial in securing the necessary investment, also in the long term. As for the operation of the water

<sup>105</sup> High level of organic pollution in river reduces the biodiversity of aquatic communities and microbiological quality.

<sup>106</sup> As of 1 January 2017, the operation is carried out by Veolia DJUR

<sup>107</sup> AMD 300 bn equals to approximately USD 620 mil.

infrastructure in Yerevan, it newly falls under a 15 -year lease agreement between the Government of Armenia and Veolia.<sup>108</sup>

With regard to groundwater resources, no monitoring of the quantity and quality of underground water is carried out in Yerevan or on the territory of the RA. This issue is discussed in the land use section.

## 10.1 Key challenges

We have made considerable efforts quantifying the main environmental issues associated with Yerevan's water supply and infrastructure management. Our first step was to gather data and measure water -related indicators according to the GCAP methodology. A summary of the results of this analysis is shown in the tables below. First, we present the resulting values of the state and pressure indicators and their relation to the water environment. Subsequently, we provide the assessment of the response indicators mapping the current policy framework.

### Surface water quality

The surface water quality has a significant potential for improvement. Based on GCAP's state indicators, we can see that anthropogenic activities have a profound negative impact on the water environment. (Table 28)

State indicator	State indicator value
<b>Drinking Water Quality</b>	
Drinking water samples complying with national potable water quality standards (%)	100%
<b>Surface Water Quality</b>	
Biochemical Oxygen Demand (BOD) in rivers and lakes - Lake Yerevan	2.8 mg/l per 5 days
Biochemical Oxygen Demand (BOD) in rivers and lakes – Hrazdan River (leaving the city)	19.06 mg/l per 5 days
Ammonium (NH <sub>4</sub> ) concentration in rivers and lakes – Lake Yerevan	831 µg/L
Ammonium (NH <sub>4</sub> ) concentration in rivers and lakes – Hrazdan River (leaving the city)	24 424 µg/L

Table 28: Water quality indicators

In comparison with the drinking water, the benchmarking of the surface water quality shows poor performance. We note that the Hrazdan River already enters Yerevan with fairly high pollutant concentrations from residential, industrial and agricultural activities upstream. The pollution levels nevertheless increase significantly as the river flows through Yerevan. Within the area of Yerevan, the “Hayelectrogortsaran”, “Grand Sun”, and “Armenal” factories are the main sources of industrial water pollution. Residential, agricultural and recreational use in the catchment basins also have a negative impact on the water quality as they result in the presence and subsequent flow of various polluting substances of physical, chemical, and biological origin into the river. Sewerage outlets along the Hrazdan River are an additional source of surface water pollution because the wastewater is discharged into the river without any treatment. The issue of wastewater treatment, as a key challenge for improving the surface water quality, is described below.

In addition, a minor part of pollution is probably also caused by garbage flowing in the river. Some portion of the garbage can be attributed to the urbanized areas located upstream.

It is also noteworthy that the quality of the surface water is not constant during the year and is linked to weather conditions. For example, after spells of rainfall, the water quality in the river grows worse for some period of time.

The GCAP benchmark is set quite strictly based on the European Environment Agency approach, while the Armenian regulatory framework (N75 Directive) is generally more lenient and uses different threshold values for different water uses. The GCAP team of experts recommends that for the Hrazdan River and Lake Yerevan the water quality should comply with the river quality requirements related to

<sup>108</sup> This lease agreement entered into force on 1 January 2017.

supporting fish life. The threshold value of Biochemical Oxygen Demand (BOD<sub>5</sub>) according to N75 Directive is 9 mg/l, for ammonium (NH<sub>4</sub>) 1200 µg/l and for phosphates (PO<sub>4</sub>) 0,2 mg/l in consideration of Cyprinid fish communities. Other, more strict, threshold values for supporting Salmonid fish communities are - 5 mg/l for BOD<sub>5</sub>, 400 µg/l for NH<sub>4</sub> and 0,1 mg/l for PO<sub>4</sub>.

	Annual average concentrations in the Hrazdan River in 2015 (entering the city)	Annual average concentrations in Lake Yerevan in 2015	Annual average concentrations in Hrazdan River in 2015 (leaving the city)
<b>BOD<sub>5</sub> [mg/l]</b>	4.43	2.81	19.06
<b>NH<sub>4</sub> [µg/l]</b>	99	831	24,424
<b>PO<sub>4</sub> [mg/l]</b>	0.20	0.42	2.94

Table 29: Annual average concentrations of BOD<sub>5</sub>, NH<sub>4</sub> and PO<sub>4</sub>

	Maximal concentrations in the Hrazdan River in 2015 (entering the city)	Maximal concentrations in Lake Yerevan in 2015	Maximal concentrations in Hrazdan River in 2015 (leaving the city)
<b>BOD<sub>5</sub> [mg/l]</b>	8.70	5.90	37.40
<b>NH<sub>4</sub> [µg/l]</b>	200	1,515	44,994
<b>PO<sub>4</sub> [mg/l]</b>	0.30	1,141	5.98

Table 30: Maximal measured concentrations of BOD<sub>5</sub>, NH<sub>4</sub>

As we can clearly see from Table 29 and 30 the water quality in most cases does not comply with the requirements. The quality of water leaving the city is quite alarming. It is a direct proof of high organic pollution where development of aquatic life is almost impossible. High organic pollution also creates a beneficial environment for faecal bacteria which cause various diseases.

Considering the fact that the Hrazdan River is also used for recreational purposes (e.g. bathing), monitoring of microbiological indicators (e.g. *E. coli* and *enterococci*) is crucial for a proper assessment of potential health risk. Unfortunately, at present the monitoring of microbiological indicators is not included in standard water quality tests. We see that upgrading of current monitoring programme of surface water quality will ensure better protection of public health.

### Water supply system and wastewater collection system

Based on the GCAP pressure indicators shown below in Table 31, several issues related to water and wastewater management for possible improvements were defined. Some of them are directly related to the quality of surface water.

Pressure indicator	Pressure indicator value
Water consumption per capita	122 L/day/capita
Industrial water consumption as percent of total urban water consumption	37%
Non-revenue water	73.2%
Annual average of daily number of hours of continuous water supply per household	23.4 h/day
Percentage of residential and commercial wastewater that is treated according to applicable national standards	0%
Percentage of dwellings damaged by the most intense flooding in the last 10 years	0.5-3%

Table 31: Indicators related to water and wastewater management

As mentioned earlier, Yerevan benefits from the high water quality of its groundwater resources. The water is supplied to the customers without additional treatment. Only chlorination is required for safety and for preventive purposes in order to protect consumers from possible water-borne diseases. The water is chlorinated at Chlorination Stations with required chlorine concentration of 0.3-0.5 mg/l.

The majority (84%) of inhabitants currently have a 24-hour access to water supply, the rest have access to drinking water for 17-23.5 hours. As we agreed a long-term plan with the water utility to gradually increase the level of continuity of water supply to 24-hour service for 100% of customers, we expect further improvements in the coming years until this target is achieved. Notwithstanding this important progress in water supply, we are aware of the fact that the overall performance and efficiency of the system does not yet reach the standards of developed countries (e.g. EU countries).

In addition, we are aware of the high share of non-revenue water (NRW), that is, the high share of total water volume which is lost during distribution to consumers and is not billed. Despite the fact that over the last 10 years the total volume of non-revenue water (NRW) decreased, the percentage of NRW within the drinking water supply system is still high (73.2% of NRW in 2016). The share of NRW in total water volume subsequently influences the price of water for consumers.

The state of the wastewater collection system also requires attention. In order to treat wastewaters centrally, the sewerage system has to enable the collection and transportation of wastewaters from all districts of the city directly to the Aeratsia wastewater treatment plant. After the rehabilitation and modernization of the Aeratsia WTP the water discharged into river Hrazdan will need to comply with the 1<sup>st</sup> class of quality norms established in the annex N11 of the Resolution N75-Ն of the Government of Armenia from 27 January 2011. Currently, this may still be a problem due to the interconnection of the sewerage and storm water networks. As mentioned previously, these interconnections were mostly made during unqualified repairs and executions of house drains. These interconnections are nevertheless considered illegal now.

Moreover, the hydraulic capacity of the sewerage system is insufficient in some parts of Yerevan. Although periodic improvement and maintenance of the urban drainage network has been carried out by Yerevan DJUR in cooperation with the City, localized flooding occurs in some parts of the city during heavy rains. This is caused by a low hydraulic capacity of sewerage or due to the lack of drainage facilities. These issues follow from inadequate coordination of urban and sewerage systems development (i.e. development of new residential areas brings about a requirement for larger capacity of the existing sewerage system which was not taken into account in some cases). We see that implementation of Green Infrastructure solutions could also possibly reduce a surface water run-off and reduce the amount of water flowing into the sewerage.

Further to the wastewater collection, the current status of its treatment is also highly insufficient. This is due to the absence of a biological treatment technology in the wastewater treatment plant and leads to further deterioration of the Hrazdan's water quality. The quality of treated wastewater does not comply with the current water use permit requirements. Considering the direct connection between the wastewater treatment efficiency and the quality of surface water, upgrading the existing wastewater system would have a beneficial effect on water quality in general.

Considering the importance of the Hrazdan River for other regions of Armenia and the resulting need to deal with the water quality issues in an integrated way, we see a great potential in coordinating our actions towards the Water Resources Management Agency with other marzes to support an integrated river basin management.

The mapping of the GCAP response indicators provided us with additional information and showed the following key issues:

Response indicator	Response indicator assessment
Metering and billing for water use is regulated	Not all of subscribers have installed a water meter. Moreover, unauthorized connections have been observed.
Water saving / reuse is encouraged through awareness campaigns	Several awareness campaigns by Yerevan DJUR have been organized.
Coverage and efficiency of water supply networks is improved through plans and investment	Partial renewal of water supply network has been done. Plans were established by Yerevan DJUR and Municipality. Investments from Yerevan DJUR, World Bank and Developing Countries Relief Fund loans.
Buildings' access to wastewater collection and treatment systems is improved through plans and investment	Plans by Yerevan DJUR and Municipality. Investments from Yerevan DJUR, World Bank and Developing Countries Relief Fund loans.
Wastewater treatment is promoted through regulations and fiscal incentives	Several plans have been realized but there is still a need to improve current insufficient system of the wastewater treatment.
Wastewater billing is regulated	Payment for wastewater collection is part of the water tariff and its calculation is based on metered water consumption. Not all of subscribers have installed a water meter.
Drinking water pre-treatment is enhanced through plans and investment	Extensive efforts by Yerevan DJUR
Drainage facilities are developed through plans and investment	Drainage facilities are built and developed for the new neighbourhoods lacking these facilities. Basic improvement and development had been under the control of Yerevan Municipality.

Table 32: Indicators related to water and wastewater management

After the data assessment process we discussed the outcomes with stakeholders<sup>109</sup> who were particularly concerned about the development and maintenance of local water facilities and the monitoring of water environment.

Based on the conclusions of our discussion with stakeholders, we identified key areas of concern and ordered them according to their level of priority (shown below in Figure 29).



Figure 29: Water challenges

### Non-revenue water

As mentioned above, the key area of concern in Yerevan's drinking water supply system is the high share of non-revenue water (NRW). Despite of a decreasing total volume of non-revenue water (NRW) over the last 10 years, the percentage of NRW within the drinking water supply system is still high. Data on NRW share, provided by Yerevan DJUR, point to poor technical conditions of the water supply network and a high rate of unauthorized water consumption not only in Yerevan but also through the entire length of the water supply system starting from the groundwater basin. Although Yerevan DJUR had taken measures to decrease the number of unauthorized and/or unmetered water consumption (e.g. installation of better metering devices, works aimed at the detection of illegalities, etc.), the decrease of water losses through service connections and leaks from the mains represents a key and permanent challenge. Tackling this challenge will also help us substantially reduce requirements on our drinking water sources.

To address this challenge efficiently and sustainably, all future actions will need to be planned on the basis of accurate localisation and mapping of the system and appropriate system data management. Without prejudice to the Committees' authority, the GCAP analysis shows that priority should be given to the establishment of GIS database for the whole water supply infrastructure in cooperation with the water operator<sup>110</sup>. The GIS database should also be established for the wastewater collection system (as will follow from the next part) to identify challenges in both systems which have to be organised in logical steps (with consideration of other infrastructure sectors).

The experts recommend to use the best available and pro-active approaches in order to decrease water losses in general. Veolia DJUR should use its knowledge of the water mains residual life (year) and statistics of pipe breakages that resulted in high leakages. Moreover, leak detection techniques, in particular leak detectors, should be used for operation and maintenance on every day basis. However, these devices must first be purchased and the staff trained in using them. At the same time, a system of the so called District metering should be used in order to identify and prioritise the city districts which are most vulnerable to leakage problems. All these activities should be carried out under the newly defined Leak Reduction Action Plan (LRAP). When implementing the LRAP a combination of several approaches will result in useful synergies. Hence, parts of the water supply system with the highest water leakages, as defined by the District metering results, should be gradually repaired along with the preparation of long-term renewal plans.

Data obtained from the localisation and mapping of water infrastructure assets should be used to develop the Master Plan for Water Infrastructure. Once the Master Plan is in place, it should be possible to proceed to the development and implementation of the plans for rehabilitation of the water supply system as well as enlargement of the centralized sewerage system.

<sup>109</sup> Stakeholders included Yerevan DJUR, Environmental Impact Monitoring Center (Ecomonitoring Center) and Water Resources Management Agency under the Ministry of Nature Protection

<sup>110</sup> As of January 2017, the operational area of Yerevan DJUR has been newly managed by a single national water system operator Veolia DJUR

The next step should then be a plan for upgrading the Central Wastewater Treatment Plant. Based on the recommendations of the GCAP expert team and in line with Committee's' future work, the city of Yerevan will also seek to integrate the Master Plan for Water Infrastructure into Urban Development Plan.

### **Insufficient treatment of wastewater and poor condition of the wastewater collection system**

Other key areas of concern are wastewater treatment and collection which represent a significant challenge. The lack of a biological treatment unit within the wastewater treatment process is a key issue which has a significant impact on the quality of treated water and hence on the quality of surface water. The aim is also to collect wastewater from all districts of the city and transport it directly to the Aeratsia WWTP. At the same time, it is necessary to highlight the importance of rehabilitation of the existing wastewater collection system before any significant upgrades in wastewater treatment technology can be designed and built. This will call for a gradual but continuous repair of the sewerage system. Attention should also be paid to highly polluted (untreated) wastewater outfalls to the River Hrazdan in particular during storm events.

As already mentioned, a GIS database should be a priority as it represents the appropriate tool for further development of the Master Plan for Water Infrastructure. GIS-based assets mapping of the water and wastewater systems within the city should also allow to assess their impact on the wider water environment such as on local rivers, groundwater, waterbodies used for recreational purposes, reused water for irrigation and storm water infiltration. In general, a GIS database provides opportunity to see the system as a whole and to solve local problems (i.e. flooded streets) in a holistic manner considering all aspects of the problems identified.

In addition to the improvement of the wastewater collection system, green infrastructure practices should be implemented within the City's Urban Development Plan, in particular, of Natural Water Retention Measures (NWRM). Implementation of measures such as filter strips along streets, infiltration swales and rainwater harvesting could possibly reduce the surface water run-off and consequently reduce the amount of water flowing to the sewerage. Implementation of these measures should also increase the area of green spaces in the city. We plan a pilot project where NWRM will be used for further promotion of Green Infrastructure practices. When preparing the Master Plan, new approaches as the Green Infrastructure practices will be included into the technical measures<sup>111</sup>. Master Plan should also outline the most suitable areas for implementation of such technical measures.

### **Inefficient water usage**

Concerning the efficiency of water usage, there are several issues which we need to improve in the future. These are connected with the irrigation practices, reuse of water, storm water management (infiltration, accumulation, re-use) and water savings in general. The use of drinking water for irrigation and watering is a concrete challenge that we would like to address early on.

To promote efficient use of water, including through alternative irrigation and watering methods, we plan to organise dedicated awareness campaigns and workshops for stakeholders and citizens in general.

## **10.2 Vision**

Cooperation with the GCAP expert team and the overall assessment of the water sector has helped us understand the necessary direction of the city development for the future. We have defined a vision and strategic objectives for 2030 as well as mid-term targets for 2025 and identified short-term actions to address the areas of concern in a logical order. Due to the water sector's governance framework, we will cooperate closely with the State Committee of Water Economy to enable achieving the vision while respecting the Ministries' authority in the matter.

For 2030, we offer a vision of the city of Yerevan which

- a) Will provide drinking water efficiently with minimal system losses.

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<sup>111</sup> These include, but are not limited to, rainwater drainage, irrigation with irrigated water, drip irrigation, use of endemic dry-resistant plants in greenery to reduce irrigation needs, use of green areas and alternative landscaping solutions to reduce the impact of rainfall.

- b) Will have sustainable water management ensuring an efficient water supply and wastewater treatment. The sewage water coming out of the city will be treated according to international standards and the concentration of pollutants in receiving waters will comply with all national standards.
- c) Will see the Hrazdan River as a highly attractive place for recreational purposes for local citizens as well as for tourists.
- d) Will support the Green Infrastructure-based alternatives. These will be preferred over traditional “grey” solutions.

### 10.3 Strategic objectives (2030) and mid-term targets (2025) and short-term actions (2017-2020)

To achieve our vision for water and wastewater management, we offer the following strategic objectives and mid-term targets defining the milestones on the way. Implementing of short-term actions presents the initiatives and programmes that we assessed as crucial to start the necessary process.

We recall that the short term actions listed are recommendations only to the Committee. They reflect the comprehensive analysis carried out under this GCAP and we will make every effort to support the implementation thereof towards the Committee to meet the mid-term and strategic targets.

Yerevan's Green City Action Plan 2017

Vision ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2025)	ST ID	Short-term action (by 2020)	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking... <sup>112</sup>
WaVa	Wa S1	Non-revenue water volumes will be less than 50 %.	WaM 1	Percentage of non-revenue water will not be higher than 65%. Main part of the non-revenue water reduction will be achieved by decreasing of unauthorized consumptions (illegal connections).	WaA 1	Launch of installation of metering devices by the water utility based on the water utility's operational experience. This will include the installation of devices at the district level as well as of better metering devices at final consumption points.	2019-2020	tbd	tbd	tbd	Water Balance Method after IWA methodology Non-Revenue Water indicator Number of metering devices installed
			WaM 2	Leak Reduction Action Plan will have been established by the Water Utility based on District Metering	WaA 2	Development of Leak Reduction Action Plan (LRAP) by the water utility	2020-2023	150,000	0		LRAP time schedule as agreed between the City of Yerevan and the water utility

<sup>112</sup> Wherever possible, measures for tracking are defined in such a way as to capture all contributions to achieving the mid-term target; where this is not possible or applicable, a percentage is given in brackets as to the contribution by the measured indicator to achieving the mid-term target.

Yerevan's Green City Action Plan 2017

Vision ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2025)	ST ID	Short-term action (by 2020)	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking... <sup>112</sup>
			WaM 3	100% of households will have 24-hour access to drinking water service.	WaA 3	Enforcement of the concession agreement between the Ministry of Energy Infrastructure and Natural Resources and the water utility	2017-2025	na	na		Indicator of Continuity in drinking water supply (hours per day, month, year)
WaVb WaVd	Wa S2	Master Plan for Water Infrastructure will become part of the Yerevan's Urban Development Plan.	WaM 4	Central inventory database of water supply system and sewerage system based on GIS will serve in every-day use.	WaA 4	Development of the Central inventory database on water infrastructure - GIS	2018-2020	180,000	3,000	tbd	Percentage of water supply and wastewater systems mapped and inserted into GIS database
			WaM 5	Master Plan for Water Infrastructure will have been developed.	WaA 5	Development of Master Plan for the water infrastructure (WIMP)	2022-2025	3,000,000 <sup>113</sup>	30,000		WIMP development time schedule as agreed between the City of Yerevan and the water utility(or State

<sup>113</sup> The CAPEX includes costs for preparation of methodology for executing the Master Plan, monitoring/metering campaigns, mathematical modelling and execution of Master Plan itself

Yerevan's Green City Action Plan 2017

Vision ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2025)	ST ID	Short-term action (by 2020)	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking... <sup>112</sup>
											Committee of Water Economy) Part of the city Urban Development Plan (Yes/No)
WaVb WaVd	WaS3	Feasibility Study for the rehabilitation of the water supply system and enlargement of the centralized sewerage system will be developed and become a strategic document for future construction works activities.	WaM6	Plans for renewal of water supply system and enlargement of sewerage will have been established by the Water Utility.		See WaA4	2025	30,000	tbd	tbd	Time schedules for the development of the Plans for renewal of water supply system and enlargement of sewerage as agreed between the City and the water utility
			WaM7	Parts of the water supply system with the highest water leakages will have been repaired.	WaA6	Repairing and rehabilitation of parts of the water supply system with the highest water leakages	2019-2025	38,500,000			Kilometres of repaired water supply system (Share of total)
			WaM8	Parts of sewerage that is surcharged, due to connections between	WaA7	Repairing of connections between sewage and storm sewers	2019-2025	5,500,000			Kilometres of repaired sewerage supply system (Share of total)

Yerevan's Green City Action Plan 2017

Vision ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2025)	ST ID	Short-term action (by 2020)	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking... <sup>112</sup>
				sewage and storm sewers will have been repaired in order to direct wastewaters to the Central WWTP.							
WaVb	Wa S4	Preparation of Tender Documentation for rehabilitation of water pipelines and enlargement of the centralized sewerage system will be assigned based on the Master Plan and Feasibility Study.		See WaM6		See WaA4	2025-2027	550,000		tbd	See WAM6
WaVb	Wa S5	Preparation of Tender Documentation on upgrading	WaM9	Feasibility study will be in place for the upgrading of the Central WWTP.		See WaA4	2025	150,000		tbd	Part of the city Development Plan (Yes/No)

Yerevan's Green City Action Plan 2017

Vision ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2025)	ST ID	Short-term action (by 2020)	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking... <sup>112</sup>
		the Central Wastewater Treatment Plant to include biological treatment units.									
WaVb	WaS6	As a part of Integrated Water Management Plan, the reuse of treated water from the Central Wastewater Treatment Plant as an alternative water source for irrigation, industrial sector, etc., will be evaluated and considered.	WaM10	An efficient system of yard and garden irrigation using surface water for Yerevan private house sector will have been promoted by awareness campaigns and workshops.	WaA8	Public awareness campaigns and workshops about the best practices of water usage, urban drainage, wastewater treatment, irrigation, Green Infrastructure solutions	2018-2020	0	0	tbd	Number of awareness campaigns and workshops per year  Number of participants
			WaM11	Pilot project on usage of Green Infrastructure practices will			2025-2027	tbd			

Yerevan's Green City Action Plan 2017

Vision ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2025)	ST ID	Short-term action (by 2020)	Timing	CAPEX (EUR)	OPEX (EUR/a)	Action owner	Key measures for tracking... <sup>112</sup>
				be established.							
WaVc	WaS7	Monitoring Programme of surface water quality will be in place and used for operational management and strategic planning.	WaM12	Monitoring Programme of surface water quality will be upgraded to monitor microbiological indicators such as faecal bacteria - E. coli and enterococci.	WaA9	The City of Yerevan will, in cooperation with representatives of the marzes, discuss with the Ministry of Nature Protection the possibility of introducing the monitoring of microbiological indicators of surface water as a legislative requirement. In the meantime, city of Yerevan will order a regular monthly analysis of the microbiological indicators directly from the Ecomonitoring Center.	2025	na	2	Ecomonitoring Center	Preparation/adoption of a legislative proposal  Monthly analyses of microbiological indicators in surface water

Table 33: Strategic framework for water

Due to the very long-term investment horizon of water infrastructure development, the strategic framework as presented above mainly captures the preparatory phases for such development. The table below lists the likely investment plans the City of Yerevan would like to support towards the Committee in the future, particularly in conjunction with the planning activities listed above.

Action	CAPEX (EUR)	Type of Document
Feasibility Study - Rehabilitation of water pipelines and enlargement of the centralized sewerage system	300,000	Feasibility Study
Tender Documentation - Rehabilitation of water pipelines and enlargement of the centralized sewerage system	100,000,000	TD for the works (based on previous information from the MP, FS)
Upgrade of the existing Central Wastewater Treatment Plant	220,000,000	Rehabilitation to be carried out in 2 phases.
Initiate Water Management Planning and implementation at the Watershed of the Yerevan Lake and the Hrazdan River	300,000	Water Management Planning (EU Procedures)

Table 34: Possible investment plans after 2025

For detailed information on all short-term actions, including their concrete benefits and timing, you can consult Annex 5.

Approach to monitoring the implementation of short-term actions is outlined in chapter 18.

## 11 Land use

The urban community of Yerevan occupies 22,328 ha of semi-desert land. The ownership breakdown presented below illustrates that almost half of that land is in the City's ownership and hence under our direct influence.

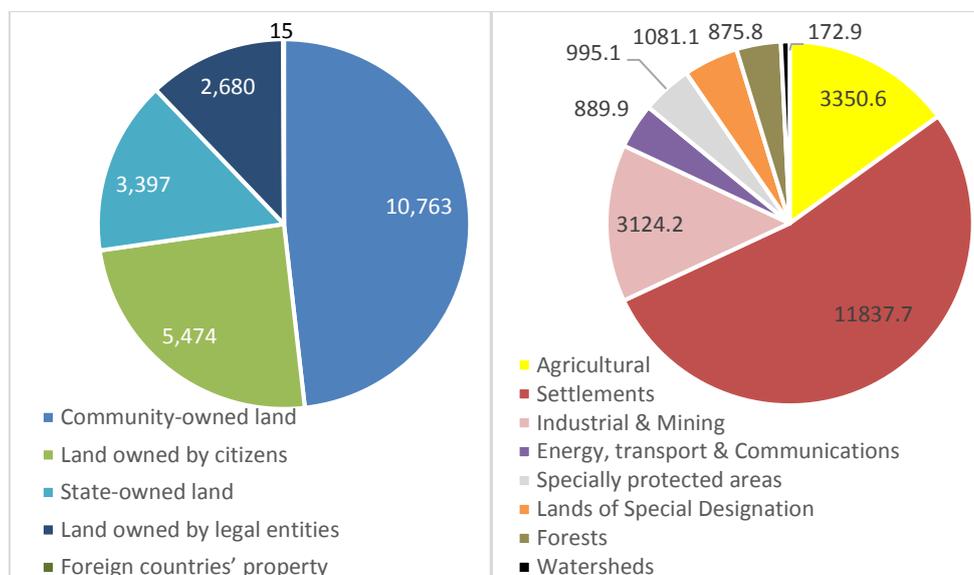


Figure 30: Land ownership and designation in Yerevan (in hectares)

### Green spaces

An important part of the land is covered by green spaces. In 2015, there was altogether 6,760 ha of green spaces in Yerevan (30.3% of the territory), ranging from parks, gardens and forest-gardens through to lawns and flower beds. 850 ha were publicly accessible (3.9% of the territory)<sup>114</sup>, the rest had a limited access or was marked as being of special purpose<sup>115</sup>.

We recall that Yerevan had gone through severe deforestation in the 1990s due to the energy crisis. In 1990, approximately 1,930 ha (8.6%) of the territory of Yerevan were covered by trees. During the crisis (1991-1995) approximately 470 ha (2.1%) worth of trees were however cut down for fuel. In the period of 1995-2000 another 700 ha (3.1%) of tree-covered area was eliminated as a result of construction works. Hence, in the early 2000s, only about 760 ha (3.4%) of forests were left in the city. The situation has since stabilised but incidences of illegal tree-cutting during urban development still occur from time to time.

By losing significant share of vegetation in the 1990s, the city also lost its natural barrier against dust and wind. During the summer, dust concentrations are thus very high by international comparisons and exceed national limits.

Air quality state indicators	Indicator values
Average annual concentration of dust	162 µg/m <sup>3</sup> annual average
Number of daily exceedances of dust concentration limits	43 days

Table 35: Indicators for dust concentrations and exceedances

In 2005-2007, about 120-km waterline was reconstructed in Tsitsernakaberd memorial and marked a turning point for development of green areas in the city. In 2005-2007, also 110 thousand trees and 162 thousand shrubs were planted. Restoration and landscaping of treeless areas as well as creation of new ones in Shengavit, Malatia-Sebastia, Davtashen districts is currently planned to continue until 2020. Extensive landscaping works are envisaged at Dalma Gardens (256 ha, a historical-cultural urban complex), as well as in the Hrazdan Gorge. Gas-resistant tree types have been planted in streets and avenues with heavy traffic to reduce the impact of vehicle emissions. Planting of dust-absorbing trees

<sup>114</sup> Yerevan development program 2016

<sup>115</sup> SEAP (2016), p. 91 (EN version)

and shrubs is planned for the southern part of the city: Shengavit, Erebuni, Nubarashen, Malatia-Sebastia districts.

As a result of all these measures, the size of public green space (green spaces of common use) in Yerevan has started to return to the pre-1990 level (See Figure 30 below). The newly planted vegetation is, however, of different structure (variety of species and maturity) compared to the original in 1990 and has a lower gas absorption capacity. Moreover, the natural dust barrier, as it was before 1990, is still to be re-created.



Figure 31: Development of green space area in Yerevan (1990-2016) and outlook till 2020 (Source: SEAP 2016)

We have made significant efforts to recover and maintain the public green spaces. However, we are limited by soil fertility, irrigation needs<sup>116</sup> and infrastructure availability. The 860 ha of public green space translates into, 7.6m<sup>2</sup> per capita<sup>117</sup>, which is a significant improvement compared to only five years before (7 m<sup>2</sup>/ca) but is still below the 9m<sup>2</sup>/ca minimum recommended by the World Health Organization.

Yerevan's Master Plan foresees further expansion of public green spaces by more than 1,300 ha to a total of 2,382 hectares by 2020, in line with the long-term goal set in 2006<sup>118</sup> to triple the size of green areas within the next 15 years. As part of these efforts, 100,000 trees have been planted in recent years, only about 70,000 trees have however survived due to poor selection of sites, imperfect irrigation and a lack of proper care. The rate of new green space addition has been 15-20 ha per year.

The Master Plan also foresees the re-creation of the 876 hectares of green barrier (buffer zone) around the city, which is in accordance with international norms that require a forested circle in a 50 km radius around cities of up to 1mln inhabitants. However, the city budget currently does not have sufficient financial resources for the development of this green barrier.

Since the adoption of these plans it has become evident that it is not possible to developed plantations on all of the areas assigned by the Master Plan; some of the lands are no longer available, others are either contaminated or eroded. It is thus becoming evident that the 2020 target is unreachable. The public land available for development of green spaces needs to be re-assessed and the concept of green space development redefined. Under such circumstances, an important contribution to this target should come from new commercial developments where developers are legally obliged to have at least 30% of green areas in their projects.

<sup>116</sup> Every hectare of green space needs about 7,000 m<sup>3</sup> of water per year, without which the maintenance and development of the green space will not be possible.

<sup>117</sup> Yerevan Development Programme 2016 (Annex to the Yerevan city council decree N 432 of December 23, 2015)

<sup>118</sup> The Master Plan was approved in 2006 and was last updated in 2011.

In addition to the creation of new green spaces, we have developed a package of measures to conserve the existing green grass and plants in the city. This includes for example restoration of existing parks and green areas, incl. residential backyards. These do not contribute to the increase in the quantity of public green spaces, but improve their condition, the health and aesthetic condition of the existing public green spaces. Furthermore, the Yerevan Design Institute<sup>119</sup> has developed projects for reconstruction of some garden-parks.<sup>120</sup> They include:

Renovation of existing pools and fountain basins, increase in the number of lawns and planting of trees corresponding to Yerevan's climate conditions

Reconstruction of the park adjacent to the Pantheon with 7 hectares of recreational space as well as increase of the park surface of the city by about 25 hectares, from the current 80 ha.

These projects should be financed both from the community budget as well as externally. We currently do not have any financing plan or any mechanism for attracting external financial resources for the expansion of the green spaces.

With regard to other regulatory initiatives governing the urban development of Yerevan, we recall the 2009 Council of Elders' decision on the procedure for mandatory improvement of the real estate property and associated common elements in the administrative territory of Yerevan City. The decision aims to enhance the quality of open space by specifying the nature, volume and conditions of improvement activities to be carried out by the owner on own land and adjacent public green spaces. The large construction projects are required to undergo environmental impact assessments and have environmental management plans. Unfortunately, the implementation has been lacking.

### **Brownfield sites**

A great potential for revegetation in Yerevan is represented by brownfield sites. Brownfield sites refer to land previously used for industrial or commercial facilities whose reuse may be complicated due to potential contamination, the scope of which may not be known. We are aware of the potential of such sites but have not been able to act upon it yet due to limited mapping of the situation and information on the respective contamination. Identification of contaminated sites is a costly, comprehensive and lengthy process so prioritization of pre-selected potentially contaminated sites is desirable. Past studies will support any such activity (see also Chapter 9 on Waste).

### **Groundwater**

Groundwater quality and availability can be a good indicator of proper land-use management in the territory of the city and its vicinity. Significant relevance to the surface and groundwater protection can be found in the Government of RA Resolution No 64-N On Criteria for Definition of Areas for Sanitary Conservation of Aquatic Ecosystems, Flow Formation, Conservation of Groundwater, and Identification of Water Protection Zones, Ecotones, and Inalienable Areas, adopted on January 20, 2005. However, only conservation of groundwater itself is not sufficient. Improved coordination and harmonization of surface water and groundwater quantity and quality monitoring activities is critical.

Since 1950s, regular observations of groundwater wells and springs in Armenia had been carried out by the Hydrogeological Expedition of the Geological Department<sup>121</sup> of the Ministry of Nature Protection. The last monitoring campaign covered the period 1990-1993. Afterwards, the status of Armenia's groundwater resources was not monitored up until 2009, despite the fact that groundwater resources is

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<sup>119</sup> Yerevan Project CJSC (official name) is a commercial entity adjunct to the City of Yerevan; it developed the city's current Master Plan

<sup>120</sup> The National Academy of Sciences of RA has recently become part of a European project funded under Horizon 2020. The project, Connecting Nature, will focus on nature-based solutions that can address urban challenges. The project was launched in June 2017 and will run for 5 years. The National Academy of Sciences of RA has taken up the follower role, i.e. of a project participant that follows the actions of the leading participants, contributes to the engineering of the solutions and commits to replicating the solution given a successful conclusion of the project. Up-to-date information on the project are available at <http://www.connectingnature.eu/>

<sup>121</sup> TONOYAN, Vahagn. EUROPEAN NEIGHBOURHOOD AND PARTNERSHIP INSTRUMENT – SHARED ENVIRONMENTAL INFORMATION SYSTEM: Armenia country report [online]. Yerevan, Armenia, 2011

the key source of the country's drinking water supply<sup>122</sup>. The groundwater monitoring program was re-established by the RoA Law On National Water Program (NWP) of 2006, with the Ministry of Nature Protection being the responsible body for the establishment and operation of the national reference monitoring network<sup>123</sup>. The monitoring network has established a baseline (reference) situation to enable the determination of trends caused by human or natural impacts. With the support of USAID Water Program some progress had been achieved with the assessment and rehabilitation of selected 69 hydrogeological objects (USAID Water Program in 2007-2008). The National Reference Groundwater Monitoring Network has been operated by the Hydrogeological Monitoring Centre SNCO<sup>124</sup>. It aims to evaluate the main patterns of formation of freshwater underground waters in the territory of Armenia, their quantitative and qualitative properties and regional changes, and make use of this information for more efficient use and protection of groundwater resources of the country, as well as development of measures to fight against negative impact on groundwater resources<sup>125</sup>. The implemented hydrogeological monitoring includes measurements at water spring and water discharge, level (pressure), as well as water temperature<sup>126</sup>.

Nevertheless, the above mentioned monitoring on the national level does not cover any groundwater structures in Yerevan's territory in sufficient detail. The purpose of the groundwater monitoring is to collect data on hydrogeological structures which are sensitive to changes such as the water regime, exploitation, climate changes, and inappropriate urban planning. In terms of quality, both the monitoring of natural background concentrations and GW quality affected by economic activities of the city is crucial. Hence, monitoring of GW in facilities handling materials which might be potentially harmful to waters is essential, however not applied in Yerevan yet.

### Urban development

The key instrument for urban development in Yerevan is the City's Master Plan (2005-2020)<sup>127</sup>. It is a strategic document<sup>128</sup> which provides for the territorial development of the community and, through zoning, specifies the usage regimes and mandatory requirements for the land. It is based on the principles of sustainable development and sets direction for territorial development as well as social, cultural, industrial, agricultural, ecological, engineering, and infrastructure installation and development solutions. The Master Plan's revision beyond 2020 is thus a key document to reflect the challenges and solutions proposed in this GCAP.

The economic decline of the 1990s followed up by a rapid growth, especially in the construction business, has negatively impacted on the urban and public space of Yerevan's city centre. The construction of new housing and office space has increased the building density in the centre and hence also the seismic threat to the buildings as Yerevan has a high seismic activity. It is all the more unfortunate that the recent economic downturn has eventually led to many of these newly constructed spaces remaining unsold and vacant. The growth in traffic coupled with a rising, albeit still moderate, motorisation rate strains the environment of the city's centre and the lack of dedicated lanes for public transportation and low presence of bicycle lanes (see chapter 5 on Transport for more details) do not support public transport and alternative mobility that could improve the situation and would also be in line with best practices of comparable European capitals.

The intensive development of the city centre has not always been welcome as some historical buildings were replaced by modern architecture. The public raised concern over the impact on the cultural heritage of the city as the architectural image changed with the new construction styles. To address some of the issues connected with the city development, legal and regulatory efforts have been undertaken at the national level to enable the preservation of the cultural heritage of the city as well as

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<sup>122</sup> Ibid

<sup>123</sup> Ibid

<sup>124</sup> As established by the Government of Armenia Decree No 1616-N of 8 September 2005; the Hydrogeological Monitoring Centre falls under the Ministry of Nature Protection

<sup>125</sup> TONOYAN, Vahagn. EUROPEAN NEIGHBOURHOOD AND PARTNERSHIP INSTRUMENT – SHARED ENVIRONMENTAL INFORMATION SYSTEM: Armenia country report [online]. Yerevan, Armenia, 2011

<sup>126</sup> Ibid

<sup>127</sup> Approved in 2005 based on the RA Government decision N 2330-N; the RA Government decision N 1402-N subsequently refers to the implementation of main activities of the Master Plan (2006-2020).

<sup>128</sup> As defined in the Law on Urban Development, Article 14.3, parts 2 and 3

to ensure sustainable development of its centre. The progress of this legislative initiative has, however, been slow.

In 2013, the Resolution 515-A and Resolution NA-066-N were adopted by the Government of Armenia and the Armenian National Assembly respectively that prescribed the inclusion of a strategic objective of "Returning the Original Architectural Spirit to the City of Yerevan", prohibiting by law construction activities not appropriate for the history and features of the Capital. As a follow-up measure, the draft Law on the Yerevan City Centre, which is currently<sup>129</sup> pending Government adoption (1<sup>st</sup> hearing passed in the National Assembly) has defined priorities for maintaining a sustainable city centre in Yerevan.

The agreed priorities so far are:

- restrictions on further construction in the core city centre
- diligent registration and profound investigation of all illegal construction
- assessment of the current situation and review of further development of the city centre from the perspectives of preservation of its historical appearance and heritage
- application of principles of green architecture, smart and sustainable cities, energy efficiency, handicapped accessibility, etc.

The above principles are still under legislative review but show that the centre of Yerevan can become the seed for the establishment, evolution and replication of sustainable urban development throughout Yerevan. We will continue the dialogue on the above legal reform, incl. the targets and timelines.

## 11.1 Key challenges

We have analysed the main environmental issues associated with land use in the city. In cooperation with the team of experts, we first gathered data and information related to land use and urban development according to the GCAP methodology. A summary of the results of this mapping are shown in the tables below.

Pressure indicator	Indicator value
Open green space area ratio per inhabitant	7.6 m <sup>2</sup> /inhabitant (2016) <sup>130</sup>
Population density on urban land	4,815 residents/km <sup>2</sup>
Percentage of urban development that occurs on existing urban land rather than on greenfield land	not available
Vacancy rates of offices	>10%

Table 36: Land-use pressure indicators

Response indicator	Indicator assessment
Density is regulated	Density targets exist in accordance with the zoning plans for each of the 12 administrative districts.
Transit-Oriented Development is promoted	The Master Plan promotes transit-oriented development, however, the last master plan was developed in 2005 and the construction permitting in practice is more focused on development of underdeveloped lands, especially in the suburbs of the city. They operate under the assumption that if the urban development succeeds, the transit routes will evolve and service new areas based on demand.
Mixed-use development is promoted through zoning regulations / incentives	Mixed development is part of the zoning regulations. However, the individual zoning plans which are the simplified instructions to the Yerevan Municipality Architecture and Urban Development Department are not detailed enough to address the mixed-use development. There are no fiscal incentives in place.

<sup>129</sup> April 2017

<sup>130</sup> Yerevan Development Programme 2016 (Annex to the Yerevan city council decree N 432 of December 23, 2015)

Table 37: Land-use response indicators

Secondly, we conducted extensive public consultation to present this data and resulting challenges, and understand the stakeholders' perception of the environmental issues connected with Yerevan's urban development and green spaces. A summary of the stakeholders' feedback is provided in Annex 6. The discussion did not raise any new issues and focused instead on how to address the challenges.

As a result of the first and second steps, we have identified three key areas of concern: a lack of green spaces and of the dust barrier, and the creation of sustainable city centre. Additionally, based on the public consultation carried out in connection with the Strategic Impact Assessment, a third area of concern was highlighted, namely a lack of systematic groundwater protection and monitoring.



Figure 32: Land-use challenges

**Lack of green spaces and the dust barrier**

The amount of green space per capita was only 7.6m<sup>2</sup> in 2016, which is below the 9m<sup>2</sup>/ca minimum recommended by the World Health Organization. The overall coverage of land, incl. around the city, with vegetation is insufficient as highlighted in the air quality assessment (See Chapter 4) where the land surface was indicated as the main source of very high dust pollution in Yerevan. As outlined above we have made considerable efforts to increase the green spaces in the recent years we, however, need to boost and redefine our activity yet to make up for the loss linked to the 1990s economic crisis as well as to expand the green spaces further under the conditions of limited available land, low quality of land assigned for potential green spaces, lack of financial resources for extensive amelioration of eroded lands, etc. We need to re-create the dust barrier around the city and identify other large open areas suitable for new green spaces. The planned mapping of contaminated sites in the city (See Chapter 9 on Waste) should feed into the identification process too. We will also aim to reflect this approach in the future Master Plan revision in 2020.

We note that the creation of new green spaces is also very closely linked to transport and building construction issues. Sustainable mobility approach based, among others, on the wide use of non-motorised transport calls for abundance of vegetation in the city to support the physical as well as emotional aspects of moving around in the open air. Synergies are thus created between transport-related and land-use related measures. Similarly, the construction permitting over greenfield sites should be strictly mandated and minimized with consideration of the proportionate density objectives. As the waste and industry chapters indicate, Yerevan hosts a number of brownfield sites<sup>131</sup>, which could be used for further urban development. Development in this sector requires flexible solutions, considering that these sites are under private ownership, require massive clean-up and are mostly concentrated only in the South of the capital. We will hence be also looking at best practices of other cities.

**Creation of sustainable city centre**

The rapid growth, especially in the construction business, as of early 2000s has negatively impacted on the urban and public space of Yerevan's city centre and raised public concern about the city's further development. Legal and regulatory efforts have been undertaken at the national level to address these issues and enable the preservation of the cultural heritage of Yerevan as well as to ensure its sustainable development. This GCAP should therefore build on these policies either directly or through changes to the Master Plan. The latter's planned 2020 revision should provide guidance on how to

<sup>131</sup> Brownfield sites refer to land previously used for industrial or commercial facilities whose reuse may be complicated due to potential contamination, the scope of which may not be known.

ensure that the land allocation and construction permitting activities fully support its implementation as well as the general principles of sustainable urban development. It should be based on re-assessed demands for public green spaces, a realistic assessment of high density and sensitive areas of the city, seek synergies with the green architecture and promote public transport and alternative mobility in order to minimize the need for more road infrastructure and support transport sustainability.

### **Lack of systematic groundwater protection and monitoring**

Systematic groundwater monitoring generates data on quantity and quality of GW which itself cannot resolve shortages of water or poor water quality, but can help us understand changes, their reasons and design potential mitigation measures.

Although some data on quality and quantity of groundwater are available for the territory of Yerevan, these data do not provide us with specific information on the whole territory, especially on sites vulnerable to the GW quality (industrial, waste management, agricultural, transport, energy operations). Current groundwater monitoring system and data management in Yerevan should hence be improved. Enhanced monitoring will provide more data and information regarding the localization, quantity and quality of groundwater aquifers in order to better understand the baseline conditions and to prevent any potential damage or pollution that may be caused by the waste disposal and management operations, industrial objects, or agricultural objects. Regular reporting and control of the GW data to local authorities is crucial.

Groundwater quality and quantity monitoring should be an integral part of operation of facilities which handle hazardous substances, and where there is a potential for GW threat (potentially contaminated sites, i.e. waste disposal sites, industrial sites). In relevant cases the monitoring of GW should be one of conditions for granting a business license to enterprises. In case a license has already been granted, the monitoring system should be also required. The GW monitoring of waste disposal sites installed and operated in accordance with the EU standards is an obvious requirement based on the best international practise.

International standards for location of waste disposal facilities and other GW threatening activities (such as available aquifers, environmental protection zones, flow formation zones, recreational zones, floods, mudflows, erosion) should always be considered.

Municipal Solid Waste Management Plan for Yerevan (activity recommended in this GCAP) and other plans including Yerevan's Urban Development Plan should consider and be in line with Water Basin Management Plans that include information on the main environmental pressures and impacts, delineation of water bodies at risk, and propose a programme of measures for improved environmental quality in the basin.

Measures to protect areas defined by the Government Resolution No 64-N On Criteria for Definition of Areas for Sanitary Conservation of Aquatic Ecosystems, Flow Formation, Conservation of Groundwater, and Identification of Water Protection Zones, Ecotones, and Inalienable Areas should become a part of all relevant decision-making processes.

## **11.2 Vision**

The overall assessment of Yerevan's urban development and green spaces combined with the assessment of other sectors, especially transport and waste, has helped us better understand the weak points in our strategic framework. We have hence defined a vision and strategic objectives for 2030 as well as mid-term targets for 2022 to close those gaps. Measures proposed as part of this GCAP build on the current initiatives and further enhance the framework so that we can make use of the full potential of sustainable urban development for our City and its citizens.

For 2030, we offer a vision of the City of Yerevan which:

- a) Will be a modern vibrant city respecting its cultural heritage as well as the need for modern infrastructure, supporting sustainable modes of transport, and effectively managed buildings.
- b) Will showcase its public buildings and landscape as examples of sustainable solutions. Commercial buildings will interleave with residential buildings in mixed urban environment surrounded by large green areas and making use of green walls and green roofs.

Yerevan's Green City Action Plan 2017

Vision ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2022)	ST ID	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR)	Action owner	Key measures for tracking <sup>132</sup>
LVa	LS1	All new developments after 2022 will have complied with specific mixed-use urban development criteria to be defined by the City as part of the Master Plan revision.	LM1	Master Plan will have been revised in accordance with the results of LA1	LA1	Carry out an assessment of possible further construction limitations of the Yerevan City Centre	2018-2020	tbd	na	Chief architect / Urban development dpt.	Parameters included in the Master Plan regarding mixed-use urban development and other construction boundaries
LVa	LS2	Both commercial as well as residential buildings will offer robust green transport infrastructure such as EVSE and bike stands supporting alternative mobility.	LM2	The City of Yerevan will have adopted rules on the implementation of green transport infrastructure in new buildings and major renovations.	LA2	Install green transport infrastructure in selected public buildings or their vicinity. (See also TA14)	2018-2022	tbd	tbd	Development and investment programmes dpt./ Real Estate management dpt.	Number of charging points in public buildings or their immediate vicinity. Number of bike stands in the public buildings or in their immediate vicinity. (35%)
					LA3	Develop rules on the implementation of green transport	2020-2022	na	na	Real Estate management dpt./ Urban	Rules on the implementation of green transport

<sup>132</sup> Wherever possible, measures for tracking are defined in such a way as to capture all contributions to achieving the mid-term target; where this is not possible or applicable, a percentage is given in brackets as to the contribution by the measured indicator to achieving the mid-term target.

Yerevan's Green City Action Plan 2017

Vision ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2022)	ST ID	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR)	Action owner	Key measures for tracking <sup>132</sup>
						infrastructure in new buildings and major renovations. (See also TA14)				development dpt.	infrastructure in new buildings and major renovations
LVa	LS3	Transit-oriented development will have become an integral part of Yerevan's urban development.	LM3	Master Plan will have been updated to include adequately detailed rules for transit-oriented district zoning plans.	LA4	Incorporate transit-oriented planning in the development of new areas and destinations	2018-2020	na	na	Urban development dpt.	Rules for transit-oriented planning
LVb	LS4	Open green space area ratio is > 10 m <sup>2</sup> per inhabitant.	LM4	Open green space area ratio is > 8.5 m <sup>2</sup> per inhabitant	LA5	Carry out evaluation, inventorisation, feasibility study and a financing strategy for enhanced and effective greening of Yerevan	2018-2019	60,000	na	Nature protection dpt.	Open green space area ratio per capita
					LA6	Develop and start implementing a long-term development plan for re-vegetation of Yerevan based on the results of the feasibility study	2019-2022	10,000 per hectar	tbd	Nature protection dpt./ Development and investment programmes dpt./	Time schedule for the plan development Number of projects implemented (85%)

Yerevan's Green City Action Plan 2017

Vision ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2022)	ST ID	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR)	Action owner	Key measures for tracking <sup>132</sup>
					LA7	Undertake a demonstration project to green a public area hotspot (such as a public transport hub)	2018-2019	30,000	3,000	Nature protection dpt.	Time schedule for the demonstration project implementation (5%)
					LA8	Continue to execute programmes supporting local ecosystems through incentives (e.g. leveraging grants for neighbourhood greening projects, financial support to innovative irrigation solutions, etc)	2018-2022	30,000	na	Nature protection dpt.	Number of programmes and allocated funds (10%)
					LA9	Develop a GIS-based environmental map of Yerevan	2018-2019	60,000	36,000	Nature protection dpt.	Time schedule of the GIS based database
					LA10 SEAP G.1	Rehabilitation and expansion of green spaces and forests	2018-2022	370,000	na	Nature protection dpt.	Open green space area ratio per capita  Newly planted trees count

Yerevan's Green City Action Plan 2017

Vision ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2022)	ST ID	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR)	Action owner	Key measures for tracking <sup>132</sup>
											Flowering count
LVb	LS5	The City of Yerevan will have adopted a long-term development plan for remediation of potentially contaminated sites (brownfield <sup>133</sup> sites) based on the lessons learnt from the implementation of pilot projects.	LM5	The City of Yerevan will have an inventory of potentially contaminated sites (brownfield sites)	LA11	Develop a thorough inventory of Yerevan's potentially contaminated sites (brownfield sites)	2018-2019-	80,000	30,000	Nature protection dpt. / Communal service dpt.	Time schedule for the inventory development
					LA12	Carry out a pilot project of remediation of a contaminated site and its transformation to a public green area equipped with amenities	2018-2030	2,000,000-6,000,000	400,000 (ca 30,000/a)	Nature protection dpt.	Time schedule for the project implementation Contribution to Open green space area ratio per capita
		The City of Yerevan will have implemented a groundwater monitoring plan <sup>134</sup>		The City of Yerevan will have adopted a groundwater monitoring plan	LA 13	Create a hydroecological map of the Yerevan territory suggesting GW monitoring	2018-2019	130,000	na	Nature protection dpt. / the Ministry of Nature Protection	Contribution to urban planning

<sup>133</sup> Brownfield means a former industrial site that is not used any more or serves a different purpose. It is usually a contaminated site

<sup>134</sup> The strategic objective and the corresponding mid-term target and short-term actions result from the SEA review process, based on comments of the Ministry of Territorial Administration

Yerevan's Green City Action Plan 2017

Vision ID	SO ID	Strategic Objective (2030)	MT ID	Mid-Term Target (2022)	ST ID	Short-term action	Timing	CAPEX (EUR)	OPEX (EUR)	Action owner	Key measures for tracking <sup>132</sup>
						system for Yerevan					
					LA14	Revitalization and enlargement of GW monitoring system in Yerevan based on the LA 13	2020-2021	200,000	20,000	Nature protection dpt. / Ministry of Nature Protection	Number of boreholes revitalized and installed Number of samples taken for chemical analyses

Table 38: Strategic framework for land use

For detailed information on all short-term actions, including their concrete benefits and timing, you can consult Annex 5. Approach to monitoring the implementation of short-term actions is outlined in Section 12.

## 12 Governance and Monitoring (GCAP management)

This GCAP outlines a robust strategic framework for improving the state of environmental assets and growing green economy. Proposed short-term actions and targets set the first necessary changes to achieve the vision and strategic objectives for 2030. With due respect to the governance framework as stipulated by the relevant laws, we will establish a governance structure to ensure GCAP implementation, regular monitoring and assessment of progress as well as subsequent reporting and cycle iteration.

Responsibility for the implementation of respective actions will primarily lie with the unit in charge of the respective area. As many actions are interlinked we will ensure cooperation between all responsible units. We will also appoint a central coordinator to ensure consistency and make use of available synergies. The central coordinator will also be responsible for managing the partnership programmes with local universities and private sector as well as ensure support of public relations and foreign relations city departments for actions aimed at raising public awareness and best practices exchange with partner cities.

We will regularly monitor and assess progress to manage any associated risks such as time intensity, incomplete baseline data, missed synergies etc. Monitoring serves as a feedback mechanism and should result in an objective picture of achievements as well as failures, and their impact, and point out areas which we will need improvement on, incl. during the implementation. To achieve this, the monitoring mechanisms need to be well calibrated and take into account the relationship between the action and respective indicators.

As for the monitoring and evaluation of actions taken especially in the energy and buildings sector, the team of experts recommended that the GCAP actions are primarily monitored, evaluated and verified on the action/programme/project level based on the incremental contribution of a particular action to the development of the corresponding indicator values. This means the change in indicator values induced by the particular action taken would be assessed separately. The team of experts argued that while the total values of indicators reflect the overall trends at the city level, they do not constitute a substantial tool to evaluate and monitor actions taken in energy and building sectors due to the following reasons:

1. Even when highly effective measures are taken to fill existing gaps in services and comfort levels, this still might not lead to improvement in the indicator values.
2. The indicators may change under the influence of factors independent from the actions taken and even external factors beyond the municipal control or jurisdiction (e.g. price fluctuations on national level, private sector investments, national energy system transformation, etc.) or year-to-year climate variations. The indicator values may even improve based on development which is negative in its nature (such as lowering comfort levels).

Monitoring will build the basis for the final stage of the GCAP process, the reporting. This concluding analysis mapping the achievements and failures of the implementation process will aim at informing the next GCAP iteration. We will be looking forward to receiving feedback from all stakeholders to harness the successful programmes and tools as well as improve those that have not delivered as expected.

The GCAP Implementation Report will hence focus on the evaluation of efficiency of actions taken and the respective investments. It will be complemented by both an internal and external audits. The report will be published.

## 13 Capital Investment list

The identification and subsequent prioritization of challenges revealed that besides improvements in the regulatory framework and its enforcement, partnerships with academic institutions as well as private sector and the introduction of certain soft measures, we also need to invest significant capital into the renovation and establishment of new infrastructure and eco-systems. This applies across all the sectors: transport, energy, waste and water, and land-use. Considering our limited ability to take loans and taking into consideration the urgency of situation, capital intensive actions have been prioritised with the highest priority going to the transport sector and air quality improvement. Capital intensive actions in other sectors have been mostly transposed into mid- and long-term targets.

The table below (Table 40) provides a summary of all capital investments identified under this GCAP. We have divided the investments timeline into three investment periods (short-term, mid-term, long-term).

The first period covers immediate future, i.e. projects planned to start before 2020. As indicated above, short-term actions focus on the most critical area. The actions aim especially at modernizing the public transport and establishing a user-friendly and comfortable transport for commuting. The aspiration for the long-term is to make it the transport of choice thanks to the highest standard of its service. In this framework, attention is also paid to the development of alternative mobility.

In the second period 2021-2025, other critical areas will be addressed and preparations for long-term investment projects would start. A major part of investment should go to energy efficiency measures, including the development of renewable sources.

Third period, 2026-2030, will cover areas which have a great potential for improvement without being critical at the moment. Significant investment into energy efficiency will continue in this period too. We expect long-term investment actions to be launched also in the water sector depending on the priorities set by the State Committee of Water Economy. A dedicated summary of potential investment into water infrastructure is provided below. (Table 41)

Sector	Action code	Action name	Estimated capital investment (EUR 000's)		
			2018 - 2020	2021 - 2025	2026 - 2030
Transport	TA1	Implement a new bus network model	85,000	tbd	tbd
	TA2	Upgrade public electric transportation	28,000		
	TA7	Develop road infrastructure	79,000		
	TA10	Purchase up to 85% of all new buses as CNG-fuelled buses.	57,000		
	TA12	Optimise city transport, improve management efficiency	10,000		
	TA13	Introduce 10 electric vehicles in its fleet	250		
	TA14	Facilitate the development of charging infrastructure.	45		
	EA2	Construct and repair works in municipal buildings by using energy efficient and renewable energy resources	21,000		
	EA3	Modernise electric appliances in pre-schools	400		
	EA14	Utilise methane for electricity generation at Nubarashen municipal solid waste landfill	293		
	EA16	Scale-up of EE lighting retrofits through revolving of savings from UNDP & EBRD/E5P investments	110	2,868	6,883

	EA17	Introducing external lighting infrastructure smart networking (to allow the operator to exercise remote access, dimming, runtime scheduling, outage detection, etc.)		1,200	2,600
	EA18	EBRD/E5P Energy Efficient Municipal Street lighting project	tbd		
<b>Industries</b>	IA1	Creation of sound program for incentivisation of material efficiency in industrial sector	50		
	IA6	Voluntary agreements on energy and clean production audits in industry		600	
<b>Water</b>	WaA1	Installation of metering devices by the water utility	(EUR 2,300/device)		
	WaA2	Leak Reduction Action Plan (LRAP)		150	
	WaA4	Central inventory database on water infrastructure - GIS	180		
	WaA5	Master Plan of the Water Infrastructure		3,000	
	WaA6	Repair and rehabilitate parts of the water supply system with the highest water leakages		38,500	
<b>Land use</b>	LA3	Develop rules on the implementation of green transport infrastructure in new buildings and major renovations.	25		

	LA4	Incorporate transit-oriented planning in the development of new areas and destinations	35		
	LA5	Carry out a feasibility study for enhanced and effective greening of Yerevan	60		
	LA6	Prepare and implement a development plan for re-vegetation of Yerevan		(10/ha)	
	LA9	Development the GIS-based environmental map of Yerevan		60	
	LA10	Develop a thorough inventory of Yerevan's potentially contaminated sites	60		
	LA11	Pilot project of remediation of contaminated site and its transformation to a green civil amenity site	1,000	2,000	
Waste	WsA1	Construction of the new sanitary landfill for MSW + Closure (restoration) of existing dumpsites	26,000	15	
	WsA2	Consider possibility of constructing a new MSW sorting and recycling plant in the framework of public-private partnership	-	-	-
	WsA4	Delivery of regular awareness campaigns focused on the waste-disposal fee and littering in cooperation with the Green city awareness centre	10	-	-
	AA2	Develop a municipal own air quality monitoring system	20	1,000	

<b>TOTAL</b>		<b>Approx.</b>	<b>414,580</b>	<b>79,983</b>	<b>14,533</b>
<b>TOTAL without investments in water sector which is not under the City's authority</b>			<b>413,550</b>	<b>33,183</b>	<b>13,983</b>

Table 39: Estimated capital investments 2018 - 2030

We recall that these investment plans are recommendations only to the State Committee of Water Economy as explained in Chapter 10. The recommendations reflect the comprehensive analysis carried out under this GCAP and the City will make every effort to support the implementation thereof towards the Committee in the future.

The table (Table 41) below then outlines investment plans that should follow the preparatory work and may fall outside of the time scope of the current GCAP.

<b>Action</b>	<b>CAPEX (EUR)</b>	<b>Type of Document</b>
Feasibility Study - Rehabilitation of water pipelines and enlargement of the centralized sewerage system	300,000	Feasibility Study
Tender Documentation - Rehabilitation of water pipelines and enlargement of the centralized sewerage system	100,000,000	TD for the works (based on previous information from the MP, FS)
Upgrade of the Central Wastewater Treatment Plant	220,000,000	Rehabilitation to be carried out in 2 phases.
Initiate Water Management Planning and implementation at the Watershed of the Yerevan Lake and the Hrazdan River	300,000	Water Management Planning (EU Procedures)

Table 40: Preparatory work outside of GCAP time scope

## 14 Final remarks

Developing a Green City Action Plan is a challenging task for any city, in particular during the very first cycle of such process. The greatest risks to manage include poor data availability, be it in terms of scope, granularity or reliability, lack of governance procedures underpinning the need for enhanced cooperation between responsible municipality departments, between the municipality and government institutions as well as between the municipality and wider stakeholders, lack of shared perception of priorities, and high expectations for the short-term.

Back in 2016, we developed the first Sustainable Energy Action Plan in line with our commitments under the Covenant of Mayors and experienced some of the above mentioned challenges. The output of the SEAP was instrumental in preparing the first Green City Action Plan, yet, the much wider scope of the GCAP and the need to develop a Strategic Environmental Assessment for it required significant additional efforts.

The development of GCAP was made possible thanks to our long-term relationship with EBRD and its commitment to support cities in their transition to green economy. The joint team of international and Armenian experts helped us determine the baseline and, following the GCAP methodology and the experts' knowledge of other cities, the current key challenges that the city of Yerevan is facing. This was further discussed with a wide group of stakeholders to verify that the perception of the entities operating and people living in Yerevan correspond with the outcome of the analysis. The stakeholders agreed with the assessment of key challenges while also calling for a wider scope of analysis especially in transport and biodiversity. These requests have mostly been addressed through GCAP short-term actions, namely those aiming to expand our knowledge and understanding of the city's environment and the impact of human activities on it.

Based on the current key challenges as well as on the understanding of Yerevan's weak points as they came through from the analysis, we defined a strategic framework for the period up to 2030. This long-term framework allowed us to be ambitious enough while also being realistic about what is achievable in the short- and mid-term. It is a framework of building blocks that assumes layers of activities that mutually interact and underpin each other into the future. A vision, along with strategic objectives and mid-term targets have been defined for all areas covered by this GCAP and further complemented by short-term actions (next 3-5 years). These are designed to strengthen current programmes and projects or kick-start new ones that altogether aim to mitigate the negative impact of human activities on the environment and enhance the quality of Yerevan's environmental assets. As GCAP is an iterative process, a review of the strategic framework is expected in about 3 years' time. This period should provide sufficient time to collect and consolidate more data and information and, through further research and analysis, address many questions and issues raised during the second round of stakeholders' engagement (SEA process). This concerns especially a more detailed analysis of feasibility of further actions in areas such as transport, water and waste, and of impact of the strategic framework, especially the short-term actions, on the climate change mitigation. Moreover, the latter was not within the direct scope of the GCAP.

Further stakeholders' engagement and enhanced cooperation with the ministries will be crucial for successful implementation of the planned short-term actions. Their involvement is needed for raising public awareness and active promotion of environmentally-friendly behaviour on day-to-day basis, active support of green economy by the private sector, and making good use of overlaps of the individual authorities' responsibilities.

It can be concluded that this GCAP, that is its implementation, will have a positive impact on the environmental assets and enhance the quality of life in the city. This assessment is also confirmed by the respective Strategic Environmental Assessment of impact on the environment (See Annex 6). To assess the actual implementation and impact, a report will be prepared at the end of the first GCAP cycle mapping the achievements as well as any potential mishaps and the corresponding lessons learnt. This will help us further improve the process and actions in the following round and ensure that the 2030 vision is achieved.

# **GREEN CITY ACTION PLAN**

**City of Yerevan**

**Annexes**

12 September 2017



**European Bank**  
for Reconstruction and Development



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Building a better  
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## 1 Annex 1: Indicators overview

This annex provides a full overview of the indicators establishing the GCAP's baseline. The indicators and the way of their calculation and assessment are based on the EBRD GCAP Methodology jointly developed with OECD and ICLEI. The indicators framework follows the Pressure-State-Response (PSR) approach that aims to map the causal links between the negative impact of human activities and the state of the environment, and the respective response by the public administration to prevent or mitigate the negative impact. Where it was not possible to apply the original indicators, indicators were either adjusted or new were formulated by the experts to capture correctly the environmental situation in Yerevan.

The summary table presented below provides a concise overview of each indicator. The most urgent environmental problems (topics) faced by the city are marked as "red", areas which do not present a critical priority but require improvement nonetheless are "amber" and areas demonstrating high compliance with green city parameters are marked as "green".

Response indicators are assigned traffic light based on the level of policy coverage and effectiveness of implementation as follows:

Existing and well implemented, and there is no significant need to further expand this type of response	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	Not existing
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Resource / Sector	Indicator (State/Pressure/Response indicator)	Value
Air quality	Average annual concentration of dust	162 µg/m <sup>3</sup> annual average
Air quality	Number of daily exceedances of dust concentration limits	43 days
Air quality	Average daily concentration of SO <sub>2</sub>	28.8 µg/m <sup>3</sup> mean daily average
Air quality	Number of days exceeding the daily limit of SO <sub>2</sub>	325 days
Air quality	Average annual concentration of nitrogen dioxide	22 µg/m <sup>3</sup> annual average
Air quality	Number of days exceeding the hourly limit of NO <sub>2</sub>	58 days in 2015 with concentration exceeding the ½ WHO AQG
GHG emissions	Annual CO <sub>2</sub> equivalent emissions per capita	3.08 tons of CO <sub>2eq</sub>
GHG emissions	Annual CO <sub>2</sub> equivalent emissions per unit of GDP	0.94 kg CO <sub>2eq</sub> / USD of GDP
Transport	Average age of car fleet (total and by type)	Cars: 16 years Buses: 15 years (Public transport buses: < 12 years) Special vehicles: 19 years Trucks: 18 years Tricycles etc.: 13 years Average all: 16 years
Transport	Percentage of diesel cars in vehicle fleet by type	Diesel cars: 1.3% (Petrol and converted CNG cars: 98.3%) Diesel buses: 19% (Petrol and converted CNG buses: 80%) Diesel trucks: 39% (Petrol and converted CNG trucks: 61%)
Transport	Public transport share run on fossil fuels	Diesel/Petrol/CNG: 89.5% (Bus: 36.5%, Microbus: 53%) Electricity: 10.5% (Trolleybus: 2.6%, Metro: 7.9%)
Transport	Motorisation rate	0.17
Transport	Kilometres of road dedicated exclusively to public transit per 100,000 population	0
Transport	Kilometres of bicycle path per 100,000 population	<15

Transport	Average travel speed on primary thoroughfares during peak hour	Bus – 20.2 km/hour Microbus- 20.8 km/hour Trolleybus – 14.8 km/hour Average – 18.6 - km/hour
Transport	Interruption of public transport systems in case of disaster	Emergency transport systems are able to run in case of disaster, but with limited efficiency / Emergency transport systems are not able to run properly in case of disaster (Qualitative assessment)
Transport	High-polluting vehicles are regulated / Energy-efficient vehicles are incentivised through fiscal instruments	Emissions standards and a requirement to have a catalytic converter on imported cars exist but are not fully and adequately implemented. While customs increase with age of a car, no fiscal instruments are offered as incentive to own and operate energy efficient vehicles.
Transport	Extension and improvement of public and non-motorised transport is planned and supported through investment in place	Some investment in buses and upgrading metro. Starting the study phase of new bus network and integrated tariff/ticketing. No investments in enabling non-motorized investments.
Transport	Public and non-motorised transport is promoted through Information and awareness campaigns	There has been no promotion of public or non-motorised transport in the last decade. There was an attempt to have GPS-enabled electronic schedules bus stations. Some of these electronic boards were installed but were not ever seriously functional.
Transport	Traffic demand is managed (congestion charges, smart technologies)	No such solutions are implemented
Transport	Parking space is managed / Incentives for effective use of parking space are in place	High traffic parts of the City Centre have designated and monitored areas for street parking. Their pricing, however, is not used to regulate driving behaviour.
Energy	Share of population with an authorised connection to electricity	91.2%
Energy	Share of population with access to heating	100%
Energy	Proportion of total energy derived from RES as a share of total city energy consumption	7%
Energy	Average duration of per consumer disruption of electricity supply per year in case of force majeure*	3.5 hours/consumer
Energy	Hours of voltage deviation per customer during the year due to technical and natural reasons*	2148 hours/consumer per year
Energy	Coverage and quality of electricity and heat supply is improved through investment (Electricity and heat provision)	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake.

Energy	Renewable energy facilities in private buildings are incentivised through fiscal instruments (Renewable energy development)	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake.
Energy	Renewable energy technologies are developed and supported through public and private investment (Renewable energy development)	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake.
Energy	Renewable energy facilities are incentivised through awareness campaigns (Renewable energy development)	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake.
Street-lighting	Percentage of total streets lit*	97%
Street-lighting	Electricity consumption per kilometre of lit road*	46,542 kWh/km
Street-lighting	Electricity consumed per light pole*	537 kWh/lighting pole/year
Street-lighting	Public investments in public street lighting / external illumination*	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake.
Buildings	Electricity consumption in residential buildings	36.2 kWh/m <sup>2</sup>
Buildings	Electricity consumption in public buildings	46.8 kWh/m <sup>2</sup> , corrected for comfort
Buildings	Heating / cooling consumption in residential buildings, fossil fuels	174 kWh/m <sup>2</sup>
Buildings	Heating / cooling consumption in non-residential buildings, fossil fuels	284 kWh/m <sup>2</sup>
Buildings	Energy efficiency in buildings is promoted through standards (Electricity and heat consumption)	"Thermal Protection of Buildings" HSHN 24-01-2016 which was developed based on the Russian code from 2003 (updated in 2012) as well as EU codes and methodologies. Very recently, the implementation lags behind as capacity building and institutional strengthening elements are underfunded.
Buildings	Public and private investment in energy efficiency in buildings (Electricity and heat consumption)	Government decree (Decree No 1504 from 25 December 2014 on Mandatory EE Provisions in Public procurement in building (re)construction) and the May 2016 amendment to the ESRE Law on mandatory compliance with EE requirements in state investment projects and residential construction has no provisions for enforcement
Buildings	Metering and billing for personal energy use is regulated (Electricity and heat consumption)	Billing is 100%-based on actual consumption. Smart metering has not been implemented
Industries	Electricity consumption in industries, per unit of industrial GDP	0.29 kWh/2010 USD
Industries	Heat consumption in industries, per unit of industrial GDP	12.26 kJ / 2014 USD

Industries	Heavy metals emission intensity of manufacturing industries	2.91 kg of heavy metals equivalent released per million USD GVA
Industries	Fossil fuel combustion in industrial processes, per unit of industrial GDP	3.46 MJ/USD
Industries	Share of industrial energy consumption from renewable energy	<1%
Industries	Share of industrial waste recycled as a share of total industrial waste produced	5%
Industries	Energy efficient industrial machinery is regulated and incentivised through fiscal instruments (electricity, heat, industrial processes)	Not Existing
Industries	Energy efficient industrial technologies (electricity, heat, industrial processes) is supported through private investment	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake
Industries	Material efficiency of newly built industrial facilities and waste recycling is regulated and incentivized through fiscal instruments	Not existing
Industries	Industrial wastewater treatment / reuse / recycle is promoted through regulations and fiscal incentives	Not existing
Water	Biological Oxygen Demand (BOD) in rivers and lakes - Yerevan Lake	2.8 mg/l per 5 days (2015)
Water	Biological Oxygen Demand (BOD) in rivers and lakes – Hrazdan river (leaving the city)	19.06 mg/l per 5 days (2015)
Water	Ammonium (NH <sub>4</sub> ) concentration in rivers and lakes – Yerevan Lake	831 µg/L (2015)
Water	Ammonium (NH <sub>4</sub> ) concentration in rivers and lakes – Hrazdan river (leaving the city)	24 424 µg/L (2015)
Water	Percentage of water samples in a year that comply with national potable water quality standards	100%
Water	Water consumption per capita	122 L/day/capita
Water	Industrial water consumption as percent of total urban water consumption	37%
Water	Non-revenue water	73.2%
Water	Annual average of daily number of hours of continuous water supply per household	23.4 h/day
Water	Percentage of residential and commercial wastewater that is treated according to applicable national standards	0%

Water	Percentage of dwellings damaged by the most intense flooding in the last 10 years	0.5-3%
Water	Metering and billing for water use is regulated	Not all of subscribers have installed a water meter. Moreover, an unauthorized connections have been observed.
Water	Water saving / reuse is encouraged through awareness campaigns	Several awareness campaigns by Yerevan DJUR have been organized.
Water	Coverage and efficiency of water supply networks is improved through plans and investment	Partial renewal of water supply network has been done. Plans were established by Yerevan Djur and Municipality. Investments from Yerevan Djur, World Bank and Developing Countries Relief Fund loans.
Water	Buildings' access to wastewater collection and treatment systems is improved through plans and investment	Plans by Yerevan Djur and Municipality. Investments from Yerevan Djur, World Bank and Developing Countries Relief Fund loans.
Water	Wastewater treatment is promoted through regulations and fiscal incentives	Several plan has been realized but there is still a need to improve current insufficient system of the wastewater treatment.
Water	Wastewater billing is regulated	Payment for wastewater collection is part of the water tariff.
Water	Drinking water pre-treatment is enhanced through plans and investment	Extensive efforts by Yerevan DJUR
Water	Drainage facilities are developed through plans and investment	Drainage facilities are being built and developed for the new neighbourhoods lacking these facilities. Basic improvement and development is under the control of Yerevan Municipality.
Water	Business and community resilience is encouraged through awareness campaigns	Existing through Ministry of Emergency Situations.
Waste	Number of contaminated sites	1 - 10 contaminated sites and potentially contaminated sites per 1,000 inhabitants
Waste	Total solid waste generation per capita	300 – 340 Kg/person/year
Waste	Share of the population with weekly municipal solid waste collection	95 %
Waste	Percentage of MSW and HW landfilled is disposed of in EU-compliant sanitary landfills	0%
Waste	Proportion of MSW that is sorted and recycled	< 5%
Waste	The remaining life of current landfill(s)	5 – 8 years
Waste	Reduction of material consumption / solid waste generation is promoted through awareness campaigns	Existing, needs improvement

Waste	Coverage of solid waste collection system is improved through plans and investment	Existing
Waste	Littering and non-compliance to sorting systems is disincentivised through fines and penalties	Not existing
Waste	Composting, recycling, and waste - to - energy facilities are developed through plans and investment	Existing
Waste	Solid waste reuse, sorting and recycling is promoted through information and awareness campaigns	Not existing
Waste	Overcapacity issues in waste disposal sites are tackled through plans and investment	Existing, needs improvement
Land-use	Open green space area ratio per inhabitant	7.9 m2/inhabitant (2010)
Land-use	Population density on urban land	4,815 residents/km2
Land-use	Percentage of urban development that occurs on existing urban land rather than on greenfield land	
Land-use	Vacancy rates of offices	>10%
Land-use	Density is regulated	
Land-use	Transit-Oriented Development is promoted	
Land-use	Mixed-use development is promoted through zoning regulations / incentives	
Biodiversity	Diversity of breeding bird community	Shannon index value = 1.1147
Resilience to natural disasters	Estimated economic damage from natural disasters (floods, droughts, earthquakes etc.) as a share of GDP	12% GDP (of Armenia)

## 2 Annex 2: Overview of priority indicators

The table below presents an overview of pressure and response indicators that fall under the key problem areas. Some challenges of medium (amber) urgency are also listed here either because of their proximity to the red range or because the experts' assessment identified a strong link between them and the related sector challenges and hence a potential for synergies.

Sector	Key Challenge	Pressure Indicator
<b>Environmental Assets</b>	High dust pollution concentration	Average annual concentration of dust: 162 µg/m <sup>3</sup> Number of daily exceedances of dust concentration limits : 43
	Limited air quality data availability	Average daily concentration of SO <sub>2</sub> : 28.8 µg/m <sup>3</sup> mean daily average Number of daily exceedances of the daily SO <sub>2</sub> limit: 325 days Number of daily exceedances of the hourly NO <sub>2</sub> limit: 58 days Annual CO <sub>2</sub> equivalent emissions per capita: 3.08 t/capita Missing comprehensive monitoring of the pollutants of air
	Soil contamination	Number of contaminated and potentially contaminated sites = Expert estimate: 1 - 10 contaminated sites per 1,000 inhabitants of Yerevan
	Limited data availability	No systematic monitoring of soil
	Low ratio of green areas	Open green space area ratio per inhabitant = 7.6 m <sup>2</sup> /inhabitant
	Loss of biodiversity	Diversity of breeding bird community, measured by the Shannon index value = 1.1147
	<b>Transport</b>	High age of all vehicles
Poor public/alternative transport infrastructures		Percentage of diesel cars in vehicle fleet by type: Diesel cars: 1.3% (Petrol and converted CNG cars: 98.3%) Diesel buses: 19% (Petrol and converted CNG buses: 80%) Diesel trucks: 39% (Petrol and converted CNG trucks: 61%)

	<p>Public transport share run on fossil fuels:                  Diesel/Petrol/CNG: 89.5%                  (Bus: 36.5%, Microbus: 53%)                  Electricity: 10.5%                  (Trolleybus: 2.6%, Metro: 7.9%)</p> <p>Kilometres of road dedicated exclusively to public transit per 100,000 population : 0</p> <p>Kilometres of bicycle path per 100,000 population : &lt;15</p> <p>Extension and improvement of public and non-motorised transport is planned and supported through investment in place:                  Some investment in buses and upgrading metro.                  Starting the study phase of new bus network and integrated tariff/ticketing.                  No investments in enabling non-motorized investments.</p>
<p>Transport management, data availability and general awareness</p>	<p>Average travel speed on primary thoroughfares during peak hour :                  Bus – 20.2 km/hour                  Microbus- 20.8 km/hour                  Trolleybus – 14.8 km/hour                  Average – 18.6 - km/hour</p> <p>Interruption of public transport systems in case of disaster :                  Emergency transport systems are able to run in case of disaster, but with limited efficiency / Emergency transport systems are not able to run properly in case of disaster (Qualitative assessment)</p> <p>High-polluting vehicles are regulated / Energy-efficient vehicles are incentivised through fiscal instruments :                  Emissions standards and a requirement to have a catalytic converter on imported cars exist but are not fully and adequately implemented. While customs increase with age of a car, no fiscal instruments are offered as incentive to own and operate energy efficient vehicles.</p>

		<p>Public and non-motorised transport is promoted through Information and awareness campaigns: There has been no promotion of public or non-motorised transport in the last decade. There was an attempt to have GPS-enabled electronic schedules bus stations. Some of these electronic boards were installed but were not ever seriously functional.</p> <p>Traffic demand is managed (congestion charges, smart technologies): No such solutions are implemented</p> <p>Parking space is managed / Incentives for effective use of parking space are in place: High traffic parts of the City Centre have designated and monitored areas for street parking. Their pricing, however, is not used to regulate driving behaviour.</p>
<b>Energy</b>	Lack of energy planning, and Institutional and financial capacity for procurement of building EE services	<p>Public and private investment in energy efficiency in buildings (Electricity and heat consumption): Government decree (Decree No 1504 from 25 December 2014 on Mandatory EE Provisions in Public procurement in building (re)construction) and the May 2016 amendment to the ESRE Law on mandatory compliance with EE requirements in state investment projects and residential construction has no provisions for enforcement</p>
	Low public awareness on the costs and benefits of modern EE solutions	<p>Heating / cooling consumption in non-residential buildings, fossil fuels : 284 kWh/m2</p>
	Lack of effective financing mechanisms for EE investments in residential buildings	<p>Coverage and quality of electricity and heat supply is improved through investment (Electricity and heat provision): Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake.</p> <p>Electricity consumption in residential buildings : 36.2 kWh/m2</p> <p>Heating / cooling consumption in residential buildings, fossil fuels 174 kWh/m2</p>

<p>Lack of enforcement of national legislation on building EE</p>	<p>Energy efficiency in buildings is promoted through standards (Electricity and heat consumption) :                  “Thermal Protection of Buildings” HSHN 24-01-2016 which was developed based on the Russian code from 2003 (updated in 2012) as well as EU codes and methodologies. Very recently, the implementation lags behind as capacity building and institutional strengthening elements are underfunded.</p>
<p>Lack of municipal funds to EE lighting retrofits</p>	<p>Electricity consumption in public buildings:                  46.8 kWh/m<sup>2</sup>, corrected for comfort</p>
<p>Municipality's limited borrowing capacity</p>	<p>Hours of voltage deviation per customer during the year due to technical and natural reasons: 2148 hours/consumer per year</p>
<p>Lack of holistic conceptual approach to external lighting</p>	<p>Electricity consumption per kilometre of lit road :                  46,542 kWh/km</p>
	<p>Electricity consumed per light pole :                  537 kWh/lighting pole/year</p>
	<p>Public investments in public street lighting / external illumination :                  Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake.</p>
<p>Lack of funds for development of renewable energy (RE)</p>	<p>Proportion of total energy derived from RES as a share of total city energy consumption : 7%</p>
	<p>Renewable energy facilities in private buildings are incentivised through fiscal instruments (Renewable energy development):                  Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake.</p>
<p>Lack of effective PPP solutions to leverage RE investments</p>	<p>Renewable energy technologies are developed and supported through public and private investment (Renewable energy development):                  Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake.</p>
<p>Limited experience in procurement of RE systems</p>	<p>Renewable energy facilities are incentivised through awareness campaigns (Renewable energy development):                  Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake.</p>

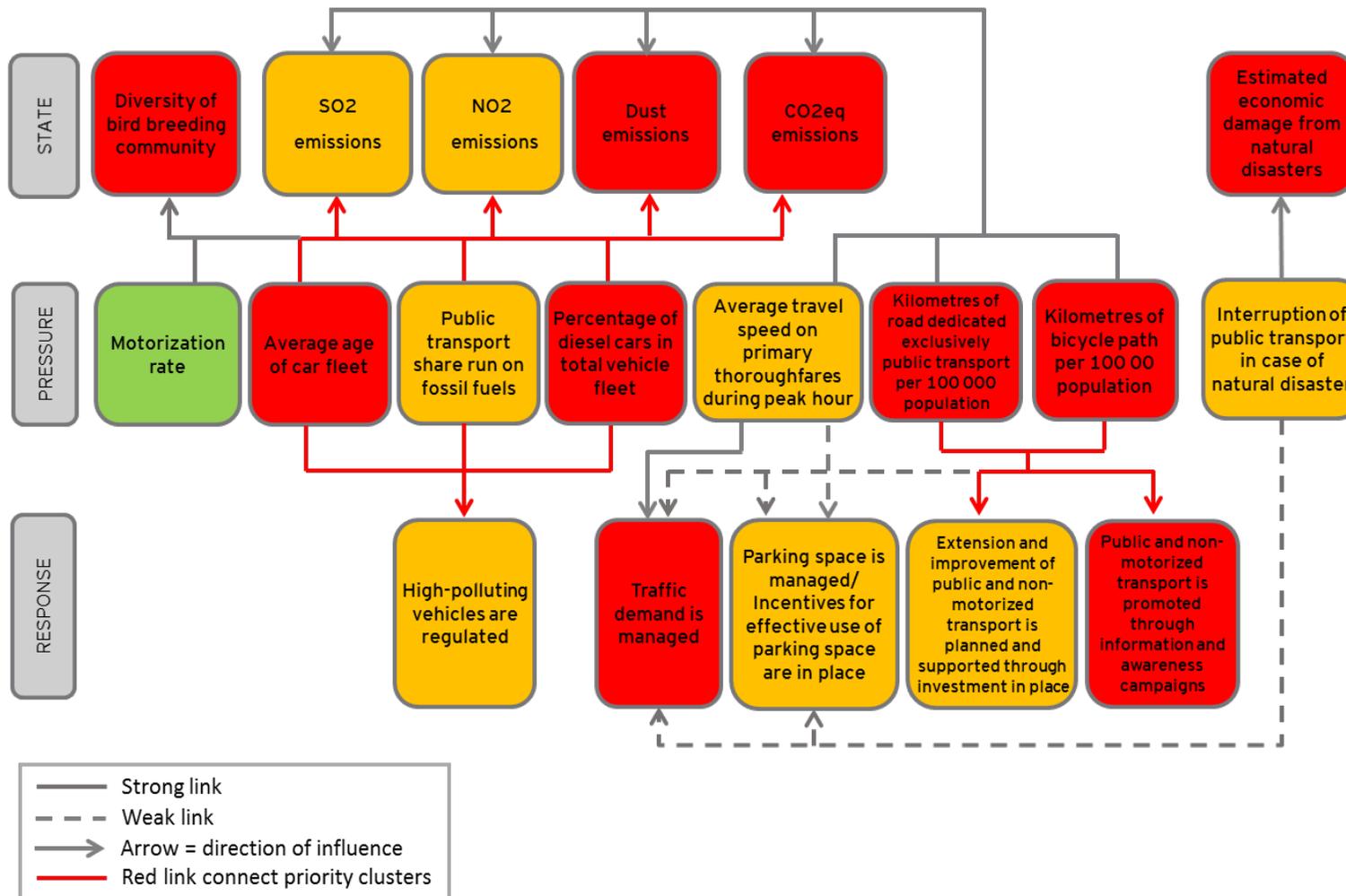
<b>Industry</b>	Lack of information and dialogue between the City and the industry	Other indicators
		Heavy metals emission intensity of manufacturing industries : 2.91 kg of heavy metals equivalent released per million USD GVA
		Share of industrial waste recycled as a share of total industrial waste produced : 5%
		Material efficiency of newly built industrial facilities and waste recycling is regulated and incentivized through fiscal instruments : Not existing
		Industrial wastewater treatment / reuse / recycle is promoted through regulations and fiscal incentives : Not existing
	Low industrial energy efficiency + energy system sustainability	Energy efficient industrial machinery is regulated and incentivised through fiscal instruments (electricity, heat, industrial processes): Not Existing
		Energy efficient industrial technologies (electricity, heat, industrial processes) is supported through private investment : Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake
		Fossil fuel combustion in industrial processes, per unit of industrial GDP : 3.46 MJ/USD
		Share of industrial energy consumption from renewable energy : <1%
		Heat consumption in industries, per unit of industrial GDP : 12.26 kJ / 2014 USD
<b>Waste</b>	Waste disposal practice	Number of contaminated sites : 1 - 10 contaminated sites and potentially contaminated sites per 1,000 inhabitants
		Percentage of MSW and HW landfilled is disposed of in EU-compliant sanitary landfills ; 0%
		The remaining life of current landfill(s): 5 – 8 years
		Overcapacity issues in waste disposal sites are tackled through plans and investment : Existing, needs improvement

	<p>Low material efficiency</p>	<p>Total solid waste generation per capita : 300 – 340 Kg/person/year</p> <p>Proportion of MSW that is sorted and recycled : &lt; 5%</p> <p>Reduction of material consumption / solid waste generation is promoted through awareness campaigns : Existing, needs improvement</p> <p>Littering and non-compliance to sorting systems is disincentivised through fines and penalties : Not existing</p> <p>Solid waste reuse, sorting and recycling is promoted through information and awareness campaigns : Not existing</p>
<p><b>Water</b></p>	<p>Non-revenue water</p>	<p>Non-revenue water : 73.2%</p>
	<p>Insufficient treatment of wastewater</p>	<p>Biological Oxygen Demand (BOD) in rivers and lakes - Yerevan Lake : 2.8 mg/l per 5 days (2015)</p>
		<p>Biological Oxygen Demand (BOD) in rivers and lakes – Hrazdan river (leaving the city): 19.06 mg/l per 5 days (2015)</p>
		<p>Ammonium (NH<sub>4</sub>) concentration in rivers and lakes – Yerevan Lake : 831 µg/L (2015)</p>
		<p>Ammonium (NH<sub>4</sub>) concentration in rivers and lakes – Hrazdan river (leaving the city): 24 424 µg/L (2015)</p>
		<p>Percentage of residential and commercial wastewater that is treated according to applicable national standards : 0%</p>
		<p>Wastewater treatment is promoted through regulations and fiscal incentives: Several plan has been realized but there is still a need to improve current insufficient system of the wastewater treatment.</p>
		<p>Wastewater billing is regulated : Payment for wastewater collection is part of the water tariff.</p>
	<p>Poor condition of wastewater system</p>	<p>Annual average of daily number of hours of continuous water supply per household : 23.4 h/day</p>
		<p>Percentage of dwellings damaged by the most intense flooding in the last 10 years : 0.5-3%</p>

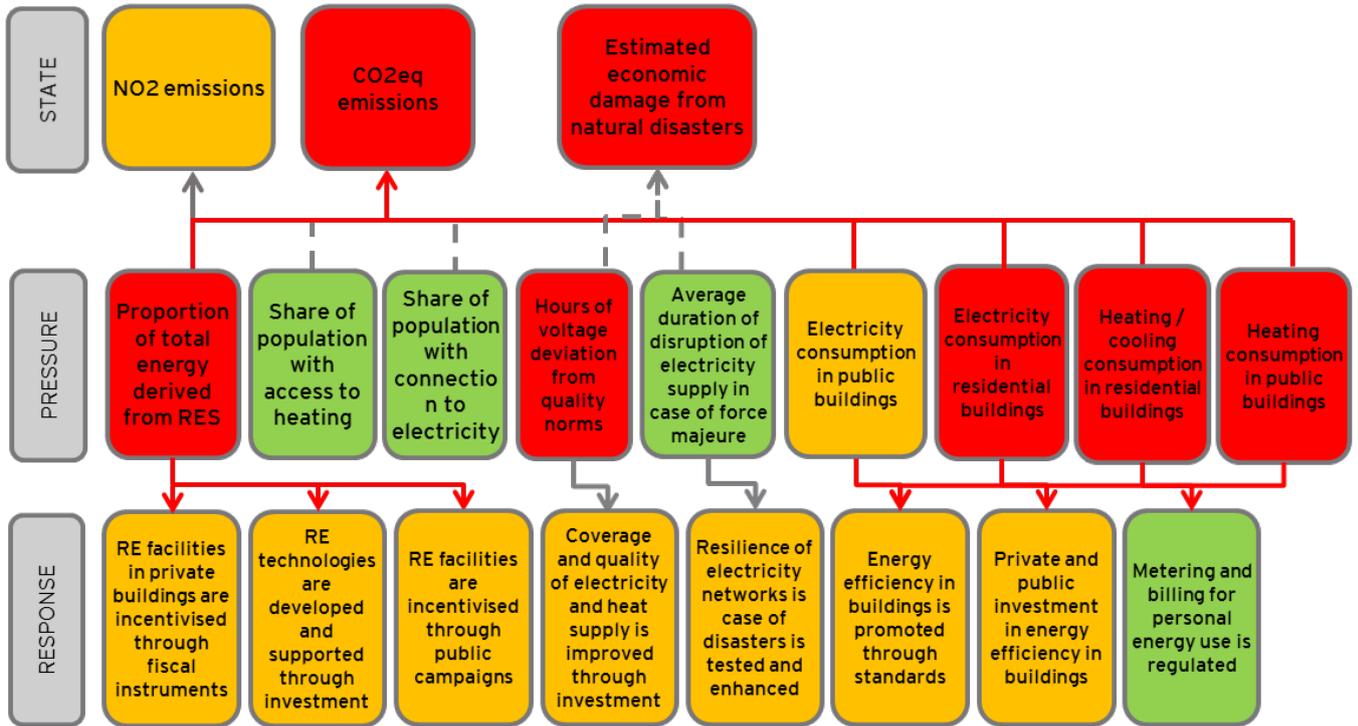
		<p>Metering and billing for water use is regulated : Not all of subscribers have installed a water meter. Moreover, an unauthorized connections have been observed.</p>
		<p>Drainage facilities are developed through plans and investment : Drainage facilities are being built and developed for the new neighbourhoods lacking these facilities. Basic improvement and development is under the control of Yerevan Municipality.</p>
	Inefficient water usage	<p>Industrial water consumption as percent of total urban water consumption : 37%</p>
		<p>Water saving / reuse is encouraged through awareness campaigns : Several awareness campaigns by Yerevan DJUR have been organized.</p> <p>Coverage and efficiency of water supply networks is improved through plans and investment : Partial renewal of water supply network has been done. Plans were established by Yerevan Djur and Municipality. Investments from Yerevan Djur, World Bank and Developing Countries Relief Fund loans.</p>
<b>Land-use</b>	Lack of green spaces and of the dust barrier	<p>Open green space area ratio per inhabitant : 7.9 m2/inhabitant (2010)</p>
	Creation of sustainable city centre	<p>Population density on urban land : 4,815 residents/km2</p> <p>Vacancy rates of offices : &gt;10%</p>
<b>Resilience to natural disasters</b>	Cross-sectoral key challenge reflected through challenges in other sectors	<p>Estimated economic damage from natural disasters (floods, droughts, earthquakes etc.) as a share of GDP : 12% GDP (of Armenia)</p>

### 3 Annex 3: Prioritization problem trees

Problem tree: Transport

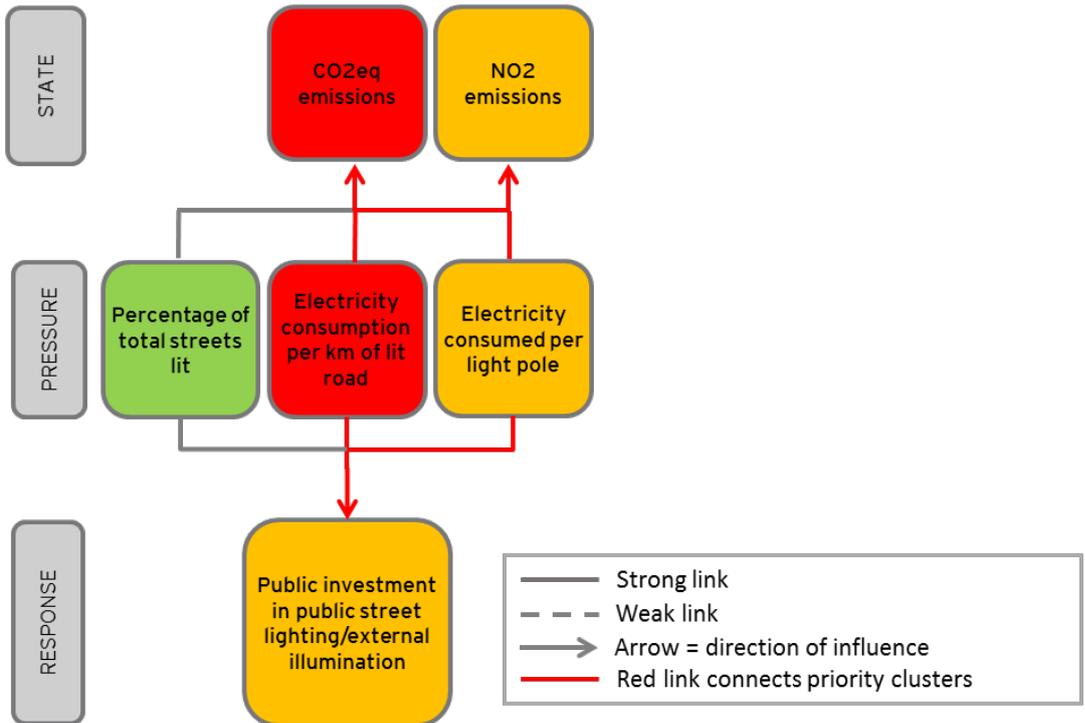


### Problem tree: Energy and Buildings

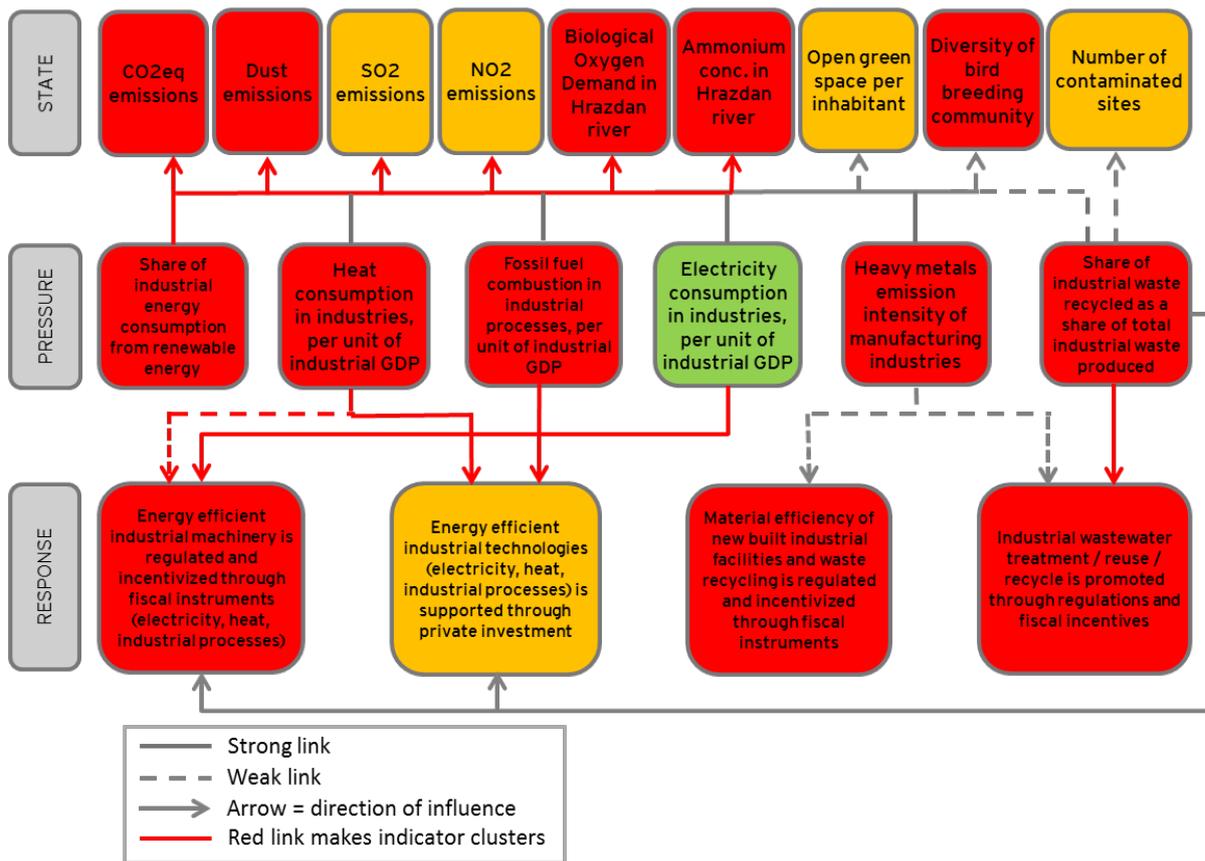


— Strong link  
 - - - Weak link  
 → Arrow = direction of influence  
 — Red link connect priority clusters

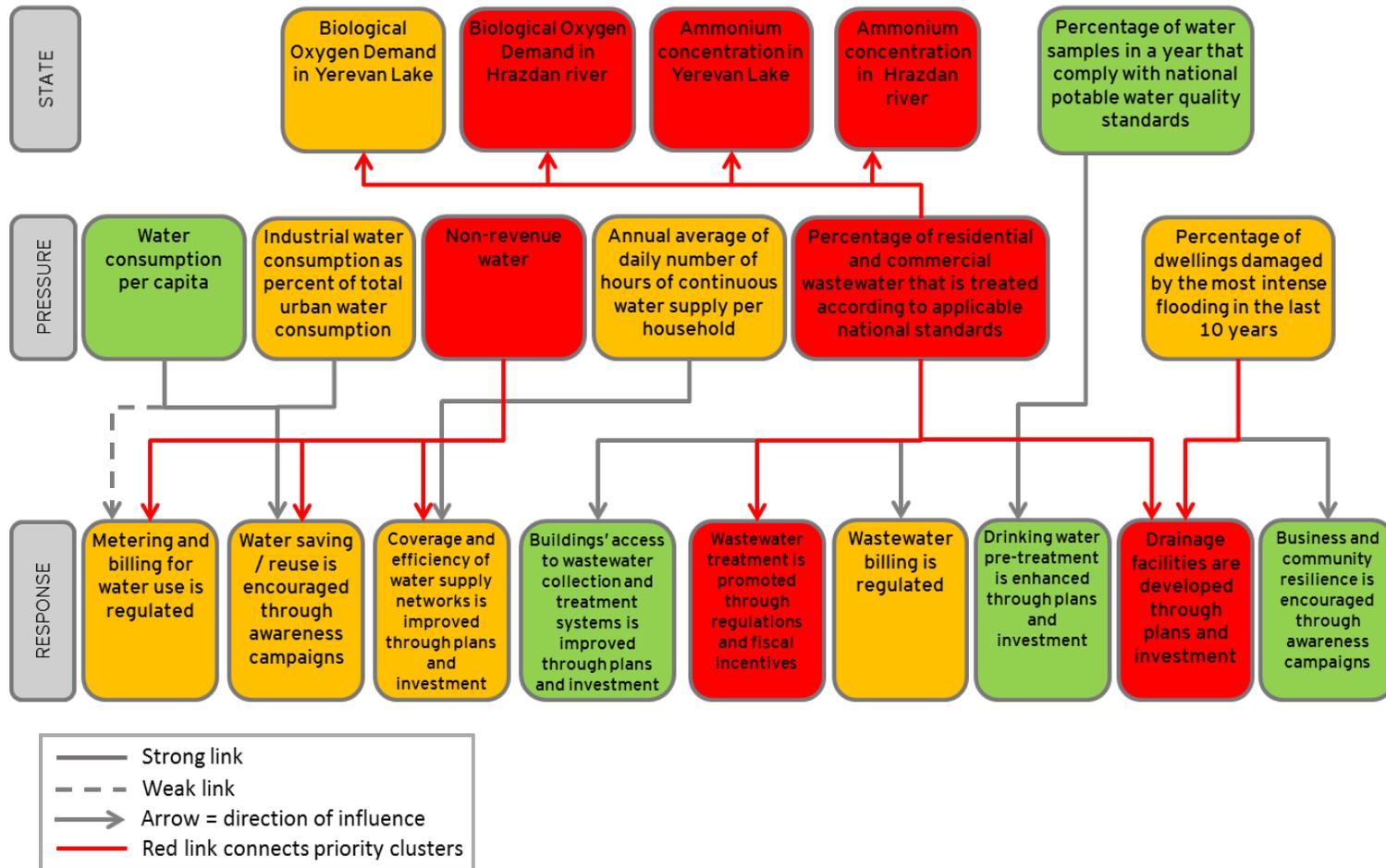
### Problem tree: Street lighting



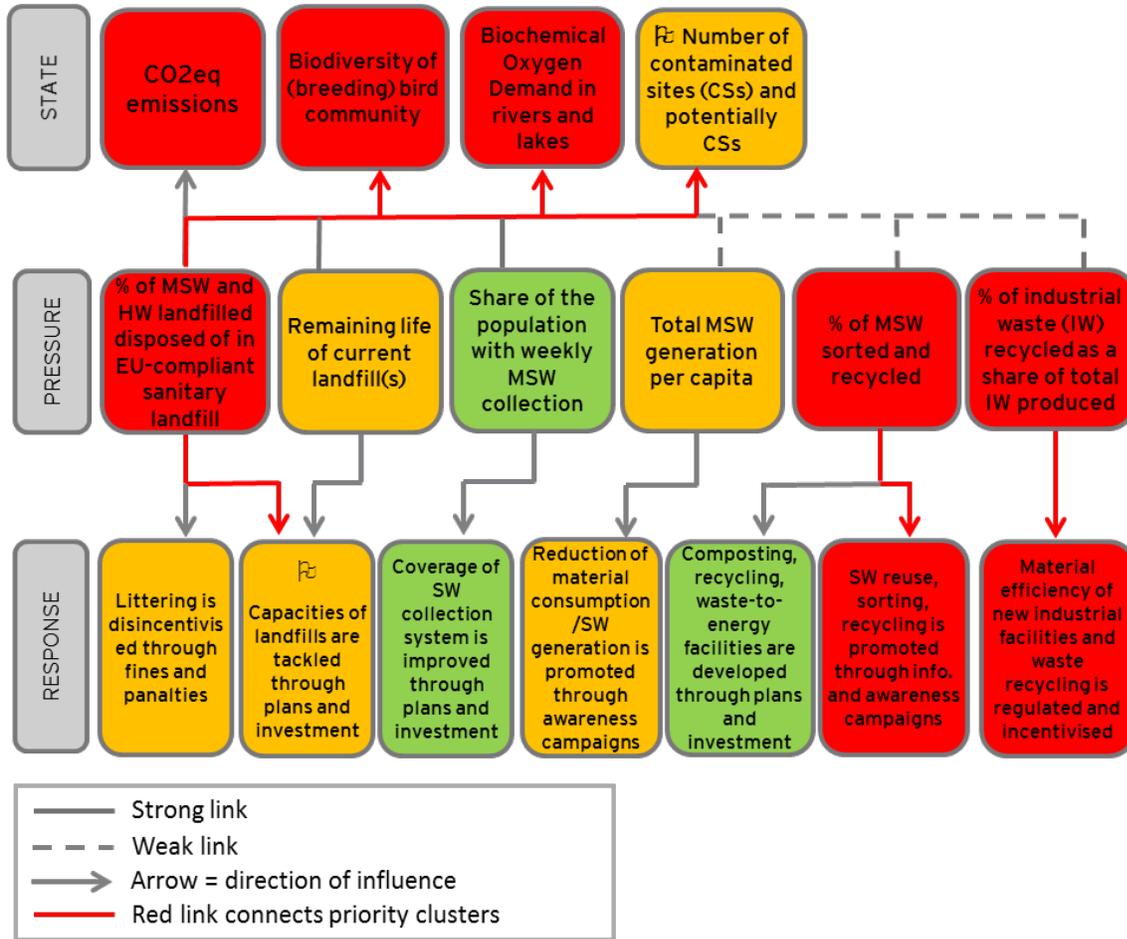
### Problem tree: Industries



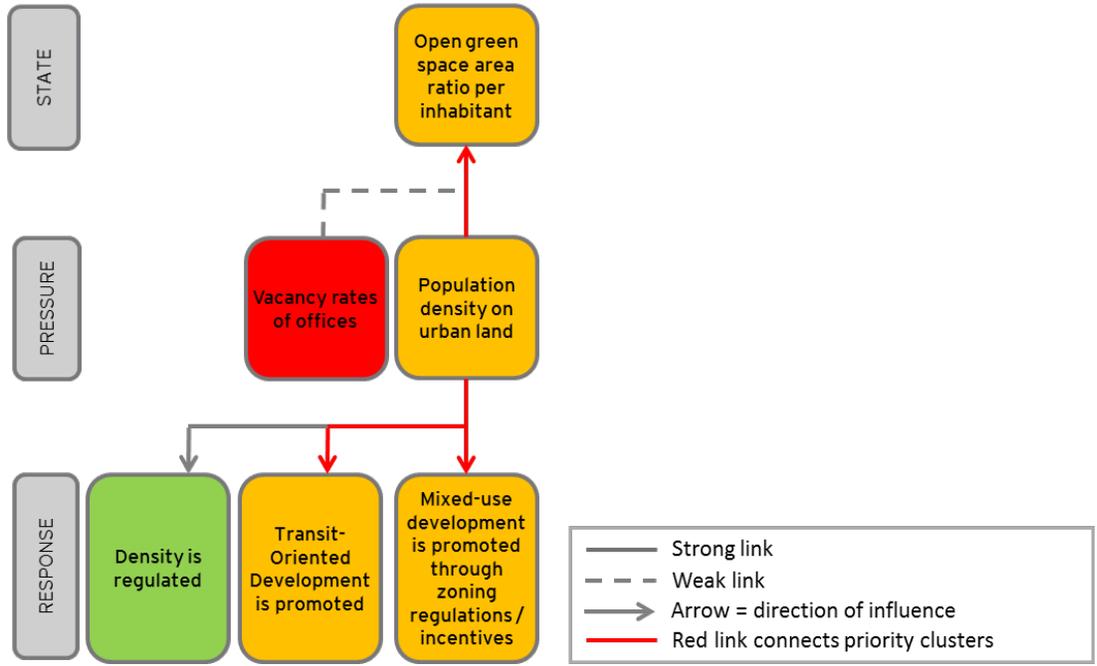
Problem tree: Water



### Problem tree: Waste



Problem tree: Land use



## 4 Annex 4: Detailed indicator description

### 1.1 State Indicators

<b>Average annual concentration of dust</b>													
<p>This indicator is used as an alternative to PM10 and PM2.5 which are not measured. The aim is to describe recent development of dust concentrations in the City of Yerevan as dust and namely PMs are closely associated with increased cancer incidence, especially cancer of the lung. Airborne particulates have ability to enter blood stream and cause DNA mutations leading to various health consequences.</p>													
Benchmark (µg/m3)	<table border="1"> <tr> <td>&lt;60 (annual)</td> <td>60-120 (annual)</td> <td>&gt;120 (annual)</td> </tr> </table>	<60 (annual)	60-120 (annual)	>120 (annual)									
<60 (annual)	60-120 (annual)	>120 (annual)											
Benchmark source	WHO/EU/EBRD/RoA												
Source of data	Ministry of Nature Protection (MNP); EIMC												
Value	162 µg/m3 annual average over 2013-15												
Trend	Downward (significant decrease between 2011-15, but still very high)												
Level of priority	<b>High</b>												
Context	<p>The level of concern is considered as High; an average annual concentration below 60 µg/m3 would be considered as low level (there is however no safe level for PM concentrations).</p> <p>Armenian methodology only examines levels of the undifferentiated dust particles. Thus the comparison to the WHO/EU limits and EBRD benchmark is directly unfeasible.</p> <p>For the time being, overall undifferentiated dust values must be used and the annual average concentration limit is evaluated. Owing to the fact that smaller particles than PM10 are not measured, an expert estimation of the distribution of different types of PMs cannot be done in order to separate concentrations of PM10 and PM2.5 on the basis of main sources of these dust emission.</p> <table border="1"> <thead> <tr> <th>Year</th> <th>The average annual concentration (µg/m3)</th> </tr> </thead> <tbody> <tr> <td>2011</td> <td>327</td> </tr> <tr> <td>2012</td> <td>451</td> </tr> <tr> <td>2013</td> <td>251</td> </tr> <tr> <td>2014</td> <td>126</td> </tr> <tr> <td>2015</td> <td>109</td> </tr> </tbody> </table>	Year	The average annual concentration (µg/m3)	2011	327	2012	451	2013	251	2014	126	2015	109
Year	The average annual concentration (µg/m3)												
2011	327												
2012	451												
2013	251												
2014	126												
2015	109												

<b>Number of daily exceedances of dust concentration limits</b>				
<p>This indicator is used as an alternative to PM10 and PM2.5 which are not measured. The aim is both to describe recent development of dust concentrations in the City of Yerevan as dust and namely PMs are closely associated with increased cancer incidence, especially cancer of the lung. Airborne particulates have ability to enter blood stream and cause DNA mutations leading to various health consequences.</p>				
Benchmark (days)	<table border="1"> <tr> <td>&lt;35</td> <td>35-70</td> <td>70</td> </tr> </table>	<35	35-70	70
<35	35-70	70		
Benchmark source	WHO/EU/EBRD/RoA			
Source of data	Ministry of Nature Protection (MNP); EIMC			
Value	43 days in 2015			

Trend	Downward
Level of priority	<b>High</b>
Context	<p>The level of concern is estimated as High; an annual number of days with excessive dust concentrations below 35 days would be considered as low level (there is however no safe level for PM concentrations).</p> <p>Armenian methodology only examines levels of the undifferentiated dust particles. Thus the comparison to the WHO/EU limits and EBRD benchmark is directly unfeasible.</p> <p>For the time being, overall undifferentiated dust values must be used and the state of play is assessed on a number of days with dust concentrations exceeding the maximum permissible concentrations (RoA MPC) on daily (150 µg/m<sup>3</sup>) average values.</p>

**Average daily concentration of SO<sub>2</sub>**

The indicator is set as average daily concentration of SO<sub>2</sub>. Data in daily period are available, SO<sub>2</sub> can have significant health effects as exposures of less than 10 minutes lead to changes in pulmonary function and respiratory symptoms.

Benchmark (µg/m <sup>3</sup> )	<20 (24-hour)	20-50 (24-hour)	>50 (24-hour)												
Benchmark source	WHO/EU/EBRD/RoA														
Source of data	Ministry of Nature Protection (MNP); EIMC														
Value	28.8 µg/m <sup>3</sup> mean daily average over 2013-15														
Trend	Fluctuating (with relatively stable mean)														
Level of priority	<b>Moderate</b>														
Context	<p>The level of concern is moderate. The national RoA MPC limit (50 µg/m<sup>3</sup>) is higher than the current WHO target (20 µg/m<sup>3</sup>), but lower than the WHO interim target 1 used by EU regulation (125 µg/m<sup>3</sup>). The limit corresponds to the EBRD upper amber range threshold.</p> <p>There is no 1-hour or 10-minutes limit, used by EU regulation and recommended by WHO respectively.</p> <p>The evaluation was made on the basis of daily average concentration data. The daily average values have relatively stable distribution, leading to a very similar annual average value. The fluctuating year-to-year trend can be seen on the annual averages:</p> <table border="1"> <thead> <tr> <th>Year</th> <th>The average annual concentration (µg/m<sup>3</sup>)</th> </tr> </thead> <tbody> <tr> <td>2011</td> <td>27.0</td> </tr> <tr> <td>2012</td> <td>27.0</td> </tr> <tr> <td>2013</td> <td>23.0</td> </tr> <tr> <td>2014</td> <td>20.0</td> </tr> <tr> <td>2015</td> <td>29.0</td> </tr> </tbody> </table>			Year	The average annual concentration (µg/m <sup>3</sup> )	2011	27.0	2012	27.0	2013	23.0	2014	20.0	2015	29.0
Year	The average annual concentration (µg/m <sup>3</sup> )														
2011	27.0														
2012	27.0														
2013	23.0														
2014	20.0														
2015	29.0														

**Number of days exceeding the daily limit of SO<sub>2</sub>**

The indicator is set as number of days with excessive concentrations of SO<sub>2</sub>. Data in daily period are available, SO<sub>2</sub> can have significant health effects in short-term exposures.

Benchmark (days)	< 1 of 20 µg/m <sup>3</sup>	≥ 1 of 20 µg/m <sup>3</sup>	≥ 1 of 50 µg/m <sup>3</sup>
Benchmark source	WHO/EU/EBRD/RoA		
Source of data	Ministry of Nature Protection (MNP); EIMC		
Value	325 days in 2015 with concentration exceeding the WHO AQG (20 µg/m <sup>3</sup> )		
Trend	Stable		
Level of priority	<b>Moderate</b>		
Context	<p>The level of concern is moderate, although the number of days with excessive concentrations is very high, confirming the context of 2.1.3. There is no 1-hour or 10-minutes limit, used by EU regulation and recommended by WHO respectively.</p> <p>The data shows that SO<sub>2</sub> concentrations are a persistent problem in the City of Yerevan, high peak hourly values can be hidden in the daily average data. The high number of exceedances indicates that the recommended 1-hour or 10-minute measuring might shift the indicator into the red level of priority.</p>		

**Average annual concentration of NO<sub>2</sub>**

The indicator is set as average annual concentration of NO<sub>x</sub> (nitrogen dioxide, respectively). Short-term exposures to NO<sub>2</sub> concentrations at levels upwards from 200 µg/m<sup>3</sup> can lead to increased bronchial responsiveness among asthmatics.

Benchmark (µg/m <sup>3</sup> )	<40 (annual)	40-80 (annual)	>80 (annual)												
Benchmark source	WHO/EU/EBRD/RoA														
Source of data	Ministry of Nature Protection (MNP); EIMC														
Value	22 µg/m <sup>3</sup> annual average over 2013-15														
Trend	Decreasing (90% between 2011-15)														
Level of priority	<b>Low</b>														
Context	<p>The level of concern seems to be low. Nitrogen dioxide national RoA MPC daily limit (40 µg/m<sup>3</sup>) is set on the WHO/EU annual average. The EBRD green range upper limit is equal to the WHO/EU limit. That makes the RoA standard comparable. However, the methodology was amended in 2013 and since then a significant drop in NO<sub>2</sub> concentrations can be observed, and there is uncertainty in the RoA calculation methodology of NO<sub>2</sub> average levels.</p> <p>The annual data is available, so a development in terms of absolute value as well as RoA MPC (40 µg/m<sup>3</sup>) can be used.</p> <table border="1"> <thead> <tr> <th>Year</th> <th>The average annual concentration (µg/m<sup>3</sup>)</th> </tr> </thead> <tbody> <tr> <td>2011</td> <td>106.0</td> </tr> <tr> <td>2012</td> <td>104.0</td> </tr> <tr> <td>2013</td> <td>32.0</td> </tr> <tr> <td>2014</td> <td>18.0</td> </tr> <tr> <td>2015</td> <td>16.0</td> </tr> </tbody> </table>			Year	The average annual concentration (µg/m <sup>3</sup> )	2011	106.0	2012	104.0	2013	32.0	2014	18.0	2015	16.0
Year	The average annual concentration (µg/m <sup>3</sup> )														
2011	106.0														
2012	104.0														
2013	32.0														
2014	18.0														
2015	16.0														

**Number of days exceeding the hourly limit of NO<sub>2</sub>**

The indicator is set number of days with excessive concentrations of NO<sub>x</sub> (nitrogen dioxide, respectively). Hourly data are available, allowing a full comparison, however the EIMC/MNP methodology on NO<sub>x</sub>/NO<sub>2</sub> level estimation remains uncertain. Short-term exposures to NO<sub>2</sub> concentrations at levels upwards from 200 µg/m<sup>3</sup> can lead to increased bronchial responsiveness among asthmatics.

Benchmark (exceedances)	< 18 of 100 µg/m <sup>3</sup>	≥ 18 of 100 µg/m <sup>3</sup>	≥ 18 of 200 µg/m <sup>3</sup>
Benchmark source	WHO/EU/EBRD/RoA		
Source of data	Ministry of Nature Protection (MNP); EIMC		
Value	3 days in 2015 with concentration exceeding the WHO AQG 58 days in 2015 with concentration exceeding the ½ WHO AQG		
Trend	Stable		
Level of priority	<b>Moderate</b>		
Context	The level of concern is moderate. The indicator combines WHO AQG and EU Air Quality regulation standard on number of days with excessive concentrations (which covers up to 18 days), where the green range upper 1-hour average limit is set at 100 µg/m <sup>3</sup> following the same logic as the EBRD ranges used for annual limits. The trend in the concentration remained stable throughout the year (2015). There is uncertainty in the RoA calculation methodology of NO <sub>2</sub> average levels (see 2.1.5).		

### Annual CO<sub>2</sub> equivalent emissions per capita

The CO<sub>2</sub> emissions per capita are measured according to data available by Armenian authorities.

Benchmark (tons/capita)	<2 (annual)	2-5 (annual)	>5 (annual)
Benchmark source	IADB (GCAP methodology), RoA INDC		
Source of data	3 <sup>rd</sup> National Communication of the Republic of Armenia, National GHG Inventory Biennial Update Report for 2012		
Value	3.08 tons of CO <sub>2</sub> equiv. emissions per capita		
Trend	Upward (2.14 tCO <sub>2e</sub> in 2010)		
Level of priority	<b>Moderate</b>		
Context	Despite being under the INDC target level performance on GHG Emissions per capita, the major concern is not with the state indicators, but the pressure indicators affecting this level of GHG emissions, particularly – the use of fossil fuels, which are imported and have major national energy security, affordability and economic viability implications. Hence, while Armenia in general (as a non-Annex B Party to the Kyoto Protocol), and Yerevan in particular (under the INDC per capita target) has no quantitative commitment or objective to reduce the per capita GHG emissions, it does have strong commitment and ambitious state and local level targets to reduce fossil / imported energy use. For this reason, the above state indicator must remain in focus.		

### Annual CO<sub>2</sub> emissions per unit of GDP

The CO<sub>2</sub> emissions per unit of GDP are measured according to data available by Armenian authorities.

Benchmark (kg/USD of GDP)	<0.35 (annual)	0.35-0.8 (annual)	>0.8 (annual)
Benchmark source	IADB (GCAP methodology), RoA INDC		
Source of data	3rd National Communication of the Republic of Armenia, National GHG Inventory Biennial Update Report for 2012		
Value	0.94 kg per US\$ of GDP		
Trend	Upward (slowly increasing since 2010, following a drastic drop between 1990-2010)		
Level of priority	<b>High</b>		
Context	This indicator is of utmost importance as it shows the high energy content of the value added within various sectors of production and may serve as a rationale for complex energy efficiency measures. Data as of 2012 (latest RoA data available).		

**Biological Oxygen Demand (BOD) in rivers and lakes - Yerevan Lake**

This indicator BOD shows how much dissolved oxygen is needed for the decomposition of organic matter present in water.

Benchmark	< 2 mg/L	2-4 mg/L	> 4 mg/L												
Benchmark source	EEA														
Source of data	Ministry of Nature Protection; Environmental Impact Monitoring Center														
Value	<table border="1"> <thead> <tr> <th>Year</th> <th>Annual average for the Yerevan Lake (mg/L)</th> </tr> </thead> <tbody> <tr> <td>2011</td> <td>3,45</td> </tr> <tr> <td>2012</td> <td>4,22</td> </tr> <tr> <td>2013</td> <td>2,93</td> </tr> <tr> <td>2014</td> <td>4,09</td> </tr> <tr> <td>2015</td> <td>2,81</td> </tr> </tbody> </table>			Year	Annual average for the Yerevan Lake (mg/L)	2011	3,45	2012	4,22	2013	2,93	2014	4,09	2015	2,81
Year	Annual average for the Yerevan Lake (mg/L)														
2011	3,45														
2012	4,22														
2013	2,93														
2014	4,09														
2015	2,81														
Trend	Stable														
Level of priority	<b>Moderate</b>														
Context	The water body is designated for various uses, e.g. for bathing and recreation as well as for fishery. This indicator shows the surface water pollution.														

**Biological Oxygen Demand (BOD) in rivers and lakes - Hrazdan river (leaving the city)**

This indicator BOD shows how much dissolved oxygen is needed for the decomposition of organic matter present in water.

Benchmark	< 2 mg/L	2-4 mg/L	> 4 mg/L
Benchmark source	EEA		
Source of data	Ministry of Nature Protection; Environmental Impact Monitoring Center		

Value	Year	Annual average for the Hrazdan river (mg/l)
	2011	8,59
	2012	13,07
	2013	10,90
	2014	18,91
	2015	19,06
Trend	Increasing	
Level of priority	<b>High</b>	
Context	The water body is designated for various uses, e.g. for bathing and recreation as well as for fishery. This Indicator is showing rather high surface water pollution.	

<b>Ammonium (NH<sub>4</sub>) concentration in rivers and lakes - Yerevan Lake</b>			
Ammonium concentrations are normally raised as a result of organic pollution, caused by discharges from waste water treatment plants, industrial effluents and agricultural runoff.			
Benchmark	< 150 µg/L	150-200 µg/L	> 200 µg/L
Benchmark source	EEA		
Source of data	Ministry of Nature Protection; Environmental Impact Monitoring Center		
Value	Year	Annual average for the Yerevan Lake (µg/l)	
	2011	690	
	2012	1253	
	2013	781	
	2014	938	
	2015	831	
Trend	Stable		
Level of priority	<b>High</b>		
Context	The water body is designated for various uses, e.g. for bathing and recreation as well as for fishery. This Indicator is showing high organic surface water pollution.		

<b>Ammonium (NH<sub>4</sub>) concentration in rivers and lakes - Hrazdan river (leaving the city)</b>			
Ammonium concentrations are normally raised as a result of organic pollution, caused by discharges from waste water treatment plants, industrial effluents and agricultural runoff.			
Benchmark	< 150 µg/L	150-200 µg/L	> 200 µg/L
Benchmark source	EEA		
Source of data	Ministry of Nature Protection; Environmental Impact Monitoring Center		

Value	Year	Annual average for the Hrazdan river (µg /l)
	2011	10 670
	2012	21 094
	2013	28 323
	2014	27 491
	2015	24 424
Trend	Stable	
Level of priority	<b>High</b>	
Context	The water body is designated for various uses, e.g. for bathing and recreation as well as for fishery. This Indicator is showing high organic surface water pollution.	

**Percentage of water samples in a year that comply with national potable water quality standards**

The analysis is made by either an internal or external laboratory. The operation unit of the water utility keeps records of the historical results of the water samples. Usually, the figure for the water quality indicator is assessed as a monthly average.

Benchmark	< 97 %	90-97 %	< 90 %
Benchmark source	IADB's ESCI (48)		
Source of data	Yerevan Djur		
Value	100%		
Trend	Stable		
Level of priority	<b>Low</b>		
Context	During the year, there were no cases of chemical and/or bacteriological diversions recorded.		

**Number of contaminated and potentially contaminated sites**

The term "Contaminated Site" (CS) refers to a well-defined area where the presence of soil contamination has been confirmed and this presents a potential risk to humans, water, ecosystems or other receptors. Risk management measures, e.g. remediation, might be needed depending on the severity of the risk of adverse impacts to receptors under the current or planned use of the site. Sensitive areas, such as industrial zones and solid waste disposal sites, should be covered.

Potentially Contaminated Site (PCS) refers to site where unacceptable soil contamination is suspected but not verified, and detailed investigations need to be carried out to verify whether there is an unacceptable risk of adverse impacts on receptors.

Because there is neither statistical data nor databases on CSs issues and data on soil contamination are not systematically collected in Yerevan, the indicated value is an expert opinion based on data available on known contaminated sites and potential sources of contamination in Yerevan.

Benchmark	<1 CS+PCS/1,000 inh.	1-10 CSs+PCSs/1,000 inh.	>10 CSs+PCSs /1,000 inh.
Benchmark source	EEA, EC		
Source of data	Publicly available statistics and databases, earlier studies		

Value	Expert estimate: 1 - 10 contaminated sites and potentially contaminated sites per 1,000 inhabitants of Yerevan
Trend	Stable (Expert estimate)
Level of priority	<b>Moderate (P<sub>2</sub>)</b>
Context	<p>There is only a very limited number of known (identified) contaminated sites in Yerevan where soil contamination was confirmed and risk assessment proved the risk. Furthermore, statistical data or estimates on number of potentially contaminated sites in Yerevan does not exist at all. Therefore, the estimation is based on the expected order of magnitudes of waste disposal sites and industrial sites in Yerevan as these sources of contamination are most frequent in EU environment. The moderate level of priority refers to relatively short industrial tradition of Yerevan and a great population growth during the second half of the 20<sup>th</sup> century.</p> <p>Nevertheless, the potential contamination of soil and groundwater in the city is a rather forgotten issue. There is almost no inkling of extent and intensity of soil contamination spread over the city, the inventory is missing. Only the contamination with POPs (Nubarashen site) and lead is already a confirmed problem in Yerevan. CSs in Yerevan represent a great potential for their remediation, phytoremediation, revegetation, creation of currently limited green zones etc. Therefore, there should be a priority given to such sites and their inventory.</p>

**Open green space area ratio per inhabitant**

This indicator captures both the city's pollution mitigation potential as well as its friendliness towards the inhabitants through open green public and urban spaces. Green areas include parks, recreation areas and other natural areas.

Benchmark (%)	< 20	20–30	> 30
Benchmark source	Based on EEA		
Source of data	Municipality of Yerevan: Yerevan development program 2016 (Annex to the Yerevan City Council decree N 432 of December 23, 2015)		
Value	7.6 m <sup>2</sup> (2016)		
Trend	Stable		
Level of priority	<b>Moderate</b>		
Benchmark source	IADB		
Context	The green space area ratio per inhabitant is based on the area of green nurseries in Yerevan dedicated for general use (852.3 ha). The total area of green areas in Yerevan amounts to 6,758.5 ha.		

**Estimated economic damage from natural disasters (floods, droughts, earthquakes etc.) as a share of GDP**

This indicator provides information on the general natural disaster risk exposure and potential severity

Benchmark (%)	< 0.5	0.5–1	> 1
Benchmark source	OECD/ICLEI		
Source of data	World Bank		
Value	12% GDP (of Armenia)		
Trend	Stable, there is no convincing indication of decline		
Level of priority	High		
Benchmark source	OECD / ICLEI		
Context	<p>Since natural disasters occur irregularly, the data on estimated economic damage is also very approximate. Looking at past events, the disaster risks seem substantial and the indicator is well in the red area.</p> <p>Armenia is located in a seismically very active area. Historically, earthquakes have reached magnitudes of 7.1M, with billions of USD of economic losses and thousands of lives lost. The average recurrence interval of earthquakes with magnitudes of at least 5.5 is 30 to 40 years.</p>		

<b>Diversity of breeding bird community</b>			
<p>This diversity index is a quantitative measure that reflects how many different species there are in a dataset (e.g. bird community), and simultaneously takes into account how evenly the individuals are distributed among those species. The value of a diversity index increases both when the number of species increases and when evenness increases. For a given number of species, the value of a diversity index is maximized when all species are equally abundant.</p>			
Benchmark (Index)	>2.0	2.0 - 1.5	1.5 - 1.0
Benchmark source	Shannon, C.E. & Weaver, W. (1949)		
Source of data	Armenian Bird Census Council (ABCC) - TSE Towards Sustainable Ecosystems NGO		
Value	2016 - 1.1147 2015 - 1.63483 2014 - 2.67445 2013 - 2.01887		
Trend	Declining		
Level of priority	High		
Context	<p>The changes (declining trend) of bird fauna diversity are the most visible since the birds are sensitive to the structural changes of their habitats. The qualitative composition of the bird fauna changed essentially when most of the city green areas were cut down and irregular urban construction was realized. If formerly birds preferring broadleaf trees used to dominate in the forests, now species typical of semi-deserts are common there.</p> <p>The quantitative composition of bird communities has changed as well. If formerly tits dominated over redstarts in numbers, now it's quite the opposite. The reason of these changes is a fatal lack of nesting sites (tree hollows and dense bushes) for small passerine birds like tits, warblers and thrushes, due to significant decrease of city green areas (deforestation). However, small passerine birds may also suffer from grey crows (and magpies) who have</p>		

settled in the city centre. They settle in the parks and gardens, and even nest in the streets. The number of crow nests keeps on growing and today they reach hundreds, maybe even thousands. The crows greatly harm the small passerine birds by ruining their nests, eating their eggs and chicks.

## 1.2 Transport

### 1.2.1 Pressure Indicators

Average age of car fleet (total and by type)	
This indicator provides information on the weighted average age of each segment of the fleet registered in Yerevan	
Benchmark (Years)	<6 6-12 >12
Benchmark source	IADB
Source of data	Ministry of Nature Protection (2016 data)
Value	Cars: 16 years Buses: 15 years (Public transport: buses 7 years; minibuses 10.5 years; trolley buses 21 years ) Special vehicles: 19 years Trucks: 18 years Tricycles etc.: 13 years (Simple average across all types: 16 years)
Trend	n.a.
Level of priority	High
Benchmark source	IADB
Context	The indicator is based only on vehicles registered in Yerevan and does not therefore reflect the impact of cars from neighbouring regions where the weighted average age of vehicles is even higher. The statistics may include a large number of vehicles which are not actively used anymore (especially due to their technical conditions), it is however impossible to dissect that share from the overall statistics. Note that the above given figures provide a potentially optimistic view of the situation as data for all vehicles produced before 1992 were provided as a bundle and all the respective vehicles are therefore assumed to be only 25 years old. As for public transport buses, they represented about 27% <sup>1</sup> of the total and, according to the information from the Yerevan Municipality, their average age is lower than that of the total fleet.

Percentage of diesel cars in vehicle fleet, by type	
This indicator aims to capture the share of the traditional fossil fuels in transport to assess the level of pollution from this sector	
Benchmark (%)	< 20 20–30 > 30

<sup>1</sup> Based on SEAP projection for 2015

Benchmark source	Based on EEA
Source of data	Ministry of Nature Protection (2014 data)
Value	Diesel cars: 1.3% (Petrol and converted CNG cars: 98.3%) Diesel buses: 19% (Petrol and converted CNG buses: 80%) Diesel trucks: 39% (Petrol and converted CNG trucks: 61%)
Trend	Cars: Downward Buses: Downward Trucks: Downward
Level of priority	<b>High (Թ)</b>
Benchmark source	IADB
Context	<p>Passenger cars are mostly run on petrol and there has been a strong trend towards petrol-fuelled buses and trucks too.<sup>2</sup> Yerevan has also seen an important growth in natural gas-fuelled transport. Officially there are several hundreds of such cars, unofficially, based on the sales of natural gas for transport in the city, it is estimated that the number is much higher. The share of these cars is likely between 1-3%.</p> <p>It is noted that the share of diesel buses, incl. minibuses, in the public transport fleet was 22% in 2012. This share is likely much higher now as all new standard buses introduced in recent years are diesel-fuelled and also many CNG-fuelled minibuses have been replaced with diesel-fuelled ones.</p> <p>(Թ) This indicator is assessed as being of high priority due to the very high share of diesel-fuelled trucks. It is also noted that 39% of all registered trucks falls under the age group of 25 years or older. Any future measures related to this indicator should take the combination of these factors into account.</p>

Share of public transport run on fossil fuels			
This indicator provides information on the energy sources of public transport while also providing information about the shares of different public transport means. This in turn reflects both the preferences of commuters and flexibility of the different modes.			
Benchmark (%)	< 30	30–50	> 50
Benchmark source	Expert judgement		
Source of data	SUDIP PIU		
Value	Diesel/Petrol/CNG: Bus: 36.5%, Microbus: 53% Electricity: Trolleybus: 2.6%, Metro: 7.9%		
Trend	Stable		
Level of priority	<b>High</b>		
Benchmark source	Expert opinion based on Clean Fleets statistics <sup>3</sup>		
Context	Yerevan public transport model is currently heavily dependent on the use of buses, in particular minibuses. This mode is preferred due to its flexibility and		

<sup>2</sup> Due to a sudden very strong trend emerging from the available data, these need to be checked with the Ministry of nature protection again to verify that data were not just misplaced.

<sup>3</sup> Clean Fleets, Clean Buses – Experience with Fuel and technology Options (2014)

	ease of use. There is an ongoing project dealing with a new bus transport model, incl. integrated tariff and ticketing system that should also consider the inter-modality potential.
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Motorisation rate				
This indicator provides information on the private ownership of cars to primarily assess the choice of transport mode.				
Benchmark (# vehicles per capita)	<table border="1"> <tr> <td>&lt; 0.3</td> <td>0.3-0.4</td> <td>&gt; 0.4</td> </tr> </table>	< 0.3	0.3-0.4	> 0.4
< 0.3	0.3-0.4	> 0.4		
Benchmark source	IADB			
Source of data	Ministry of Nature Protection			
Value	0.17			
Trend	Upward			
Level of priority	<b>Low</b>			
Benchmark source	IADB			
Context	In Yerevan, the motorisation rate is more likely to reflect the economic situation of its inhabitants rather than their choice of transport mode. The ownership of car is considered an important sign of social status which is also reflected in the upward trend. Public transport will need to offer a high quality of service and comfort to disincentivise the move to private transport for commuting.			

Kilometres of road dedicated exclusively to public transit per 100,000 population				
This indicator reflects the level of prioritisation of public transport in the city.				
Benchmark (%)	<table border="1"> <tr> <td>&gt; 40</td> <td>10–40</td> <td>&lt; 10</td> </tr> </table>	> 40	10–40	< 10
> 40	10–40	< 10		
Benchmark source	IADB			
Source of data	Experts' estimate			
Value	0			
Trend	n.a.			
Level of priority	<b>High</b>			
Benchmark source	IADB			
Context	Yerevan does not currently make use of dedicated lanes for public transport.			

Kilometres of bicycle path per 100,000 population				
This indicator reflects the level of promotion of cycling in the city.				
Benchmark (%)	<table border="1"> <tr> <td>&gt; 25</td> <td>15–25</td> <td>&lt; 15</td> </tr> </table>	> 25	15–25	< 15
> 25	15–25	< 15		
Benchmark source	IADB			
Source of data	Experts' estimate			
Value	<15 km (less than 150 km in total)			
Trend	n.a.			
Level of priority	<b>High</b>			
Benchmark source	IADB			

Context	Yerevan has not adopted an active cycling policy yet; cyclists need to use public roads, which hampers development of cycling as a mode of transport.
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Average travel speed on primary thoroughfares during peak hour			
This indicator provides information on transport bottlenecks in the city.			
Benchmark (km/h)	> 30	15-30	< 15
Benchmark source	IADB		
Source of data	SUDIP PIU		
Value	Bus – 20.2 km/hour Microbus- 20.8 km/hour Trolleybus – 14.8 km/hour Average – 18.6 - km/hour		
Trend	Downward (decreasing average speed)		
Level of priority	<b>Moderate</b>		
Benchmark source	IADB		
Context	The above figures are not linked to any concrete transport hotspots or peak hours and relate to the average daily speed only. In comparison with the common speed limit in Yerevan (40 km/h on secondary roads, 60 km/h on main thoroughfares, and 70 km/h on urban highways) the above average speed seems low.		

Interruption of public transport systems in case of disaster			
This indicator informs about the exposure and hence sensitivity of public transport to disasters. It is a qualitative assessment of the ability of public transport systems to run efficiently during a natural disaster (flood, earthquake, storm...)			
Benchmark (km/h)	> 30	15-30	< 15
Benchmark source	IADB		
Source of data	Expert assessment		
Value	Emergency transport systems are able to run in case of disaster, but with limited efficiency		
Trend	n.a.		
Level of priority	<b>Moderate</b>		
Benchmark source	OECD / ICLEI		
Context	The ability of public transport to operate efficiently depends on the severity of the natural disaster. In case of a major disaster, transport is likely to be disrupted. In case of declaration of emergency, the public transport will be subject to instructions by the Ministry for Emergency Situations.		

## 1.2.2 Response Indicators

High-polluting vehicles are regulated / Energy-efficient vehicles are incentivised through fiscal instruments
This indicator reflects the level of regulatory activity targeting reduction of pollution from transport

Source of data	Legislative review, expert assessment
Overview of responses	Emissions standards and a requirement to have a catalytic converter on imported cars exist but are not fully and adequately implemented. While customs increase with age of a car, no fiscal instruments are offered as incentive to own and operate energy efficient vehicles.
Level of priority	<b>Moderate</b>
Benchmark source	EBRD GCAP Methodology
Context	A) Emissions standards exist but the compliance testing requirement is suspended as it was deemed ineffective. Hence there is no testing of emissions. B) Public sector offers no fiscal incentives for ownership of energy efficient vehicles, other than indirectly through import tariffs. Import tariffs increase as the age of the vehicle increases. C) Imported cars have to have catalytic converters, though after entering the country emissions testing system exists to ensure that they are functional and remain in place.

**Extension and improvement of public and non-motorised transport is planned and supported through investment in place**

This indicator reflects the level of planning activity and investment commitment to promotion of public transport

Source of data	Expert assessment
Overview of responses	Some investment in buses and upgrading metro. Starting the study phase of new bus network and integrated tariff/ticketing. No investments in enabling non-motorized investments.
Level of priority	<b>Moderate</b>
Benchmark source	EBRD GCAP Methodology
Context	A) Investment in new buses. B) Upgrading of metro power supply equipment and passenger cabins. C) Newly initiated “New Bus Network and Integrated Tariff and Ticketing System for Yerevan” plan and implementation (anticipated completion date of mid 2017). D) Several strategy documents highlight the key role of public transport but lack detailed analysis of size of investments needed for a size of impact expected.

**Public and non-motorised transport is promoted through Information and awareness campaigns**

This indicator reflects the level of commitment to promotion of public and non-motorised transport

Source of data	Expert assessment
Overview of responses	No campaigns exist
Level of priority	<b>High</b>
Benchmark source	EBRD GCAP Methodology
Context	There has been no promotion of public or non-motorised transport in the last decade. There was an attempt to have GPS-enabled electronic schedules bus stations. Some of these electronic boards were installed but were not ever seriously functional.

**Traffic demand is managed (congestion charges, smart technologies)**

This indicator reflects the level of regulatory and operational management activity targeting reduction of pollution from transport as well as promotion of public transport and alternative fuels	
Source of data	Expert assessment
Overview of responses	No such solutions are implemented
Level of priority	<b>High</b>
Benchmark source	EBRD GCAP Methodology
Context	There is increasing digital monitoring of vehicular traffic in Yerevan streets, esp. In the City Centre. This system, however, is primarily for identifying and citing moving and parking violations. It is not designed to assist the management of traffic demand.

Parking space is managed / Incentives for effective use of parking space are in place	
This indicator reflects the level of regulatory and operational management activity targeting reduction of pollution from transport as well as promotion of public transport and alternative fuels	
Source of data	Expert assessment
Overview of responses	High traffic parts of the City Centre have designated and monitored areas for street parking. Their pricing, however, is not used to regulate driving behaviour.
Level of priority	<b>Moderate</b>
Benchmark source	EBRD GCAP Methodology
Context	For the past 2-3 years, street parking at the City Centre is possible in designated areas and with pay. Violators are fined very effectively. Payment options are not too varied. A, relatively low, 12,000 AMD annual flat fee allows unlimited parking in designated areas throughout the city.

Public transport emergency management (in publicly and/or privately run networks) is planned and tested	
This indicator reflects the level of regulatory and operational management preparedness to deal with emergency situations	
Source of data	Municipality of Yerevan
Overview of responses	Public transport emergency management is planned and tested by the Ministry for Emergency Situations.
Level of priority	<b>Low</b>
Benchmark source	EBRD GCAP Methodology
Context	Emergency situations are managed by the Ministry for Emergency Situations that is responsible for all necessary planning and coordination.

### 1.3 Buildings and energy

#### 1.3.1 Pressure Indicators - Buildings

Electricity consumption in residential buildings	
This indicator provides information on the energy intensity of electricity consumption in residential building	

Benchmark (kWh / m2)	< 21	21 – 26	> 26
Benchmark source	IEA EEE Market Report 2015, Odyssee-Mure database. CISBE Guides 17, 72, 286.		
Source of data	Expert Calculation based on official electricity consumption and residential housing space reported by National Statistical Service <sup>4</sup>		
Value	36.2 kWh/m2		
Trend	Stable		
Level of priority	<b>High</b>		
Context	UNDP Green Urban Lighting Project surveys for Armenian urban communities indicate still a very large share of incandescent light bulbs as well as a remaining share of electric heating, which leads to high electricity use.		

<b>Electricity consumption in public buildings</b>			
This indicator provides information on the energy intensity of electricity consumption in non-residential building. The actual average value is 23.4kWh/m2, which however is a result of a low lighting comfort level, reduced areas supplied with lighting, all aimed at cost minimization. To account for reduced comfort, the value was corrected for 100% lighting comfort.			
Benchmark (kWh / m2)	< 122	122 – 213	> 213
Benchmark source	IEA EEE Market Report 2015, Odyssee-Mure database. CISBE Guides 17, 72, 286.		
Source of data	Calculated based on average indicators for 120 public buildings under Yerevan Municipality's jurisdiction		
Value	46.8 kWh/m2, corrected for comfort		
Trend	Stable		
Level of priority	<b>Moderate (P) – excessively low, due to undersupply, low purchasing power and low comfort in the buildings)</b>		
Context	The public buildings predominantly use electricity for lighting purposes, in addition to small office equipment and other appliances. In most cases the buildings are not equipped with air conditioning, and also deliver below comfort-level quality of lighting to keep the electricity bills manageable. The low electricity consumption per m2 is favourable for climate change mitigation but speaks about low comfort and underserved demand.		

<b>Heating / cooling consumption in residential buildings, fossil fuels</b>			
This indicator provides information on the energy intensity of heating/cooling using fossil fuels in residential buildings. Value is corrected for reduced comfort. Most residential buildings are heat up to 60-80% of normal thermal comfort levels, heated space and hours of heating.			
Benchmark (kWh / m2)	< 96	96 – 126	> 126
Benchmark source	IEA, Odyssee, CIBSE		

<sup>4</sup> Armenia's Population consumed 1.876 TWh in 2015. ARMSTAT reports average housing per capita is 22.5 m2 for Yerevan dwellers. For 1,071,500 population of Yerevan this amounts to 24,108,750 m2 total residential space. According to SEAP, 873 GWh total electricity was consumed by population in 2012. The indicator received by formula is 873 GWh/24.1 mil m2.

Source of data	Typical residential building pilot project audits UNDP Improving EE in Buildings Project
Value	174 kWh/m <sup>2</sup> , normalized for comfort
Trend	Stable
Level of priority	<b>High</b>
Context	Yerevan hosts approximately 4.5 thousand prefabricated panel residential buildings which lack any kind of insulation and impose not only a major energy intensity on the residential building sector but also create a major affordability and comfort concern for the residents.

Heating / cooling consumption in non-residential buildings, fossil fuels			
This indicator provides information on the energy intensity of heating using fossil fuels in non-residential buildings. Value is corrected for reduced comfort. Most public buildings are heat up to 50-60% of normal thermal comfort levels, heated space and hours of heating.			
Benchmark (kWh / m <sup>2</sup> )	< 127	127 – 210	> 210
Benchmark source	National benchmark: <60 Green; 61-95 Amber; >96 Red, which would account for underheating (by temperature, area heated and hours of heating) 96 Red cut-point proposed by experts based on R2E2 – Armenia EE retrofitting program for public buildings; the EIB/GCF Yerevan EE in Buildings Project Assessments. The GCAP methodology has substantially higher benchmarks which are reasonable for countries with commonly cooled public buildings, which is not the case in Yerevan.		
Source of data	Average 2013 specific energy consumption of gas for heating purposes for 160 public buildings		
Value	284 kWh/m <sup>2</sup> (adjusted for 50% comfort levels)		
Trend	Stable		
Level of priority	<b>High</b>		
Context	Public buildings in Yerevan have a common spread from very low to very high energy consumption for heating purposes only. Commonly, the hundreds of kindergartens, schools, cultural and athletic centres, polyclinic buildings are not equipped with cooling or ventilation systems. Thus, while the specific energy consumption may seem low compared to the indicators proposed by GCAP methodology, the reason for such low level of consumption is the lack of cooling technology in place and comfort levels often below 50%.		

### 1.3.2 Response Indicators: Buildings

Energy efficiency in buildings is promoted through standards (Electricity and heat consumption)	
Source of data	National Legislation, State Committee on Urban Development (mud.am)
Overview of responses	“Thermal Protection of Buildings” HSHN 24-01-2016 which was developed based on the Russian code from 2003 (updated in 2012) as well as EU codes and methodologies. Very recently, the implementation lags behind as capacity building and institutional strengthening elements are underfunded.

Trend	Initializing, slow progress expected
Level of priority	<b>Moderate</b>
Benchmark source	EEA (EBRD GCAP methodology)
Context	While the GCAP methodology and benchmark indicate the current energy mix supplying Yerevan with RES as moderately satisfactory, in the light of Armenia's national energy security, the RES development could be stronger in line with the respective high national priority.

Public and private investment in energy efficiency in buildings (Electricity and heat consumption)

Source of data	National Legislation, State Committee on Urban Development (mud.am)
Overview of responses	Government decree (Decree No 1504 from 25 December 2014 on Mandatory EE Provisions in Public procurement in building (re)construction) and the May 2016 amendment to the ESRE Law on mandatory compliance with EE requirements in state investment projects and residential construction has no provisions for enforcement
Trend	Initializing, slow progress expected
Level of priority	<b>Moderate</b>
Benchmark source	EEA (EBRD GCAP methodology)
Context	The legal provisions made the energy efficiency requirement a mandatory element in all investment programmes targeting public sector, including the IFI loans, along with mandatory seismic reinforcement.

Metering and billing for personal energy use is regulated (Electricity and heat consumption)

Source of data	National Legislation, State Committee on Urban Development (mud.am)
Overview of responses	Billing is 100%-based on actual consumption. Smart metering has not been implemented
Trend	Stable
Level of priority	<b>Low</b>
Benchmark source	EBRD GCAP methodology
Context	The electricity and gas (heat) billing is consumption-based on the level of each individual consumer/household, pricing is market-based, there is a possibility to disconnect. Electric meters have been partially replaced to digital allowing for application of dual tariff (night and day tariffs vary by 25%).

### 1.3.3 Pressure Indicators: Energy

Share of population with an authorised connection to electricity

Benchmark (%)	> 90	70–90	< 70
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Benchmark source	IADB
Source of data	Armenian electric networks
Value	91.2%
Trend	Stable
Level of priority	<b>Low</b>
Context	Since Armenia has a fully integrated system, the data for Yerevan is the same as shown by the nationwide energy mix. Armenia has had a high level of electrification since Soviet years. The connection may even be at a higher rate, however, there seems to be unauthorized access to the grid, which is being dealt with. In addition, the Electric Networks continuously connects new subscribers to keep up to speed with the urban development.

Share of population with access to heating

Benchmark (km/h)	> 90	70–90	< 70
Benchmark source	OECD/ICLEI		
Source of data	Armenian electric networks, RusGas		
Value	100%		
Trend	Stable		
Level of priority	<b>Low</b>		
Context	Since there is almost no central heating, being "connected" to heating means being connected to electric or gas distribution networks. Every consumer has access to at least one of the utility networks for heating. Nonetheless, "access" does not guarantee using these services for heating. Surveys indicate (EDRC) that with the growing prices for natural gas, there has been a registered switch back to firewood use from registered natural gas subscribers.		

Proportion of total energy derived from RES as a share of total city energy consumption (in TJ; compared to benchmark of 20% (links to EU target))

Benchmark (%)	> 20	10–20	< 10
Benchmark source	EEA (EBRD GCAP methodology)		
Source of data	PSRC		
Value	7%		
Trend	Increasing, projected to grow by 50% by 2019		
Level of priority	<b>Low</b>		
Context	If excluding the large scale hydro, which is considered non-renewable, the share of small hydro and other renewables in the energy mix is 7%, comprised of small hydro to large extent, and small capacities of wind and solar systems.		

Average duration of disruption of electricity supply per consumer per year in case of force majeure

Measured by Public Services Regulatory Commission (PSRC) - Frequency of power outages (disconnections) per customer measured as "System Average Interruption Frequency Index (SAIFI)"	
Benchmark (km/h)	< 3      3-5      >5
Benchmark source	PSRC
Source of data	PSRC
Value	3.5 hours/consumer. This is the total disconnections, the level for disruption under force majeure is <b>0.27</b> . Minimal threshold <3, average = [3;5]
Trend	Stable
Level of priority	<b>Low</b>
Context	The indicator for force majeure disruptions is low, however there is a relatively high level of disruptions due to other technical reasons. Nonetheless, these are beyond the city authorities' jurisdiction.

Total duration of voltage deviation from set quality norms	
	<438      439-1000      >1000
Benchmark source	PSRC
Source of data	PSRC
Value	2,148 hours/consumer per year
Trend	Stable
Level of priority	<b>High</b>
Context	While the GCAP methodology does not consider this indicator, the figure (2,148 hours) represents 25% of the total hours in a year and speaks about a gross failure of the electricity supplier to ensure service quality. While for the buildings sector it may have impact on household electric appliances, for industry – it can affect the quality of output duration of industrial processes and safety of equipment. In heating sector this voltage variability results in need for additional voltage regulation equipment resulting in additional costs.

### 1.3.4 Response Indicators: Energy

Coverage and quality of electricity and heat supply is improved through investment (Electricity and heat provision)	
Source of data	National Legislation, IFI Green credit lines
Overview of responses	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake.
Trend	Initializing, progress expected
Level of priority	<b>Moderate</b>
Benchmark source	EBRD GCAP methodology

Context	While coverage of electricity is improving, the quality still remains an issue. As to the quality of heat provision, the efforts to rehabilitate district heating in Yerevan only succeeded in 36 buildings. The remainder of the market is covered by individual heating solutions which are elaborated and efficient only to the extent of technologies' affordability to individual consumers.
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Renewable energy facilities in private buildings are incentivised through fiscal instruments (Renewable energy development)

Source of data	National Legislation, IFI Green credit lines
Overview of responses	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake.
Trend	Initializing, progress expected
Level of priority	<b>Moderate</b>
Benchmark source	EBRD GCAP methodology
Context	Net metering legislation adopted incentivizing solar panels for autonomous electricity producers with capacity under 150 kW. Feed-in tariff established for solar PV for under 1 MW electricity producers. Several IFI green credit lines offer grant co-financing for EE & RES investments (10-20% grant for qualifying investment loans) and leasing on below-market terms. More support is necessary to push the market and enhance the private investments in this direction, including public sector taking the lead, private sector receiving more affordable financing, etc. The Yerevan SEAP includes measures for RES promotion and residential buildings.

Renewable energy technologies are developed and supported through public and private investment (Renewable energy development)

Source of data	National Legislation, IFI Green credit lines
Overview of responses	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake.
Trend	Initializing, progress expected
Level of priority	<b>Moderate</b>
Benchmark source	EBRD GCAP methodology
Context	Net metering legislation adopted incentivizing solar panels for autonomous electricity producers with capacity under 150 kW. Feed-in tariff established for solar PV for under 1 MW electricity producers (comparable to wind energy feed-in tariff). Several IFI green credit lines offer grant co-financing for EE & RES investments (10-20% grant for qualifying investment loans) and leasing on below-market terms. More support is necessary to push the market and enhance the private investments in this direction, including public sector taking the lead, private sector receiving more affordable financing, etc.

	The Yerevan SEAP includes measures for RES promotion and residential buildings, particularly use of SWHs on public buildings, and solar PV for common-space lighting. National legislation also promotes small HPPs.
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Renewable energy facilities are incentivised through awareness campaigns (Renewable energy development)	
Source of data	National Legislation, IFI Green credit lines
Overview of responses	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake.
Trend	Initializing, progress expected
Level of priority	<b>High</b>
Benchmark source	GCAP methodology
Context	The awareness measures so far have been insufficient. SEAP envisions sustainable energy days and Energy Bus campaigns. Funding and resources have not been provided for their implementation however.

The resilience of electricity networks in case of disaster is tested and enhanced through investment	
Source of data	National Legislation, National Energy Security Concept, 2013
Overview of responses	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake:
Trend	Initializing, progress expected
Level of priority	<b>High</b>
Benchmark source	GCAP methodology
Context	National energy security threats, expected internally, include the natural disaster, among others however, the specific steps and actions aimed at the enhancement of the energy system resilience are lagging.

## 1.4 Street lighting

### 1.4.1 Pressure Indicators

Percentage of total streets lit			
This indicator provides information on the share of underserved streets, which are largely in the private housing sector on the city suburbs			
Benchmark (%)	>85	70-85	<70
Benchmark source	TRoACE/ESMAP		
Source of data	Yerevan Illumination Company YerQaghLuys		
Value	97% [threshold for best performing cities of the world >85%		
Trend	Stable		

Level of priority	<b>Low</b>
Context	Despite a high indicator, it is important to gradually bring external lighting to all parts of the city

<b>Electricity consumption per kilometre of lit road</b>			
This indicator provides information on the energy intensity of electricity consumption in external lighting networks in parts where lighting service is available.			
Benchmark (kWh/km)	<20000	20000-30000	>30000
Benchmark source	TRoACE/ESMAP		
Source of data	Calculated based on data provided by YerQaghLuys		
Value	46,542 kWh/km, [the upper threshold = 30,000 kWh/km]		
Trend	Stable		
Level of priority	<b>High</b>		
Context	The energy intensity per km of lit road is high due to still large share of compact sodium bulbs, as well as high lighting quality, whereby all streets are to a minimum performance standard		

<b>Electricity consumed per light pole</b>			
This indicator provides information on the energy intensity of electricity consumption in external lighting networks in parts where lighting service is available measured based on individual luminary performance.			
Benchmark (kWh/pole/year)	<250	250-550	>550
Benchmark source	TRoACE/ESMAP		
Source of data	YerQaghLuys		
Value	537 kWh/lighting pole/year [upper threshold =126kWh/m2]		
Trend	Stable		
Level of priority	<b>Moderate</b>		
Context	The city external lighting system holds 65149 poles which consume over 35 million kWh electricity per year		

## 1.4.2 Response Indicators

<b>Public investments in public street lighting / external illumination</b>	
Source of data	National Legislation, State Committee on Urban Development (mud.am)
Overview of responses	The UNDP and E5P, as well as the EBRD loan resources are used to improve the efficiency of Yerevan street lighting, however, more efforts are needed and the lighting network needs to be expanded until 100% of all roads are supplied with lighting.
Trend	Initializing, slow progress expected
Level of priority	<b>Moderate</b>

Benchmark source	GCAP
Context	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake. Recommend to seek PPP solutions to enhance the investment.

## 1.5 Industry

### 1.5.1 Pressure Indicators

Electricity consumption in industries, per unit of industrial GDP			
This indicator provides information on the energy efficiency of industry in terms of electricity.			
Benchmark (kWh/2010 USD)	< 0.3	0.3 - 0.4	> 0.4
Benchmark source	OECD/ICLEI		
Source of data	Electric Networks of Armenia, interpolated from national data		
Value	0.29 kWh/2010 USD		
Trend	n/a		
Level of priority	Low		
Context	The indicator is low predominantly due to absence of heavy and energy intensive industries throughout Yerevan.		

Heat consumption in industries, per unit of industrial GDP			
This indicator provides information on the energy efficiency of industry in terms of heat.			
Benchmark (kJ/2010 USD)	< 0.1	0.1 – 0.25	> 0.25
Benchmark source	OECD/ICLEI		
Source of data	RusGas, National Statistical Service		
Value	12.26 kJ / 2014 USD [the upper threshold = 0.25 KJ/2010 USD]		
Trend	Stable		
Level of priority	High		
Context	The analysis of gas consumption in the industrial sector by months indicated, that the level of consumption goes up by 78% during the heating season. This indicates the energy consumption for heating, which has very low efficiency. The remaining gas consumption is reported in fossil fuel combustion for industrial processes.		

Heavy metals emission intensity of manufacturing industries			
This indicator aims to capture the pollution intensity of manufacturing industries in terms of heavy metals while relating it to the economic growth to show the level coupling.			
Benchmark (kg of heavy metals equivalent released)	< 0.02	0.02-0.04	> 0.04

per million USD GVA)	
Benchmark source	EEA (EBRD GCAP methodology)
Source of data	ArmEco Monitoring Center
Value	2.91 kg of heavy metals equivalent released per million USD GVA
Trend	Stable
Level of priority	<b>High</b>
Context	The heavy metal emission is high but the data analysis indicates that this may be related to the presence of mining and metallurgy in Yerevan area, rather than fuel use. The reported heavy metal emissions were insignificant for all metals and consistently high for molybdenum.

**Fossil fuel combustion in industrial processes, per unit of industrial GDP**

This indicator measures the fossil fuel use productivity of industries.

Benchmark (MJ/USD)	< 1.4	1.4 – 2.2	> 2.2
Benchmark source	OECD/ICLEI		
Source of data	RusGas, National Statistical Service		
Value	3.46 MJ / USD		
Trend	Stable		
Level of priority	<b>High</b>		
Context	In addition to the low electricity use in industry, the only other significant energy source is natural gas, 22 % of which is used within this sector for industrial purposes. Despite the absence of major heavy industry in Yerevan, the energy intensity based on 2014 GDP (\$) still exceeds the upper benchmark (2.2 MJ/USD).		

**Share of industrial energy consumption from renewable energy**

This indicator measures the greening of the industry in terms of energy consumption.

Benchmark (%)	> 20	10–20	< 10
Benchmark source	OECD/ICLEI		
Source of data	National Statistical Service		
Value	< 1%		
Trend	Stable		
Level of priority	<b>High</b>		
Context	The share of RES utilization is low in industrial sector and nearly none have been witnessed within any energy audits or sector evaluations by experts, with rare exceptions of minor use of solar water heating in SMEs, which is not a noticeable scale, and certainly no sufficient to pass the minimal threshold of 10%.		

**Share of industrial waste recycled as a share of total industrial waste produced**

Recycling means any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.

Because data on recycling of any waste in Armenia are not available, the data on waste used were accepted for the purpose of indicator rating. It is understood that waste recycling is a subgroup of waste use.

Benchmark (%)	> 95% (90%)	80 – 95% (90%)	< 80%
Benchmark source	OECD/ICLEI		
Source of data	National statistical service of the Republic of Armenia		
Value	~ 5 % (Expert estimate)		
Trend	Variable		
Level of priority	High		
Context	The timeline data on waste used by organizations for Armenia were available. In the scale of whole Armenia the share of industrial waste used as a share of total industrial waste produced is even lower, less than 1 %, according to national statistical data.		

### 1.5.2 Response Indicators: Industry

Energy efficient industrial machinery is regulated and incentivised through fiscal instruments (electricity, heat, industrial processes)

This indicator assesses whether there are any regulatory measures in place that incentivise energy efficiency in industrial processes in terms of electricity consumption.

Source of data	National Legislation
Overview of responses	Not Existing
Trend	Stable
Level of priority	High
Benchmark source	EBRD GCAP methodology
Context	There are no fiscal instruments targeted at energy efficient industrial machinery

Energy efficient industrial technologies (electricity, heat, industrial processes) is supported through private investment

This indicator assesses whether there are any regulatory measures in place that incentivise energy efficiency in industrial processes in terms of heat consumption.

Source of data	National Legislation, IFI Green credit lines
Overview of responses	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake
Trend	Initializing, progress expected
Level of priority	Low
Benchmark source	EBRD GCAP methodology

Context	There are a number of green credit lines that lend at relatively favourable terms (compared to average market rates) for energy efficiency investments in MSMEs and large industries, including the EBRD Energocredit, the IFC SEF, KfW MSME EE credit line, the Green for Growth Fund, etc. The lending has been reported by IFIs as slow and limited compared to the available financial resource capacity. Many barriers remain, such as the low awareness of entrepreneurs, low borrowing capacity (debt to asset ratio), lending terms too high for energy efficiency investments, etc.
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**Material efficiency of newly built industrial facilities and waste recycling is regulated and incentivized through fiscal instruments**

The indicator assesses whether there are any policies or programmes in place to encourage industrial waste reduction and recycling, such as penalties for low rates of recycling by industry, mandatory recycling rates, or subsidies for material efficient technologies and recycling facilities.

Source of data	Previous expert studies and local expert knowledge
Overview of responses	There are no such instruments in use today
Trend	The situation is not clear. One positive trend that may have indirect impact on the development of such instruments is the new sanitary landfill and sorting of MSW that Yerevan expects to initiate soon. International tenders and commencement of construction for these is slated for 2017.
Level of priority	<b>High</b>
Benchmark source	EBRD GCAP Methodology, expert knowledge of local and international best practice
Context	The RoA Law on Waste (2004) states that there shall be economic incentives, providing privileges to those enterprises that recycle and utilize waste. There are, however, no specific mechanisms or regulations developed to offer and deliver these incentives. There are a few companies in Armenia, many located in Yerevan, that are using MSW fractions, mainly plastics, as input for their products and operations. This is occurring in the absence of incentives and may increase if proper incentives are introduced.

**Industrial wastewater treatment / reuse / recycle is promoted through regulations and fiscal incentives**

This indicator assesses whether there are any regulatory measures in place that incentivise an environmentally friendly treatment of wastewater.

Source of data	National Legislation
Overview of responses	None existent
Trend	Stable
Level of priority	<b>High</b>
Benchmark source	GCAP methodology
Context	Not addressed within national legislation

## 1.6 Water

### 1.6.1 Pressure Indicators

Water consumption per capita			
This indicator is generally obtained using billing records that indicate the number of cubic meters measured in a given period. This amount of water is then divided by the total population associated with the households included in the billed figures.			
Benchmark	120-200 L / day / capita	80-120 or 200-250 L / day / capita	< 80; >250 L / day / capita
Benchmark source	IADB		
Source of data	Yerevan Djur		
Value	122 l/day/capita		
Trend	Stable		
Level of priority	Low		
Context	This Indicator is important due to the overall Water Balance Data and demand management policy in a water supply authority.		

Industrial water consumption as percent of total urban water consumption			
Flagged if industrial water consumption represents a larger portion of total urban water consumption than international norms. Industrial water consumption marked as 'green' may still have water efficiency challenges, but total water consumption does not represent a burden on municipal water resources beyond international norms.			
Benchmark	< 17 %	17-50 %	> 50 %
Benchmark source	EBRD		
Source of data	Yerevan Djur		
Value	37%		
Trend	It may change		
Level of priority	Moderate		
Context	The value of 37% describes non-household water use, e.g., industry, offices, recreational areas etc. Hence, the industrial water consumption alone would be lower.		

Non-revenue water			
Percentage of water that is lost from the treated water entering the distribution system and that is unaccounted for and not directly billed by the water provider. This includes actual water losses (e.g., leaking pipes) and billing losses (e.g. broken water meters, absence of water meters, and illegal connections). It should be calculated as the ratio of water production out of actual water consumption.			
Benchmark	< 0-30%	30-45 %	> 45 %
Benchmark source	IADB		
Source of data	Yerevan Djur		
Value	73.2%		
Trend	Stable		
Level of priority	High		

Context	<p>Although this Indicator is calculated for the territory serviced by Yerevan Djur and there is no separate monitoring for the Yerevan city area it may be assumed to be nearly the same.</p> <p>This must be a long-standing and strategic task to decrease the Non-revenue water.</p>
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Annual average of daily number of hours of continuous water supply per household				
Benchmark	<table border="1"> <tr> <td>&gt; 20 h/day</td> <td>12-20 h/day</td> <td>&lt; 12 h/day</td> </tr> </table>	> 20 h/day	12-20 h/day	< 12 h/day
> 20 h/day	12-20 h/day	< 12 h/day		
Benchmark source	IADB			
Source of data	Yerevan Djur			
Value	23,4 h/day			
Trend	Stable			
Level of priority	<b>Moderate</b>			
Context	<p>This Indicator represents a priority for the Municipality as well as Yerevan Djur. This is also highlighted in the Annual Reports.</p> <p>The national regulatory framework requires that &gt;85% of households should have 24h water supply. Currently, &gt;85% of households have supply of water 23.4 hours/day on average. The rest of households has more than 17h water supply. That is the reason why is the level of priority evaluated as moderate.</p>			

Percentage of residential and commercial wastewater that is treated according to applicable national standards				
Benchmark	<table border="1"> <tr> <td>&gt; 60 %</td> <td>40-60 %</td> <td>&lt; 40</td> </tr> </table>	> 60 %	40-60 %	< 40
> 60 %	40-60 %	< 40		
Benchmark source	IADB			
Source of data	Yerevan Djur, Environmental Impact Monitoring Center			
Value	0 %			
Trend	Stable			
Level of priority	<b>High</b>			
Context	<p>Only minor part of city wastewaters is treated. Due to insufficient treatment technology at waste water treatment plant, the quality of treated wastewater doesn't comply with the current water use permit. Poor quality of treated wastewater has negative impact on quality of water in Hrazdan river.</p>			

Percentage of dwellings damaged by the most intense flooding in the last 10 years				
Percentage of dwellings that were affected in terms of assets and health.				
Benchmark	<table border="1"> <tr> <td>&lt; 0,5 %</td> <td>0,5-3 %</td> <td>&gt; 3</td> </tr> </table>	< 0,5 %	0,5-3 %	> 3
< 0,5 %	0,5-3 %	> 3		
Benchmark source	IADB			
Source of data	Yerevan Djur, Municipality			
Value	0,5-3 % (expert estimate)			
Trend	Stable			
Level of priority	<b>Moderate</b>			

Context	No flooding caused by high flow in Hrazdan river has occurred in last 10 years. Based on available information, the flooding occurred only during a heavy rains which was mainly caused by insufficient collecting of rainwaters. The rainwater can't drain fast enough and consequently, the streets are flooded.
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## 1.6.2 Response Indicators

<b>Metering and billing for water use is regulated</b>	
Benchmark source	EBRD GCAP Methodology
Source of data	Yerevan Djur
Value	Not all of subscribers have installed a water meter. Moreover, an unauthorized connections have been observed.
Level of priority	<b>Moderate</b>
Context	Yerevan Djur provides drinking water not only for Yerevan city but also for approximately 30 villages around it. Considering the high level of priority identified for non-revenue water, the current framework may need to be reconsidered to bring about improvement in water billing and network operation.

<b>Water saving / reuse is encouraged through awareness campaigns</b>	
Benchmark source	EBRD GCAP Methodology
Source of data	Yerevan Djur, Municipality
Value	Several awareness campaigns by Yerevan Djur have been organized.
Level of priority	<b>Moderate</b>
Context	Despite the awareness campaigns there has still been observed water usage inefficiency (e.g. an inefficient watering of urban green spaces).

<b>Coverage and efficiency of water supply networks is improved through plans and investment</b>	
Coverage is controlled by the Yerevan Municipality and efficiency under the responsibility of Yerevan Djur.	
Benchmark source	EBRD GCAP Methodology
Source of data	Yerevan Djur and Yerevan Municipality
Value	Partial renewal of water supply network has been done. Plans were established by Yerevan Djur and Municipality. Investments from Yerevan Djur, World Bank and Developing Countries Relief Fund loans.
Level of priority	<b>Moderate</b>
Context	According to the contract between Yerevan Municipality and Yerevan Djur there was a plan for an AMD 10 million investment. AMD 16.5 million have already been invested, which is more than required by contract. Despite of the

	<p>investments, there is still a need for further extensive investments, mainly to improve overall efficiency of water supply network.</p> <p>From 2017, a new contract with the same company will be signed and new investments should be discussed.</p>
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### Buildings' access to wastewater collection and treatment systems is improved through plans and investment

Benchmark source	EBRD GCAP Methodology
Source of data	Yerevan Djur and Yerevan Municipality
Value	Plans by Yerevan Djur and Municipality. Investments from Yerevan Djur, World Bank and Developing Countries Relief Fund loans.
Level of priority	<b>Low</b>
Context	<p>"Yerevan city development plan 2014-2017" describes that there are plans for the improvement of "Aeratsia" wastewater treatment plant in 2 stages: A) short term: to recover the mechanical cleaning system and sludge treatment to temporarily satisfy the nature protection norms, and B) long term: to implement biological and chemical treatment units to satisfy international norms of wastewater treatment. For the 2014-2017 only the first stage was planned to be implemented, in total EUR 10.27 million investment. EUR 1.83 million investment to rehabilitate the main sewerage systems was planned too.</p>

### Wastewater treatment is promoted through regulations and fiscal incentives

Benchmark source	EBRD GCAP Methodology
Source of data	Yerevan Djur and Yerevan Municipality
Value	Several plan has been realized but there is still a need to improve current insufficient system of the wastewater treatment.
Level of priority	<b>High</b>
Context	<p>"Yerevan city development plan 2014-2017" describes that there are plans for the improvement of "Aeratsia" wastewater treatment plant in 2 stages: A) short term: to recover the mechanical cleaning system and sludge treatment to temporarily satisfy the nature protection norms, and B) long term: to implement biological and chemical treatment units to satisfy international norms of wastewater treatment.</p> <p>First stage has been realized but there is still a need to improve current insufficient system of the wastewater treatment to comply with national standards.</p>

### Wastewater billing is regulated

Benchmark source	EBRD GCAP Methodology
Source of data	Yerevan Djur
Value	Payment for wastewater collection is part of the water tariff.

Level of priority	<b>Moderate</b>
Context	It's supposed that amount of collected wastewater is the same as water consumption. Improvements in metering of water consumption will have to be done.

<b>Drinking water pre-treatment is enhanced through plans and investment</b>	
Benchmark source	EBRD GCAP Methodology
Source of data	Yerevan Djur
Value	Extensive efforts by Yerevan Djur
Level of priority	<b>Low</b>
Context	In Yerevan Djur, water is mainly received from mountainous sources that completely correspond to the Drinking Water Sanitary Norms and Rules applicable in the Republic of Armenia, and is supplied to the customers without additional treatment. However, for safety and preventive purposes, the water is chlorinated by chlorination stations ensuring availability of 0.3-0.5 mg/dm <sup>3</sup> residual chlorine in water.

<b>Drainage facilities are developed through plans and investment</b>	
Basic improvement and development of drainage facilities is under the control of Yerevan Municipality.	
Benchmark source	EBRD GCAP Methodology
Source of data	Yerevan Djur and Yerevan Municipality
Value	Drainage facilities are being built and developed for the new neighbourhoods lacking these facilities. Basic improvement and development is under the control of Yerevan Municipality.
Level of priority	<b>High</b>
Context	Basic improvement and development is identified in the "Four-year Yerevan Development Plan 2014-2017". The plan foresees to recover 4,150 m (150-400 mm diameter) drainage collectors during the 4-year period. Moreover, a mandatory fundamental cleaning programme for drainage systems each year is established with additional maintenance whenever needed. From the expert point of view, an overall concept of development and renewal of drainage system is lacking. Technical condition of the system is almost unknown because there is no comprehensive information on the system as a whole. Establishing of proper development and renewal plan is considered as high priority.

<b>Business and community resilience is encouraged through awareness campaigns</b>	
Benchmark source	EBRD GCAP Methodology
Source of data	Yerevan Municipality

Value	Existing through Ministry of Emergency Situations.
Level of priority	<b>Low</b>
Context	

## 1.7 Waste

### 1.7.1 Pressure Indicators

Total solid waste generation per capita			
Data on the Municipal solid waste generation per capita were searched in format: kg/person/year. The primary records on waste generation refer to its volume. The 0.25 factor is used for the conversion from volume to weight. It is expected that together with household waste also commercial waste and street sweepings are collected and reported to official statistics.			
Benchmark	<300	300-500	>500
Benchmark source	OECD/ICLEI		
Source of data	Calculations based on data of the National statistical service of the Republic of Armenia		
Value	300 – 340 kg/person/year (Expert estimate)		
Trend	Variable		
Level of priority	<b>Moderate</b>		
Context	It is assumed that the data on MSW production are reported by authorized organizations for waste collection. There is no weighing machinery to verify the amount of waste disposed of in dumpsites serving Yerevan. The amount of waste disposed is only estimated for the purpose of official reporting, based on the expected number of vehicles and the capacity of vehicles. Calculated figure of waste generation is in good compliance with the figure used in National GHG Inventory (340 kg/person/y).		

Share of the population with regular municipal solid waste collection			
The study of local conditions of the waste collection system revealed that weekly collection of waste in Yerevan would lead to poor results. The waste collection system in Yerevan is set for more frequent (every day or every other day) collection of waste to achieve satisfactory results. Therefore, the collection of data focused on the share of population with regular MSW collection.			
Benchmark	90-100 %	80-90 %	<80 %
Benchmark source	IADB		
Source of data	Consultants' calculations based on data of the National statistical service of the Republic of Armenia		
Value	>95% (Expert estimate)		
Trend	Upward (Expert estimate)		
Level of priority	<b>Low</b>		

Context	Simple extrapolation of the last statistical data available would lead to rough assumption of about 85 – 90% of population of Yerevan covered with regular MSW collection.							
	MSW	2008	2009	2010	2011	2012	2013	2014
	Collected (%)	57,97	64,74	78,72	84,9	80,38	83,33	84,68
	Considering that since 2015 the new integrated waste collection system in Yerevan has been implemented, the continuous increasing trend of MSW collection system is expected to be even intensified. The MSW collection system providing company refers to 100% coverage.							

<b>Proportion of MSW that is sorted and recycled (total and according to the type of waste e.g. paper, glass, batteries, PVC, bottles, metals)</b>			
Formally and informally recycled materials are those diverted from the waste stream, recovered, and sent for processing into new products, following the local government permits and regulations.			
Benchmark	>25 %	15-25 %	<15 %
Benchmark source	IADB		
Source of data	Local experts opinion, previous expert studies		
Value	< 5 % (Expert estimate)		
Trend	Not apparent		
Level of priority	High		
Context	<p>Because the official data on recycling of any waste in Armenia is not available, the data from previous studies based on their own research methods were used.</p> <p>The formal system of municipal solid waste collection and disposal does not include separate collection, sorting or any type of waste treatment. Waste sorting for recycling in Yerevan (Armenia) is a matter of rather informal activities (scavengers collecting mainly metals, paper, plastics, food waste, combustibles, buy-in centres, collection points).</p>		

<b>Percentage of MSW and HW landfilled is disposed of in EU-compliant sanitary landfills</b>			
Percentage of the city's municipal solid waste (MSW) and hazardous waste (HW) generated on its territory is disposed of in sanitary landfills. Waste sent for recovery (composting, recycling, etc.) is excluded.			
To be considered sanitary, the MSW landfill should have leachate and landfill gas collection and treatment systems.			
Benchmark	90-100 %	80-90 %	<80 %
Benchmark source	IADB		
Source of data	Municipality of Yerevan		
Value	0 %		
Trend	Stable		
Level of priority	High		

Context	<p>No MSW and HW is disposed of in EU-compliant sanitary landfills because most of the MSW generated in Yerevan and HW generated on it's territory is disposed of on official controlled dumping sites without proper technical security measures.</p> <p>Littering and burning of MSW are typical examples of scarce illegal waste disposal practices.</p> <p>In 2017, an international tender will be called for construction of new MSW sanitary landfill in Yerevan as well as sorting facility and waste treatment. All operated dumpsites should be closed.</p> <p>In contrary there is no plan for construction of HW landfill for Yerevan or HW sector within the planned MSW sanitary landfill.</p>
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<b>The remaining life of current landfill(s)</b>			
The indicator aims to capture the remaining useful life of the site of the sanitary or controlled landfill, based on the city's municipal solid waste generation projections (in years).			
Benchmark	>8 years	5-8 years	< 5 years
Benchmark source	IADB		
Source of data	Previous expert studies		
Value	Up to 8 years		
Trend	<p>Increasing</p> <p>A new sanitary landfill is scheduled to be built in Yerevan starting in 2017 with capacity of about 28 years</p>		
Level of priority	Moderate		
Context	<p>There are neither environmentally friendly operated landfills nor sanitary landfills in Armenia. Waste is disposed of on dumpsites without any proper lining, gas collection system, etc. The main dumpsite serving Yerevan can be considered to be a legal controlled dumpsite with capacity for the next 8 years.</p> <p>A new sanitary landfill is scheduled to be built in Yerevan starting in 2017. It will replace the existing managed dumps, the largest of which is the Nubarashen site. The existing ones will eventually be closed. The new sanitary landfill to be built should comply with EU solid waste management standards.</p>		

## 1.7.2 Response Indicators

Reduction of material consumption / solid waste generation is promoted through awareness campaigns	
The indicator captures the measures in place to promote reduction of material consumption and solid waste generation, with a particular emphasis on awareness campaigns.	
Benchmark source	EBRD GCAP Methodology, expert knowledge of local and international best practice
Source of data	Local expert knowledge
Overview of responses	Some activities aimed at reduction of plastic grocery bags. Some grocery stores have started charging for bags. But overall, no campaigns on reduction of material consumption and solid-waste generation.
Trend	There is greater, though still nascent citizen awareness of waste and its link to personal consumption. Making progress towards reducing consumption of certain types of materials may not take as long as it did for the no-plastic-bag campaign (see Context below).
Level of priority	Moderate
Context	The no-plastic-bag campaigns started showing results in 4-5 year period. It first manifested itself by major supermarkets offering paper-bag alternatives and a 3-4 years later charging for plastic bags. Making advances on additional reductions on this particular type of material/waste and material waste in general may not take as long but concerted effort will be needed.

Coverage of solid waste collection system is improved through plans and investment	
Larger parts of Yerevan are more regularly provided with waste collection services as a result of implementation of MSW management plans and additional investments.	
Benchmark source	EBRD GCAP Methodology, expert knowledge of local and international best practice
Source of data	Previous expert studies and local expert knowledge, Household Survey Microdata
Overview of responses	With assistance from international financial institutions, Yerevan Municipality has developed MSW management strategy and investment plan and is implementing them step-by-step. This is evident by the downward trend in illegal disposal and an increase in legal collection and disposal. Illegal dumping by Yerevan households had decreased from 41% of households in 2004 to 15% in 2014.
Trend	Legal collection and disposal is expected to increase due to implementation of investment and MSW management plan.
Level of priority	Low
Context	With assistance from international financial institutions, Yerevan Municipality has developed MSW management strategy and investment plan and is implementing them step-by-step. Over the past decade, the process of implementing investment plans has been slow due to lack of institutional capacity. This may, however, change as the municipality relies on the institutional experience gained over the past decade.

Littering and non-compliance to sorting systems is disincentivised through fines and penalties

The indicator aims at policy measures set in place in order to motivate citizens to dispose their waste in a proper way via motivating fines on the one part, and on the other part to discourage them from littering and non-compliance to sorting via penalties.

Benchmark source	EBRD GCAP Methodology, expert knowledge of local and international best practice.
Source of data	Municipality, Expert knowledge
Overview of responses	There are littering fines established and collected in Yerevan. There is a street view monitoring system in place. Individual offence is penalised.. There is no official municipal solid waste sorting system in Yerevan.
Trend	Littering is clearly declining
Level of priority	Medium
Context	<p>The problem of littering in Yerevan is not well understood and requires research. It is often stated that people lack awareness and “sophistication.” They are deemed as “backward” and in need of education. A study of Yerevan citizens, however, suggests that some citizens in fact do it intentionally, even if misguidedly, as an act of civil disobedience or expression of discontent with “corrupt, unresponsive municipality.”</p> <p>It is unlikely that a fine or penalty system will work if it relies on street-level person-to-person monitoring. Jaywalking fines, for instance, were put in place and in very short while were forgotten as a measure that should be implemented.</p> <p>Any anti-littering initiative, be it punitive or educational, should be based on a better understanding of the problem of littering and identify effective mechanisms to tackle the challenge.</p> <p>In Yerevan there is no official waste sorting system established yet.</p>

**Composting, recycling, and waste-to-energy facilities are developed through plans and investment**

The indicator aims at planning of the future municipal solid waste treatment or utilization facilities like material use or energy use facilities.

Benchmark source	EBRD GCAP Methodology, expert knowledge of local and international best practice
Source of data	Previous expert studies and local expert knowledge
Overview of responses	Plans are being implemented for investments in sorting and recycling facilities with international tender expected in 2017.
Trend	Sorting and recycling of waste is expected to improve and the municipality is expected to develop plans and investment opportunities in this direction. Composting, however, is still not on the radar screen of policymakers and city officials.
Level of priority	Low
Context	Some informal activity taking place on recycling of plastics, paper, metals, car batteries, building materials/parts. Methane is being harvested from Nubarashen dump, though not being converted to energy. Plans are being implemented for investments in sorting and recycling facilities with international tender expected in 2017.

<b>Solid waste reuse, sorting and recycling is promoted through information and awareness campaigns</b>	
The indicator focuses on corrective measures to improve the level of solid waste reuse, sorting and recycling, namely information and awareness campaigns.	
Benchmark source	EBRD GCAP Methodology, Expert knowledge of local and international best practice.
Source of data	Previous expert studies and local expert knowledge
Value	No information or awareness campaigns in place.
Trend	Not obvious
Level of priority	<b>High</b>
Context	Some informal activity taking place on recycling of plastics, paper, metals, car batteries, building materials/parts. Information on recycling possibilities, however, is scarce.

<b>Overcapacity issues in waste disposal sites are tackled through plans and investment</b>	
The indicator aims at plans and investments that are planned to secure sufficient capacities of waste disposal sites serving to the city. Both municipal (non-hazardous waste landfill) and industrial (hazardous waste) sector should be covered.	
Benchmark source	EBRD GCAP Methodology, expert knowledge of local and international best practice
Source of data	Previous expert studies and local expert knowledge
Value	International tender to build new sanitary landfill for MSW in Yerevan planned and forthcoming in 2017
Trend	N/A
Level of priority	<b>Moderate</b>
Context	<p>Municipality has developed a solid waste management strategy and is implementing it step by step. In 2017, an international tender will be called for construction of new MSW sanitary landfill in Yerevan as well as sorting facility and waste treatment. Municipality's solid waste management plans take into account regional waste disposal needs.</p> <p><input type="checkbox"/> Nevertheless, the future capacities for the hazardous waste disposal are not tackled through solid waste management strategy for Yerevan. Considering that there is no hazardous waste EU standard like disposal site serving in Yerevan industrial sector until now, planning of construction of such facility(ies) should become one of the priorities for the waste management sector policy.</p>

## 1.8 Land-use

### 1.8.1 Pressure Indicators

<b>Population density on urban land</b>			
This is a standard indicator measuring the average distribution of population within the city.			
Benchmark (Residents / km2)	70,00–20,000	4,000-7,000; 20,000-25,000	<4,000; >25,000
Benchmark source	IADB		

Source of data	ArmStat: Marzes of the Republic of Armenia and Yerevan city in figures, 2014, 2015, and 2016; Population Census 2001 and 2011
Value	4,815 residents/km <sup>2</sup>
Trend	While there was a 3.5% drop in population density between 2001 and 2011, since then there has been a slight year-to-year increase.
Level of priority	<b>Moderate</b>
Benchmark source	IADB
Context	Data available is for the de jure population as at 1 January of each year. The area of Yerevan has remained constant at 223 km <sup>2</sup> .

**Percentage of urban development that occurs on existing urban land rather than on greenfield land**

This indicator provides information on the urban sprawl.

Benchmark (%)	>40	20-40	<20
Benchmark source	OECD / ICLEI		
Source of data			
Value	na		
Trend			
Level of priority			
Context			

**Vacancy rates of offices**

This indicator provides information on the efficiency of the office buildings development.

Benchmark (%)	< 6%	6 – 10%	> 10%
Benchmark source	OECD / ICLEI		
Source of data			
Value	> 10%		
Trend	Decreasing		
Level of priority			
Context			

**1.8.2 Response Indicators**

**Density is regulated**

Source of data	Review of urban planning policy and legislation
Overview of responses	Density targets exist in accordance with the zoning plans for each of the 12 administrative districts.
Trend	
Level of priority	<b>Low</b>

Benchmark source	
Context	

**Transit-Oriented Development is promoted**

Source of data	Review of urban planning policy and legislation
Overview of responses	The Master Plan promotes transit-oriented development, however, the last master plan was developed in 2005 and the construction permitting in practice is more focused on development of underdeveloped lands, especially in the suburbs of the city. They operate under the assumption that if the urban development succeeds, the transit routes will evolve and service new areas based on demand.
Trend	
Level of priority	Medium
Benchmark source	
Context	

**Mixed-use development is promoted through zoning regulations / incentives**

Source of data	Review of urban planning policy and legislation
Overview of responses	Mixed development is part of the zoning regulations. However, the individual zoning plans which are the simplified instructions to the Yerevan Municipality Architecture and Urban Development Department are not detailed enough to address the mixed-use development. There are no fiscal incentives in place.
Trend	
Level of priority	Medium
Benchmark source	
Context	

## 5 Annex 5: Short-term Action Profiles

This annex provides a detailed overview of all new<sup>5</sup> short-term actions of the Green City Action Plan (GACP). Coding of actions follows the coding employed in the main GCAP report.

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<sup>5</sup> „New“ refers to those actions plans not covered in the Strategic Energy Action Plan of 2016

<b>AA1</b>	<b>Support to the national authorities to improve air quality policy and methodology</b>		
Action classification	Policy improvement Capacity building		
Objective	Cooperation of the City and national authorities in air quality methodology and policy improvement, leading to an air quality policy that is fully comparable to the EU/WHO standards, transparent and open to the public.		
Description	<p>The City should cooperate with and support the national authorities in:</p> <ul style="list-style-type: none"> <li>- improving the reporting of emission values in short-term periods (linked to AA2 covering the municipal level)</li> <li>- publishing of methodology for monitoring and measuring of air quality (enabled by the monitoring system developed under AA2 and including the corrective measures described in AA3). The methodology that adheres to the EU/WHO standards should be recommended to relevant bodies and endorsed</li> <li>- recalculation of historical emission data series on the basis of the methodology</li> </ul> <p>This action should create the over-arching policy framework of the technical (AA2) and corrective (AA3) measures for air quality improvement in the City of Yerevan.</p> <p>In order to practice effective corrective activity in air pollution originating in transport, the City should recommend relevant bodies and endorse:</p> <ul style="list-style-type: none"> <li>- creation of an integrated technical inspection system of vehicles that is comparable to the EU standard, and includes emission testing</li> <li>- targeted traffic-related actions performed on the municipal level to achieve better maintenance of vehicles and trustworthiness of the data of the fleet fuel mix and emission performance (link to TA11)</li> </ul>		
Action owner	Nature protection department		
Stakeholders	Hydrometeorological Service, Ministry of Nature Protection, Ministry of Health		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	If outsourced: Due diligence of the current system of air quality monitoring, reporting and verifying.	(20; if outsourced)	na
	If outsourced: Revision and design of the integrated technical inspection of vehicles.	(30; if outsourced)	na
Calculation Method	Expert estimate		
Savings and benefits	Benefits will relate to improved policy framework, incl. improved scope, reliability and accessibility, and improved knowledge and understanding of air quality dynamics across time and sources of pollution.		
Financing options	Yervan Municipality, other state institutions, NGOs, Academic Institutions		
Recommended year of implementation	2018 - 2022		

Plan	<p>The methodology and policy will be improved in three stages:</p> <ol style="list-style-type: none"> <li>1. preparatory stage - composition of methodology and policy updates in cooperation of the City and national authorities</li> <li>2. deployment stage - implementation of the methodology and policy</li> <li>3. commissioning stage - operation of effective systems combining monitoring, corrective measures and the over-arching policies and methodology</li> </ol>
Key measures for tracking	<p>Due diligence Developed air quality policies</p>

AA2	Develop municipal air quality monitoring system		
Action classification	Monitoring and data collection Capacity building		
Objective	Establish a monitoring system providing transparent real-time information on air quality of the City and cooperate with the Hydrometeorological Institute for data processing and analysis . The information will be publicly available and is derived from the data recorded by the municipal measuring devices. The monitoring data should also be applicable for the optimization of traffic flow.		
Description	<p>In order to successfully implement an integrated monitoring system of air pollution in the City, the following actions are proposed:</p> <ul style="list-style-type: none"> <li>- The city should establish an integrated system of air quality monitoring and air pollution modelling, including on-line interactive map of air pollution, and also of traffic monitoring and modelling.</li> <li>- The city will procure its own stationary/mobile monitoring system of air pollution gathering short-term period data (e.g. 10- or 20-minute values, that can be compared with EU/WHO as well as national standards), within the limits of budgetary possibilities and available external funding</li> <li>- The city will hire technical personnel and provide them with necessary training to make them capable of operating the system</li> </ul>		
Action owner	Nature protection department		
Stakeholders	Hydrometeorological Service, Ministry of Nature Protection, Ministry of Health		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Development of IT tool for gathering, storage, processing and release of data, including an interactive map	30	tbd
	Installation of network of monitoring devices throughout the City	1 000	na
	The Municipality will facilitate 2 experts for the information analysis and control	na	20
Calculation Method	Expert estimate; local expert costs: EUR 800 gross wage / month		
Savings and benefits	Benefits will relate to improved monitoring scope and reliability of data, and improved knowledge and understanding of air quality dynamics across time and sources of pollution.		
Financing options	Yerevan Municipality, other state institutions, EBRD, EID, ADB, GCF, UNDP		
Recommended year of implementation	2018 - 2022		
Plan	<p>The system will be developed in three stages:</p> <ol style="list-style-type: none"> <li>1. preparatory stage - accommodation of funding and tendering of IT and technical tools</li> <li>2. deployment stage - implementation of the system, staff training and testing</li> <li>3. commissioning stage - system is put into operation</li> </ol>		

Key measures for tracking	Time schedule of the project development Number of municipal monitoring stations
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AA3	Establish a corrective system for air quality		
Action classification	Policy improvement Capacity building		
Objective	Empower the municipality to take corrective measures to reduce air pollution.		
Description	<p>Corrective measures are a key-stone of short-term pollution regulation and long-term air quality improvement. Therefore, the City should:</p> <ul style="list-style-type: none"> <li>- receive and evaluate real-time information on incidents of air pollution exceeding norms, sources of such pollution and measures to be taken (or already taken) to reduce pollution (data collection system covered by AA2 action)</li> <li>- on the basis of the data obtained, take action or cooperate with national authorities to reduce the level of pollution</li> <li>- have a mechanism to initiate corrective actions in the event of adverse meteorological conditions, when human health is threatened (given by national norms comparable to EU/WHO standards)</li> </ul>		
Action owner	Nature Protection dpt./ Development and investment programmes dpt.		
Stakeholders	Hydrometeorological Service, Ministry of Nature Protection, Ministry of Health		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	The Municipality will facilitate 1 expert for the information analysis and control	tbd	10
Calculation Method	Expert estimate, local expert costs: EUR 800 gross wage per month		
Savings and benefits	Benefits will relate to the reduction of air pollution and improved air quality		
Financing options	Yerevan Municipality, other state institutions, EBRD, EID, ADB, GCF, UNDP,		
Recommended year of implementation	2019 - 2022		
Plan	<p>The system will be developed within three stages:</p> <ol style="list-style-type: none"> <li>1. preparatory stage - composition of methodology and policy updates</li> <li>2. deployment stage - implementation of the system, staff training and testing</li> <li>3. commissioning stage - system is put into operation</li> </ol>		
Key measures for tracking	Number of self-monitoring entities Number and regularity of data sets Number of stationary / mobile monitoring stations		

AA4	<b>Monitor and assess regularly all GCAP actions targeting air-quality improvements</b>		
Action classification	Policy improvement Capacity building		
Objective	Provide holistic view of the actions taken under GCAP and their impact on air quality		
Description	For assessment and review of programs targeting air-quality improvements established under GCAP, it is necessary to periodically review and evaluate all actions taken. Collection of data on impact of individual actions and their effectiveness for targeting air-quality improvements in Yerevan will be performed and used to evaluate each projects.		
Action owner	Nature protection department		
Stakeholders	Hydrometeorological Service, Ministry of Nature Protection, Ministry of Health		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	A dedicated official in charge of collecting data and periodically reviewing the progress of actions taken	na	na
Calculation Method	na		
Savings and benefits	Benefits will relate to continuous improvement of the monitoring system and hence the ability to better plan and carry out measures targeting the reduction of air pollution and improved air quality.		
Financing options	Yerevan Municipality, other state institutions		
Recommended year of implementation	2018 - 2021		
Plan	Quarterly assessment of actions should be put in place for the first three years. Half-yearly or yearly assessment can be applied after this period based on the results.		
Key measures for tracking	Data sets collected and used in evaluation of measures taken		

BA1	Set up a “Green City Awareness Centre”		
Action classification	Cooperation and collaboration Capacity building Awareness and demonstration		
Objective	The Green City Awareness Center (GCAC) will facilitate the Green city action plan implementation. The main objective is to institutionalize cooperation within a public sector and between a public and a private sector on the GCAP implementation.		
Description	<p>The “Green City Awareness Centre” will be a platform created from representatives of the Yerevan municipality, NGO(s) supported by an international expertise and possibly by research institution(s) to cooperate on the waste management data collection, awareness spread and capacities building in local public institutions including the Yerevan municipality and public. The Green city awareness centre will assist in the GCAP-waste sector activities implementation, will assist employees of the communal sector of the Yerevan municipality in building their own capacities.</p> <p>The capacity building will be organised repeatedly and will focus on the following topics:</p> <ul style="list-style-type: none"> <li>- environmental aspects of the waste management system incl. waste management facilities and monitoring of their performance</li> <li>- economic aspects of the public waste management system</li> <li>- social aspects of the public waste management system</li> <li>- collection of waste management data and monitoring its performance</li> <li>- role of public institutions in awareness campaigns</li> <li>- role of the public in awareness campaigns</li> <li>- examples of good practice</li> </ul> <p>The Green city awareness centre will also provide regular and effective awareness campaigns focused on:</p> <ul style="list-style-type: none"> <li>- performance of the WMS in Yerevan, its improvements and future changes planned</li> <li>- the planned waste disposal and waste treatment facilities</li> <li>- need for sustainable waste collection fee</li> <li>- sorting, recycling and proper waste collection</li> <li>- waste generation prevention, re-use of waste, biodegradable waste composting, HW separate collection, Pb batteries handling, etc.</li> <li>- volunteering</li> </ul>		
Action owner	Nature Protection department		
Stakeholders	Ministry of Nature Protection, universities, NGOs, international experts		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	The Municipality will provide a suitable residence for the GCAC, furnish it with work equipment	20	tbd
	Local experts from research institution(s), NGOs, municipality, etc., total 24 expert working-months per year	na	20

	The Municipality will facilitate 1 part-time (international) expert to cooperate on the GCAC waste management agenda	na	30
Calculation Method	Local expert costs: EUR 800 gross wage per month		
Savings and benefits	The Green City Awareness Center will provide crucial support to the GCAP implementation.		
Financing options	Yerevan Municipality, grants		
Recommended year of implementation	2019-2020		
Plan	na		
Key measures for tracking	"Time schedule for the establishment of the Green City Awareness Centre		

<b>BA2</b>	<b>Municipal Staff training courses</b>		
Action classification	Capacity building		
Objective	Capacity building of the relevant municipal staff Recognition of biodiversity as an integral part of urban planning		
Description	In order to establish capabilities for protection of environment and biodiversity in Yerevan, training course in necessary scientific methods and best practices will be performed. The aim is for the city officials to recognise biodiversity as an integral part of its urban planning and aim to preserve the biodiversity richness that makes Armenia and Yerevan one of the world biodiversity hotspots.		
Action owner	Nature protection department		
Stakeholders	Ministry of Nature Protection, NGOs		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Traning professionals	na	15
Calculation Method	Expert estimate		
Savings and benefits	Benefits will relate to more informed decisions and better planning by the municipality		
Financing options	Municipality, other state institutions, R2E2		
Recommended year of implementation	2018 - 2022		
Plan	Capacity building of the relevant municipal staff on EIA process, biodiversity topics, scientific data collection methods, on-line database operation, etc. will be in place		
Key measures for tracking	Number of training courses Number of trained personnel Involvement of the trained personnel in the activities of the Green City Awareness centre		

<b>BA3</b>	<b>The Green City Awareness Centre will establish cooperation between Municipality, NGOs, universities and research institutions on biodiversity data collection and evaluation.</b>		
Action classification	Monitoring and data collection		
Objective	Common research and data collection projects Cooperation between the academic institutions, NGOs and municipality		
Description	The Green City Awareness Centre will establish cooperation between Municipality, NGOs, universities and research institutions on biodiversity data collection and evaluation.		
Action owner	Nature protection department		
Stakeholders	Ministry of Nature Protection, universities, NGOs		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	na	na	na
Calculation Method	na		
Savings and benefits	Benefits will relate to increased cooperation of stakeholders and improved knowledge and understanding of local ecosystems. This will support better planning of actions targeting biodiversity.		
Financing options	Municipality, other state institutions, Academic Institutions, NGOs		
Recommended year of implementation	2020 - 2022		
Plan	2020 - Organise networking events for officials from the municipality, NGOs and academics 2021 - Follow up of the networking events by establishing concrete research project frameworks and their financing 2022 - Commencement of concrete research projects		
Key measures for tracking	Plan of cooperation Number and topics for common research projects		

<b>BA4</b>	<b>The Green City Awareness Centre will set up a public database to publish the biodiversity and ecosystems data comparable to international indicators available.</b>		
Action classification	Monitoring and data collection Cooperation and collaboration		
Objective	To establish cooperative framework for systematic biodiversity data collection		
Description	For evaluation of the current state of the biodiversity and ecosystems data on selected biodiversity indicators should be regularly and systematically collected, evaluated and published. General consensus on what data will be collected should be reached.		
Action owner	Nature protection department		
Stakeholders	Ministry of Nature Protection, universities, NGOs		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Biodiversity indicators will be monitored by involved institutions and subjects	4	na
Calculation Method	Expert estimate		
Savings and benefits	Benefits will relate to improved public awareness of local ecosystems. This is likely to lead to gradual behavioural changes in the direction of environment protection.		
Financing options	Yerevan Municipality, other state institutions, Academic Institutions, NGOs		
Recommended year of implementation	2021-2022		
Plan	In 2021 a panel discussion on which biodiversity indicators should be regularly and systematically monitored and to set up uniform methodology compliant to each scientific discipline In 2022 monitoring in compliance with the agreed methodology will be commenced.		
Key measures for tracking	Biodiversity database project specifications Time schedule for the database implementation Number of data sets Frequency of updating		

<b>TA1</b>	<b>Implementation of a new bus network model, incl. dedicated bus lanes, and an integrated tariff and ticketing system (in line with the ongoing project).</b>		
Action classification	Capital Investment		
Objective	To promote an efficient, environmentally- and user-friendly, comfortable and well-connected public transport to make it the transport of choice.		
Description	<p>The new bus network model is to provide Yerevan with an efficient interconnected bus network that is served by standard city buses. The current use of mini-buses is to be phased out. The system is to be complemented by an integrated tariff and ticketing system to promote the use of public transport and use the potential of all available modes. The system is to introduce also loyalty schemes (period passes).</p> <p>This action assumes that the ongoing project, run in parallel with but independently of GCAP, delivers in accordance with the project framework. It is also anticipated that it will outline a framework for the establishment of the Public Transport Authority to oversee the management of Yerevan's public transport</p>		
Action owner	SUDIP PIU		
Stakeholders	Citizens, private sector, non-governmental organisations		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	to be identified in the results of the ongoing project; it is however assumed that this will include among others: - robust IT-based systems supporting the operation of the network model as well as the ticketing - ticketing hardware - new expert personnel for the Public Transport Authority - new personnel for the ticketing system operator	85 000 000	tbd
Calculation Method	na		
Savings and benefits	to be identified in the results of the ongoing project		
Financing options	Yerevan Municipality, other state institutions, EBRD		
Recommended year of implementation	2018 - 2019		
Plan	to be identified in the results of the ongoing project		
Key measures for tracking	<p>GHG emission savings: 33,139 tons of CO<sub>2</sub>e/year          Fuel savings: 145,340 MWh/year/OPEX savings          Air quality improvements          Share of public transport in commuting</p>		

<b>TA2</b>	<b>Upgrade electric public transport</b>
Description	See SEAP T.2 and T.3

<b>TA3</b>	<b>Integration of sidewalks and pedestrian paths as an integral part of the transportation system in the city</b>		
Action classification	Capital Investment		
Objective	To promote an efficient, environmentally- and user-friendly, comfortable and well-connected public transport to make it the transport of choice.		
Description	Sidewalks and pedestrian paths are an integral part of mobility as people move to, from and between transport stops, stations and hubs. Moreover, mobility also includes alternative ways of moving around the city esp. walking. This requires a well integrated and maintained network of sidewalks and pedestrian paths to enable such movement as well as to make it inviting and comfortable. This project should, in its first stage, support the implementation of TA1. At the same time, it is to be aligned with actions LA6 and LA7 focused on green space development.		
Action owner	Transport department / Department of Urban development		
Stakeholders	Citizens, private sector		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	The municipality tenders the works and coordinates the project with the contractor.	investment costs will depend on the actual project design	maintenance costs will depend on the actual project design
	Coordination of project implementation by transport and nature protection departments.	na	na
Calculation Method	na		
Savings and benefits	Savings are expected to relate to - environment in terms of green-house gas emissions reductions thanks to increased use of public transport - health as it is expected that people will prefer walking at short distances		
Financing options	Yerevan Municipality		
Recommended year of implementation	2018 - 2020		
Plan	This is a gradual process whose stages need to be consistent with the implementation of the integrated bus network. Priority should be given to sidewalks and pedestrian paths in Yerevan's centre as well as between major transport hubs and stations. This activity should be well coordinated with the greening activities under action LA5.		
Key measures for tracking	Share of public transport in commuting Satisfaction of commuters with public transport		

TA4	Organisation of a hackathon to support the creation of a public transport mobile application		
Action classification	Public awareness and demonstration		
Objective	To promote an efficient, environmentally- and user-friendly, comfortable and well-connected public transport to make it the transport of choice.		
Description	<p>Hackathons are a popular instrument used by cities to raise public awareness of a topic as well as to make use of innovative thinking and programming skills of the public and private sector (esp. start-ups). The aim of the event is to provide Yerevan with prototypes of a mobile application that facilitates the use of public transport. incl. collection of feedback. The best prototypes as evaluated by an independent panel consisting of Yerevan municipality's representatives, independent experts and representatives of the public should be offered a sponsorship for their further development and piloting. The final application should provide both the citizens and tourists with all transport-related information such as real-time route planner, schedules, transport stops identification, service interruption and offer them the possibility to pay for a ticket in real-time. Further on, such an application could be used to also gather feedback on the quality of service.</p>		
Action owner	Transport department		
Stakeholders	Citizens, private sector		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	<p>The municipality coordinates the organisation of the event and is represented in the independent panel. Further technical expertise is provided by experts from academia and the private sector. Public is also represented.</p>	na	10
<p>The municipality will seek to attract sponsors of the event and may provide some funding itself.</p>	5	na	
Calculation Method	na		
Savings and benefits	<p>Savings are expected to relate to</p> <ul style="list-style-type: none"> <li>- environment in terms of green-house gas emissions reductions thanks to increased use of public transport</li> <li>- capital investment in terms of reduced need to install ticketing machines</li> <li>- operational costs in terms of maintenance of ticketing machines as well as conduct of customer satisfaction and use surveys</li> </ul>		
Financing options	Yerevan Municipality, local businesses (IT sector)		
Recommended year of implementation	2018		

Plan	Hackathon is to be organised in line with the implementation schedule of the new bus network and ticketing system
Key measures for tracking	Share of public transport in commuting Satisfaction of commuters with public transport Number of data sets available to public Number of downloads of the application

<b>TA5</b>	<b>Implementation of a pilot regarding the introduction of public transport stop displays</b>		
Action classification	Capital Investment		
Objective	To promote an efficient, environmentally- and user-friendly, comfortable and well-connected public transport to make it the transport of choice.		
Description	Public transport stop displays are among tools supporting user-friendly access to real-time information on the transport services. Provision of such information enhances the reliability of public transport and its attractiveness for the citizens. The municipality tested similar displays in 2012 and this pilot should build on the previous experience. Moreover, it should make use of data resulting from the use of IoT technologies in the new bus network.		
Action owner	Transport department		
Stakeholders	Citizens, private sector		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Purchase and installation of public transport stop displays	60	9
Calculation Method	It is assumed that the pilot project will cover up to 20 bus stops. A bus stop display is estimated at EUR 3,500 incl. installation and site preparation. Annual OPEX is estimated at 15% of CAPEX.		
Savings and benefits	Savings are expected to relate to - environment in terms of green-house gas emissions reductions thanks to increased use of public transport - time saved thanks to real-time information about public transport		
Financing options	Yerevan Municipality, other state institutions, EBRD		
Recommended year of implementation	2018		
Plan	Implementation of the pilot should be scheduled so that it complements the implementation of the new bus network model.		
Key measures for tracking	Share of public transport in commuting Satisfaction of commuters with public transport		

<b>TA6</b>	<b>Establish an open data platform</b>		
Action classification	Cooperation and collaboration Capital investment		
Objective	To strengthen the city's capability to monitor the state of the city across all sectors, support public awareness and social inclusion as well as provide business opportunities for private sector.		
Description	The platform will make available to the public data on various activities related to the city (e.g. public transport routes and schedules, public transport stops, public transport tariffs, bike paths, air quality, water quality, noise map). The data can be used by citizens to search for information or by entrepreneurs to develop mobile applications and data-driven services. The data should be accessible in a machine readable format in Armenian as well as in English, to allow for development of products and services for both locals and tourists. The initial scope of data will at least reflect the GCAP short-term targets, further extensions will follow the European best practices.		
Action owner	Transport department		
Stakeholders	Citizens, private sector, NGOs, academic institutions, ministries, other cities		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Procurement of the data platform or platform services.	75	tbd based on the platform scope
	Establishment of the platform coordinator.	na	na
Calculation Method	na, estimated based on expert's opinion		
Savings and benefits	Indirect savings related to - more versatile, effective and efficient services		
Financing options	Yerevan Municipality, local businesses		
Recommended year of implementation	2018 - 2020		
Plan	Select data streams for publishing Select IT tool for publishing		
Key measures for tracking	Number of data sets available to public		

<b>TA7</b>	<b>Develop road infrastructure (new, including bypass roads and road junctions)</b>
Description	See SEAP T.5

<b>TA8</b>	<b>Introduction of regular monitoring of passenger satisfaction and quality of service of public transport</b>		
Action classification	Monitoring and data collection		
Objective	To promote an efficient, environmentally- and user-friendly, comfortable and well-connected public transport to make it the transport of choice.		
Description	<p>Regular monitoring of passenger satisfaction and quality of public service is an integral part of public transport management. It helps address complaints and inefficiencies in a timely manner so that the public transport service can be continuously improved and attract demand.</p> <p>This action is linked to Action TA17 which targets the development of quality indicators. When introduced in practice, the indicators should become part of the service providers' performance assessment. This action is also linked to Action TA4 through which a mobile application is developed that should also enable collecting passengers' feedback.</p>		
Action owner	Transport department		
Stakeholders	Citizens, private sector, NGOs, academic institutions		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Monitoring should be primarily carried out through the public transport mobile application. Its development is covered under Action TA4.	na	na
	The municipality / Public Transport Authority may decide to organise additional ad-hoc surveys.	na	(5)
	Analysis and processing of the survey results is likely to fall under the Public Transport Authority when established. Cooperation with the academic institutions and private sector implementing Action TA17 is also assumed.	na	na
Calculation Method	na		
Savings and benefits	<p>Savings are expected to relate to</p> <ul style="list-style-type: none"> <li>- environment in terms of green-house gas emissions reductions thanks to increased use of public transport</li> <li>- operational costs savings stemming from the reduction of physical customer satisfaction surveys</li> </ul>		
Financing options	Yerevan Municipality, "Yerevan Metroliten" LLC		

Recommended year of implementation	2018 - 2020
Plan	Regular monitoring of passenger satisfaction and quality of public service will follow the development of quality indicators and the public transport mobile application.
Key measures for tracking	GHG emission savings Air quality improvements Share of public transport in commuting Satisfaction of commuters with public transport

<b>TA9</b>	<b>Strengthen the City's awareness campaigns through e.g. the introduction of regular "Day without cars", "Biking weekends" etc.</b>		
Action classification	Public awareness and demonstration		
Objective	To strengthen public awareness about the key role of transport in mitigating climate change and improving public health.		
Description	Awareness campaigns related to alternative mobility are a popular tool used by cities. They are also popular with the citizens. Initiatives such as "Day without cars" and "Biking weekends" are organised as to not interrupt the functioning of the city. Depending on the growing acceptance and popularity, they may become a regular event or extend their scope. The schedule of such events should be announced in advance and the programme should be consulted upon with stakeholders. Some events may be aligned with the annual European Mobility Week.		
Action owner	Transport dpt. / Information and Public Relations Department		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Preparation and organisation of events, incl. engagement of sponsors and alternative mobility "ambassadors" as well as event volunteers	na	50
Calculation Method	OPEX assumption is based on five events each assumed to incur costs of EUR 10,000; this excludes contributions from sponsors		
Savings and benefits	Savings are expected to relate to - green-house gas emission reduction owing to the embracement of alternative mobility - air quality improvement		
Financing options	Yerevan Municipality, NGOs, Academic Institutions		
Recommended year of implementation	2017 - 2020		
Plan	Gather feedback from stakeholders on potential events Prepare a yearly schedule of events Call for sponsors, alternative mobility "ambassadors" and volunteers		
Key measures for tracking	Share of public transport in commuting Satisfaction of commuters with public transport Public feedback on awareness campaigns		

TA10	Purchase up to 85% of all new buses as CNG-fuelled buses		
Action classification	Capital Investment		
Objective	To promote an efficient, environmentally- and user-friendly, comfortable and well-connected public transport to make it the transport of choice.		
Description	<p>CNG is considered an alternative, environmentally-friendly fuel that is widely introduced in public transport fleets to support improvement of air quality and long-term greenhouse gas emissions reduction targets. CNG is a popular fuel in Armenia and has been widely used in the public transport, i.e. in the minibus fleet. The gradual phase-out of minibuses and phase-in of standard city buses fuelled by CNG is hence a natural development.</p> <p>Technical specifications for the bus tender(s) should ensure that the chosen technology will produce minimum nanoparticles and ultrafine particles.</p>		
Action owner	Transport department		
Stakeholders	Citizens, private sector, NGOs		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Purchase of 310 CNG-fuelled buses	57,000	operational costs are generally lower than comparable costs for diesel-fuelled buses
Calculation Method	SEAP 2016 estimates the phase-in of about 90 city buses between 2017 and 2020. The new bus network model is likely to result in an even higher number of newly purchased buses in the next five years. This number is estimated to be between 300-400 buses, incl. back-up. 85% of such a fleet amounts to about 255-360 buses. The CAPEX is thus estimated for an average of 310 buses. One CNG-fuelled bus is estimated at EUR 185,000.		
Savings and benefits	<p>Savings are expected to relate to</p> <ul style="list-style-type: none"> <li>- environment in terms of green-house gas emissions reductions owing to the bus network optimisation, higher energy efficiency compared to the current fleet and lower emissions compared to diesel alternative</li> <li>- operational costs in terms of energy consumption (same reasons as above)</li> </ul>		
Financing options	Yerevan Municipality, EBRD, EIB, ADB		
Recommended year of implementation	–2018-2022		
Plan	Gradual phase-in of CNG buses in accordance with SEAP 2016 and its implementation plan.		
Key measures for tracking	<p>GHG emission savings</p> <p>OPEX savings</p> <p>Air quality improvements</p> <p>Fuel savings / OPEX savings</p>		

<b>TA11</b>	<b>Recommend to relevant bodies and endorse the creation of an integrated technical inspections system</b>		
Action classification	Cooperation and collaboration		
Objective	To strengthen the city's capability to monitor the development and the characteristics of its overall fleet and to increase its capacity to take targeted action against main polluters of the transport sector.		
Description	There is an overall lack of data on the technical state of the existing fleet of vehicles in Armenia. The creation of a national integrated technical inspection system would support targeted actions against main polluters from transport not only in Yerevan but also in other cities in Armenia. Such system would also include inspection of emissions supporting better maintenance on the part of the vehicle owners.		
Action owner	Transport department		
Stakeholders	Ministry of Nature Protection, Ministry of Transport, police, other cities, citizens, private sector		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Cooperation and coordination with the relevant ministries and police	na	na
	Cooperation and coordination with the other cities	na	na
Calculation Method	na		
Savings and benefits	Savings are expected to relate to - green-house gas emission reduction - air quality improvement		
Financing options	Yerevan municipality and other state institutions		
Recommended year of implementation	2018 - 2020		
Plan	Initiate discussion with relevant ministries Initiate discussion with other cities		
Key measures for tracking	GHG emission savings Air quality improvements Technical data availability		

<b>TA12</b>	<b>Optimise city transport, improve management efficiency (incl. waste disposal, sanitation and other machinery)</b>
Description	See SEAP T.6

<b>TA13</b>	<b>Introduce 10 electric vehicles into municipal fleet by the end of 2020</b>		
Action classification	Public awareness and demonstration Capital investment		
Objective	To promote e-mobility as an alternative, environmentally friendly type of mobility.		
Description	<p>Republic of Armenia adopted its National Energy Efficiency Action Plan that foresees gradual introduction of electric vehicles in the country. SEAP 2016 anticipates the programme to take off in Yerevan. Public fleets are commonly used to promote alternative fuel mobility, which also facilitates the development of infrastructure. This action builds on the commitments described above and foresees an introduction of 10 electric vehicles into the municipal fleet. The presence of the vehicles will serve to promote e-mobility and alert public to the location of charging stations. The implementation of this action is linked to Action TA14 and TA16.</p>		
Action owner	Transport department		
Stakeholders	Electricity Distribution Operator, citizens, NGOs, private sector		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Purchase of electric vehicles	250	not estimated; related mainly to charging
Calculation Method	The cost of an electric vehicle is assumed at EUR 25,000 (mid-size cars)		
Savings and benefits	<p>Savings are expected to relate to</p> <ul style="list-style-type: none"> <li>- green-house gas emission reduction</li> <li>- air quality improvement</li> </ul>		
Financing options	Yerevan Municipality, EBRD, EIB, ADB		
Recommended year of implementation	2018 - 2020		
Plan	Purchase of electric vehicles should follow the installation of corresponding public charging infrastructure (see also Action TA14).		
Key measures for tracking	<p>GHG emission savings 11 tons of CO<sub>2</sub>e/year                      Energy savings: 24 MWh/year                      Air quality improvements: 0.000375 tons of PM saved/year                      OPEX savings                      Number of EVs registered in Yerevan and using the EVSE</p>		

TA14	Facilitate the development of charging infrastructure		
Action classification	Public awareness and demonstration Capital investment		
Objective	To promote e-mobility as an alternative, environmentally friendly type of mobility.		
Description	<p>Republic of Armenia adopted its National Energy Efficiency Action Plan that foresees gradual introduction of electric vehicles in the country. SEAP 2016 anticipates the programme to take off in Yerevan. Public fleets are commonly used to promote alternative fuel mobility, which also facilitates the development of infrastructure. This action builds on the commitments described above and foresees the facilitation of development of charging infrastructure in Yerevan. This should be done through facilitated administrative procedures regarding the installation of charging stations in the public space, lease of public land for such installations, active cooperation with the electric Distribution System Operator.</p> <p>In connection with Action TA13, the municipality may also tender the purchase and installation of charging stations in the vicinity of the municipality buildings or tender for charging services. The latter could be combined with Action TA16.</p>		
Action owner	Transport department		
Stakeholders	Distribution System Operator for Electricity, citizens, NGOs, private sector		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Purchase of EVSE, incl. installation or purchasing the respective services	45	na
	Services of Charging Point Operator	na	tbd
Calculation Method	It is assumed that three (3) charging stations would be installed with a total of seven (7) charging points. This would include one fast charging and two slow charging stations. The cost of the charging station is assumed at EUR 9,000 incl. installation for slow chargers and EUR 27,000, incl. installation for a fast charger.		
Savings and benefits	Savings are expected to relate to - environment in terms of green-house gas emissions reductions thanks to the use of electric cars		
Financing options	Yerevan Municipality, other state departments, EBRD, EIB, ADB		
Recommended year of implementation	2018 - 2020		
Plan	This action should be launched in 2017. Facilitation of administrative procedures should go hand in hand with the coordination with the electric Distribution System Operator.		
Key measures for tracking	Number of EVs registered in Yerevan and using the EVSE		

TA15	Apply a zero tariff for parking of all electric vehicles within the City boundaries		
Action classification	Public awareness and demonstration		
Objective	To promote e-mobility as an alternative, environmentally friendly type of mobility		
Description	<p>Zero tariff parking for electric cars has become a widely used tool to support e-mobility in cities. It complements other actions such as facilitation of charging station development and the emobility sharing scheme pilot.</p> <p>This action was sanctioned by the Council of Elders' decree N 675-Ն on 14 February 2017 (during the GACP development). It is kept here for complementarity reasons and to highlight its importance for the future emobility market development.</p> <p>The use of this programme should be monitored and assessed on regular basis. It can inform the plans for further development of charging infrastructure in Yerevan.</p> <p>A further step may be to allow the electric vehicles to use dedicated bus lanes once they are introduced.</p>		
Action owner	Transport department		
Stakeholders	Citizens, private sector		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Monitoring and reporting activities will be covered by the action owner.	na	na
Calculation Method	n/a		
Savings and benefits	<p>Savings are expected to relate to</p> <ul style="list-style-type: none"> <li>- green-house gas emission reduction</li> <li>- air quality improvement</li> </ul>		
Financing options	na		
Recommended year of implementation	2017		
Plan	The zero tariff has been introduced. Reporting on the use should be carried out at least half-yearly.		
Key measures for tracking	Number of EVs registered in Yerevan		

TA16	Develop an electric car sharing system in the city		
Action classification	Public awareness and demonstration		
Objective	To promote e-mobility as an alternative, environmentally friendly type of mobility.		
Description	Organise a public tender for a pilot project for electric car sharing system. The tender participants will be required to identify suitable locations for the installation of Electric Vehicle Supply Equipment (charging stations), install it and operate it as well as design and operate the electric vehicles sharing scheme. The City will provide (rent-out) the necessary land for installation, facilitate the related administrative procedures and provide free parking for the system fleet for the period of the pilot. The City may decide to launch more than one pilot at the same time to test different solutions and support competition. This may include a service with a driver.		
Action owner	Transport department		
Stakeholders	Citizens, private sector, Distribution System Operator for Electricity, NGOs		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Preparation and organisation of public tender; services of an external mobility expert and legal services may be needed	na	5
	Carrying out the facilitation activities related to the project	na	na
Calculation Method	na		
Savings and benefits	Savings are expected to relate to - green-house gas emission reduction owing to the use of electric vehicles instead of fossil-fuelled vehicles - air quality improvement		
Financing options	Yerevan Municipality, other state departments, local businesses		
Recommended year of implementation	2018-2019		
Plan	This action should be executed after preliminary results of Action TA14 are available.		
Key measures for tracking	Number of EVs registered in Yerevan and using the EVSE Use of the new service		

<p><b>TA17</b></p>	<p><b>Cooperate with the local academic institutions, or alternatively seek long-term partnerships, to develop an all transport model and related transport concepts</b></p>								
<p>Action classification</p>	<p>Capacity building Cooperation and collaboration Monitoring and data collection Feasibility study</p>								
<p>Objective</p>	<p>To promote the development of key management tools and strategic analyses for the transport system planning (strategic and operational). To build institutional and personal capacity for transport planning in the future.</p>								
<p>Description</p>	<p>The City in cooperation with academic institutions or the private sector will develop a transport model covering all kinds of transport. The model will serve to monitor, manage and predict transport flows within the city, to optimise public transport and to actively manage air quality. The research and modelling should also cover: - introduction of sensors around the city to provide relevant input for development of the transport model (sensors should collect data about traffic flow, air quality and weather conditions), this action partially overlaps with AA2 - development of a concept for regulating heavy-load vehicles transit through the city - development of a concept of car-free centre - development of a pre-feasibility study to re-introduce tram (light rail) service in the City using best practices from other cities; the study should focus on the integration potential of such transport mode, financial feasibility, public transport comfort increase potential, environmental benefits and potential users interest; the study should also look into the feasibility of increasing the number of trolleybus routes - development of transport performance indicators emphasizing not only the time of travel but also other parameters, such as experience of pedestrians, experience of passengers in public transport, safety of bicycle travel, etc. - identification of opportunities to enhance intermodal connections for both intra- and inter-city transportation - tracking of investments in general transport infrastructure vs. dedicated public transport infrastructure</p>								
<p>Action owner</p>	<p>Transport department</p>								
<p>Stakeholders</p>	<p>Academic institutions, private sector, Public Transport Authority, public transport companies, citizens, NGOs, Ministry of Nature Protection, Ministry of Transport</p>								
<p>Resource Requirements</p>	<table border="1"> <thead> <tr> <th>Description</th> <th>Estimated CAPEX (EUR 000's)</th> <th>Estimated annual OPEX (EUR 000's)</th> </tr> </thead> <tbody> <tr> <td>Municipal coordinator for the cooperation with academic institutions (should be merged with one of the key heads of department for GCAP implementation)</td> <td>na</td> <td>na</td> </tr> </tbody> </table>	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)	Municipal coordinator for the cooperation with academic institutions (should be merged with one of the key heads of department for GCAP implementation)	na	na		
Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)							
Municipal coordinator for the cooperation with academic institutions (should be merged with one of the key heads of department for GCAP implementation)	na	na							

	Establishment of expert groups, organisation of regular sessions	na	10
	Development of transport model	tbd	na
	Development of transport-related concepts	tbd	na
Calculation Method	NA		
Savings and benefits	Savings will relate to - operational and capital investment savings owing to cooperation with academic institutions - indirect savings owing to more effective public transport		
Financing options	Yerevan Municipality, Academic Institutions, European funds, private sector		
Recommended year of implementation	2018 - 2022		
Plan	Establish cooperation framework with partner institutions and experts Establish an annual work plan across all sectors; prioritise in accordance with GCAP 2017 Develop specifications for the transport model Develop the model prototype and test it (iterate) Finalise the model, maintain it and upgrade it as required Use the model for strategic and operational planning Develop transport-related concepts and feasibility studies as anticipated and agreed in annual work plans		
Key measures for tracking	Cooperation agreement Annual plans of cooperation City Transport model in active use Feasibility studies		

TA18	Use the City's partnership with the City of Paris to learn the best practices in greening public transport		
Action classification	Cooperation and collaboration		
Objective	To strengthen the city's technical capacities and support best practices exchange.		
Description	<p>Yerevan has established a wide range of partnerships with cities around the world. These relationships may be used to strengthen Yerevan's capacity to find and implement the most effective solutions to the existing challenges. As transport has been highlighted as a priority issue, Yerevan should use especially its partnership with Paris to seek for solutions in this area. Paris faces many problems regarding traffic congestion, lack of parking, poor air quality and other transport-related issues, and has been testing innovative solutions to deal with them. Paris could hence support Yerevan with some lessons learnt and provide examples of best practices.</p> <p>Other existing city partnerships could also be used in this regard. Yerevan could consider organising a dedicated best practices conference inviting all partner and sister cities.</p>		
Action owner	Transport department		
Stakeholders	Citizens, NGOs, private sector, academic institutions, ministries		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Organisation of a series of events with the City of Paris (or other partner or sister cities)	na	30
Calculation Method	It is assumed that three events are organised annually; two of them will be held in Paris and one in Yerevan		
Savings and benefits	Savings are related to costs avoided by enhanced knowledge and understanding of best practices.		
Financing options	Yerevan Municipality, other state institutions, local businesses, NGOs		
Recommended year of implementation	2018-2020		
Plan	Prepare relevant communication with Paris Organise the events		
Key measures for tracking	Concrete actions for GCAP 2020		

IA1	<b>Create sound program for incentivisation of material efficiency in industrial sector</b>		
Action classification	Cooperation and collaboration		
Objective	Increase material efficiency in industrial and related service sector in Yerevan in order to reduce the amount of all waste generated, to reduce the amount of hazardous waste generated, to start-up research-development-innovation process, to preferably use secondary raw materials, to reduce material consumption, to save operational costs. The objective is one of milestones on the way to the circular economy.		
Description	<p>The programme should comprise a chain of actions, development of legal and policy toolbox, incentives and dis-incentives, etc. all heading to higher material efficiency. The process can bring many benefits for Yerevan economy, environment, can create new job positions, can interconnect research institutions and private sector, etc.</p> <p>Examples of basic conditions for every private entity to reach high material efficiency on national level are following:</p> <ul style="list-style-type: none"> <li>- obligation to dispose the waste duly according to law and international standards (in case of landfilling - to use sanitary landfills)</li> <li>- tariffs for waste disposal are higher than for waste treatment, utilisation, prevention</li> <li>- every entity can be overseen by state inspection office</li> <li>- every entity can be penalised for mishandling its waste, in extreme cases, it may be revoked business licenses</li> <li>- every entity has a choice either to invest in its own waste management/disposal facility and its operation or to outsource these services</li> </ul> <p>Such conditions can initiate development of new waste service sector. The modern waste management system is based on the principles:</p> <ul style="list-style-type: none"> <li>- polluter pays (everyone who generates pollution (generates waste) must pay in order to realize its responsibility)</li> <li>- proximity and self-sufficiency principle (transport of waste and location of waste management facilities should be designed in the way that ensures independence on the external systems)</li> <li>- extended producer responsibility (producers of products are responsible for their products even for their end-of-life products)</li> </ul> <p>These principles should be taken into account when designing the programme</p>		
Action owner	Development and Investment programmes department		
Stakeholders	Ministry of Economic Development, Ministry of Nature Protection, private sector		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Development of the programme	50	na
Implementation of the program	na	20	
Calculation Method	na		
Savings and benefits	Higher material efficiency. Cost savings strongly dependent on difference of value of primary and secondary raw materials. More jobs create higher income VAT		
Financing options	Municipality, grants		
Recommended year of implementation	2018 - 2023		

Plan	Implementation in stages
Key measures for tracking	Incentivisation programme

<b>IA2</b>	<b>Organize an annual expo oriented on material efficiency in industrial sector</b>		
Action classification	Cooperation and collaboration Awareness and demonstration		
Objective	To announce that Yerevan incentivisation measures are being planned/in place to support material efficiency in industrial sector. To declare improvements done and plans for the future. All this in order to attract and to mediate mutual cooperation between the investors, goods suppliers, service suppliers (local and foreign) and Yerevan industrial, waste management and service sectors.		
Description	When there is a motivation-discourage system driving industries to higher material efficiency in place, the local market is attractive for local and international investors in material efficiency and waste management technologies - such state creates competition. Therefore, an expo will be organised by the stakeholders involved presenting stable legislative environment and incentivising local industries and potential investors in higher material efficiency. The expo will serve as a platform for investors and industries representatives come together, will catalyse business and impact investments in the sector.		
Action owner	Development and Investment programs department		
Stakeholders	Private sector, Ministry of Economic Development and Investments, Ministry of Labor and Social Affairs, Ministry of Territorial Administration		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Advertising campaign	na	50
	Organization of an expo	na	10
Calculation Method	Expert Judgment		
Savings and benefits	There are no direct savings that could be linked to this action, but the action is aiming at promotion of the industrial sector's efficiency.		
Financing options	Municipality, private sector		
Recommended year of implementation	2017 - 2020		
Plan	After the completion of the Ten-Year Waste Management Plan for Yerevan (activity 1 in waste sector) and after the data on other waste generated on the territory of Yerevan will be published for at least 5 years retrospective period, as well as after the Sound program for incentivisation of material efficiency in industrial sector will be created and implemented the regular expo can be organised.		
Key measures for tracking	Annual expo event		

IA3	<b>Implement and introduce a voluntary rating system for green production/Eco friendly industry</b>		
Action classification	Capacity building Cooperation and collaboration Monitoring and data collection		
Objective	Identification of environmentally friendly production Support for suppliers of sustainable technologies and solutions		
Description	In order to promote opportunities for local “green” businesses in public procurement with preference granted to local “green” business suppliers that meet all technical specifications and are cost-competitive, and/or offer innovative sustainable energy solutions, a voluntary rating system for green production/Eco friendly industry should be established. Partners from the industry with high rating would be encouraged in public procurement.		
Action owner	tbd		
Stakeholders	Private sector, Ministry of Economic Development and Investments		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Deployment & Implementation of the Program	40	20
Calculation Method	Expert judgment		
Savings and benefits	There are no direct savings that could be linked to this action, but the action is aiming at promotion of the industrial sector's efficiency.		
Financing options	Municipality, Grants		
Recommended year of implementation	2019 - 2020		
Plan	Implementation in stages (legal analysis, procurement specifications development, application of specifications in public procurement)		
Key measures for tracking	Green production rating system		

IA4	<b>Introduce an annual Green Business of the Year Award by the City of Yerevan.</b>		
Action classification	Cooperation and collaboration		
Objective	Recognizing and awarding best practices in sustainable economy		
Description	In order to promote co-operation between the industry and the municipality, Green Business of the Year Award by the City of Yerevan will be introduced. This will advance the recognition and promotion of best practices in sustainable economy in Yerevan and recognise business that adopt practices and policies that improve the quality of life for their customers, employees, communities, and the city.		
Action owner	tbd		
Stakeholders	Private sector, Ministry of Economic Development and Investments, NGOs		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Funds for event organisation & Award prize money	na	20
Calculation Method	na		
Savings and benefits	There are no direct savings that could be linked to this action, but the action is aiming at promotion of the industrial sector's efficiency.		
Financing options	Municipality, grants, private sector		
Recommended year of implementation	2019 -2020		
Plan	early 2019 - Round of application from different industry participants mid - 2019 - evaluation of application and sustainable practices of each participant late - 2019 - announcement of winners and ceremony for award presentation		
Key measures for tracking	Green Business of the Year Award		

IA5	Prepare the establishment of Centre of Excellence for Clean Production		
Action classification	Capacity building Cooperation and collaboration		
Objective	Establishing a professional body that industrial entities approach when they want to embark on clean production path.		
Description	<p>Given the low material and energy efficiency of industrial production in Yerevan and the industry's impact on the local environment, a large opportunity for sharing of methods for improvement of either efficiency exists.</p> <p>The establishment of Centre of Excellence for Clean Production will support enterprises in Yerevan to identify cost-effective solutions for improved resource efficiency and minimise ecological footprint of these enterprises.</p>		
Action owner	tbd		
Stakeholders	Private sector, Academic institutions, Ministry of Economic Development and Investments, NGOs		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Human resources	na	tbd
Calculation Method	na		
Savings and benefits	There are no direct savings that could be linked to this action, but the action is aiming at promotion of the industrial sector's efficiency.		
Financing options	Municipality, grants, private sector		
Recommended year of implementation	2020 - 2022		
Plan	Implementation in stages; concrete stages depend on the action owner who may be different from the Municipality		
Key measures for tracking	Time schedule for the project		

<b>IA6</b>	<b>Establish voluntary agreements on energy audits in industry to motivate companies (e.g. via small grants) to increase energy efficiency</b>		
Action classification	Monitoring and data collection Feasibility study		
Objective	Aim is to motivate industry companies to increase energy efficiency through conducting energy audits and implementing recommended energy efficiency measures. This will improve indicators in the industrial sector: "Heat consumption in industries, per unit of industrial GDP" and "Heavy metals emission intensity of manufacturing industries".		
Description	<p>The Municipality of Yerevan initiates dialogue with the industrial companies to motivate them to implement energy efficiency measures via voluntary agreements including:</p> <ol style="list-style-type: none"> <li>1. Companies commit themselves to increase energy efficiency by at least 1% annually during 2021-2030;</li> <li>2. Companies order energy audits in compliance with the law and municipality of Yerevan provides subsidy to carry out energy audits (around 50% of the costs);</li> <li>3. Municipality of Yerevan arranges a partnership with financial sector and facility negotiation between companies and financial institutions aimed at financing of energy saving measures with acceptable payback (less than 10 years).</li> <li>4. Recommended energy efficiency measures are implemented by the companies.</li> </ol>		
Action owner	Municipality in cooperation with financial sector		
Stakeholders	Private sector, financial institutions, NGOs		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	carrying out energy and clean production audits (50% cofinancing from the municipality - potentially covered from environmental taxes)	200	na
	implementing energy efficiency and clean production measures	400	na
	programme management including external consulting	na	tbd
Calculation Method	Expert judgment		
Savings and benefits	Savings will relate to higher energy efficiency from measures to be taken on the basis of energy audit results.		
Financing options	Grants		
Recommended year of implementation	2020 -2022		

Plan	<ol style="list-style-type: none"> <li>1. negotiation stage and conclusion of voluntary agreements</li> <li>2. energy audits and subsidies</li> <li>3. negotiating with financial sector and establishing financing conditions</li> <li>4. implementation of measures</li> <li>5. monitoring of implementation and evaluation of achieved higher efficiency</li> <li>6. reporting</li> </ol>
Key measures for tracking	<p>Heat consumption in industries per unit of industrial GDP</p> <p>Heavy metals emission intensity of manufacturing industries</p> <p>Number of voluntary agreements</p> <p>Funds allocated to the programme</p>

<b>IA7</b>	<b>Introduce a grant programme combined with voluntary agreements with the molybdenum industrial companies</b>		
Action classification	Cooperation and collaboration Investment		
Objective	Decrease in SO2 emissions and reduction of local SO2 concentrations and daily emission levels		
Description	The molybdenum-producing companies will have voluntarily committed to apply measures to improve efficiency of their technology processes and thus decrease energy consumption and related emissions of SO2, GHG and other polluting substances combined with introduction of a grant programme combined with voluntary agreements with the molybdenum industrial companies.		
Action owner	tbd		
Stakeholders	Private sector, financial institutions, NGOs		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Grant programme	80	na
Calculation Method	Expert judgment		
Savings and benefits	Benefits will relate to the improvement of air quality as a result of reduction of pollutants		
Financing options	Donor organizations in nature protection		
Recommended year of implementation	2018 -2020		
Plan	<ol style="list-style-type: none"> <li>1. negotiation stage and conclusion of voluntary agreements</li> <li>2. technology process audits</li> <li>3. negotiating with financial sector and establishing financing conditions</li> <li>4. implementation of measures</li> <li>5. monitoring of implementation and evaluation of achieved higher efficiency</li> <li>6. reporting</li> </ol>		
Key measures for tracking	Monitoring system of the measures applied as a part of the grant programme		

<b>EA1</b>	<b>Introduce the energy management in municipal institutions and capacity building for municipal energy managers</b>
Description	See SEAP H.1, H.2., P.1.
<b>EA2</b>	<b>Invest in construction repair works within energy efficiency activities in municipal buildings, thermal rehabilitation of public buildings in accordance with Yerevan SEAP. Installation of solar water heaters in administrative buildings, pre-schools, sports schools and complex sports schools for children</b>
Description	See SEAP P.2, P.4, P.5, P.6
<b>EA3</b>	<b>Modernize electric appliances in kindergartens (electric cook stoves, water heaters, etc)</b>
Description	See SEAP P.8
<b>EA4</b>	<b>Use energy efficient luminaires in the internal lighting systems of administrative buildings</b>
Description	See SEAP P.3

<b>EA5</b>	<b>Integrate Energy Performance Contracting (EPC) into municipal procurement, initiating EPC projects and capacity building</b>		
Action classification	Capital Investment Capacity building		
Objective	Integrate EPC into municipal procurement and initiate EPC pilot projects and capacity building for ESCOs, EPC facilitators and municipality representatives		
Description	<p>In order to successfully develop market for local companies providing energy services based on EPC, to help bring private sector participation in municipal sector, and take advantage of private sector knowledge and skills, the following actions are proposed:</p> <ul style="list-style-type: none"> <li>- Integrating energy performance contracting into municipal procurement procedures related to building renovations.</li> <li>- Capacity building is provided for energy service companies (ESCOs), the newly established EPC facilitators and municipality representatives (around 5-10 ESCOs to be trained in the first year of the action and at least 3 EPC facilitators and 20 municipality representatives). Training will focus on the contractual and operational arrangements related to ESCO business and EPC.</li> </ul>		
Action owner	Municipality of Yerevan, with support from donors & IFIs (e.g. EBRD, EIB, UNDP, R2E2, etc.)		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Investment cost of 20 pilot EPC projects (50% of investment costs are covered by the scheme). The operational costs will be covered from the saved energy costs so we assume zero OPEX.	tbd	na
	Facilitation cost of 20 pilot projects - national and foreign experts	na	20
	New personnel administering the financial mechanism and facilitation	na	20
Calculation Method	Expert's estimate		
Savings and benefits	EPC contracts will allow companies to attract specialized energy-efficiency service providers in traditional construction and renovation works, to implement successful solutions for upgrading the buildings, to reduce external funding needs and to mitigate investment risks. Savings will be calculated based on energy consumption and reduction of costs (adjusting for weather conditions) compared to previous years, change in exploitation and maintenance expenses, as well as recalculation of embedded financial intermediation.		
Financing options	Own means of the Municipality for construction works, ESCO's own means or loan funds of commercial banks, energy-efficient assets		

Plan	The support scheme will be developed within three stages: 1. preparatory stage - preparation of education materials and capacity building 2. establishing financial mechanism - creating rules for funding, establishing capital reserve, staff training and testing 3. EPC pilot projects implementation
Key measures for tracking	Number of EPCs initiated, energy saved

<b>EA7</b>	<b>Develop a charitable campaign for LED lamps for socially vulnerable households, leverage external financing</b>
Description	See SEAP R.5

<b>EA8</b>	<b>Co-finance small-scale common space EE retrofits in MAB sector by attracting commercial loans</b>
Description	See SEAP R.2

<b>EA9</b>	<b>Promote and get guarantees in residential buildings by reducing risks in EE investments</b>
Description	See SEAP R.3

<b>EA 10</b>	<b>Develop market for local companies providing energy services based on energy performance contracting (EPC)</b>		
Action classification	Capital Investment Capacity building		
Objective	Integration of Energy Performance Contracting (EPC) into municipal procurement, initiating EPC projects and capacity building		
Description	<p>In order to successfully develop market for local companies providing energy services based on EPC, to help bring private sector participation in municipal sector, and take advantage of private sector knowledge and skills, the following actions are proposed:</p> <ul style="list-style-type: none"> <li>- The Municipality of Yerevan will seek help from donors and IFIs active in the field for technical assistance. Special financial mechanism is established fund to co-finance EPC pilot project. It is assumed that 50% of the pilot project investments will be covered by the mechanism. The Fund will employ EPC facilitators to prepare pilot projects during the years 2-10 of the action. In the second and third year one pilot project will be started (contract will be signed) and in the following years three pilot projects per year will be started. It is assumed that external experts experienced in EPC project facilitation will be consulted on regular basis. The pilot projects will allow the new ESCOs to get experience and references needed.</li> <li>- The city will hire personnel and provide them with necessary training to make them capable of operating the mechanisms.</li> </ul>		
Action owner	Municipality of Yerevan, with support from donors & IFIs (e.g. EBRD, EIB, UNDP, R2E2, etc.)		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
		X (x) cost of energy saving measures	operation costs are reduced by amount of energy saved
Calculation Method	Expert's estimate		
Savings and benefits	EPC contracts will allow companies to attract specialized energy-efficiency service providers in traditional construction and renovation works, to implement successful solutions for upgrading the buildings, to reduce external funding needs and to mitigate investment risks. Savings will be calculated based on energy consumption and reduction of costs (considering adjustments of weather conditions) compared to previous years, change in exploitation and maintenance expenses, as well as recalculation of embedded financial intermediation.		
Financing options	Own means of the Municipality for construction works, ESCO's own means or loan funds of commercial banks, international financial organizations, REEF		
Recommended year of implementation	2020-2025		
Plan	In annual renovation activities will be chosen municipal buildings which have sufficient energy efficiency and meet ESCO funding criteria, such as through the REEF		
Key measures for tracking	Number of EPC contracts / buildings targeted, % energy saving, private investments		

<b>EA11</b>	<b>Use renewable energy and municipal solid and liquid waste in municipal buildings. Install solar water heaters in administrative buildings, pre-schools, sports schools and complex sports schools for children and teenagers where there is demand for hot water</b>
<b>Description</b>	<b>See SEAP P.5</b>
<b>EA12</b>	<b>Use solar PVs for external lighting facilities of yard areas and entrances of multi-apartment buildings</b>
<b>Description</b>	<b>See SEAP L.3</b>
<b>EA13</b>	<b>Promote installation of solar water heaters and PV systems in private housing areas through private investments</b>
<b>Description</b>	<b>See SEAP R.4</b>
<b>EA14</b>	<b>Utilize methane for electricity generation at Nubarashen municipal solid waste landfill</b>
<b>Description</b>	<b>See SEAP M.1</b>
<b>EA15</b>	<b>Develop a replicable financing scheme for residential and public building energy efficiency with built-in repayment, revolving and credit guarantee features</b>
<b>Description</b>	<b>See SEAP P.5, R.3</b>
<b>EA16</b>	<b>Gradually replace inefficient lights throughout Yerevan using the savings for a built-in repayment mechanism to allow for loans as well as a revolving mechanism for reinvesting any further savings into further street lighting upgrades</b>
<b>Description</b>	<b>See SEAP L.1</b>

<b>EA 17</b>	<b>Develop a database and capacity assessment for introducing external lighting infrastructure smart network to allow the operator to exercise remote access, dimming, runtime scheduling, outage detection, etc</b>		
Action classification	Capital Investment Capacity building		
Objective	Integration of smart technologies in the street lighting network.		
Description	Develop a database and capacity assessment for introducing external lighting infrastructure smart networking (to allow the operator to exercise remote access, dimming, runtime scheduling, outage detection, etc.)		
Action owner	Development and investment programmes department		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
		10,000 / year	
Calculation Method			
Savings and benefits	Annual reduction of the cost of exploitation and maintenance of the external lighting system, change in the volumes of energy consumption in accordance with the quality of lighting.		
	Improving the quality of outdoor illumination, comfort and safety conditions, exploitation and maintenance costs, EE investment financing from savings.		
Financing options	Municipality of Yerevan with support from donors & IFIs (e.g. EBRD, EIB, UNDP, R2E2, etc.)		
Recommended year of implementation	2020-2021		
Plan	Feasibility analysis, development of new framework, implementation by stages		
Key measures for tracking	Database developed on Yerevan street-lighting infrastructure		

<b>EA 18</b>	<b>Develop a logistical framework and assessment for enhancing the efficient lighting revolving fund with energy saving proceeds accumulating from both UNDP and EBRD/E5P funded projects (after EBRD loan repayment) to generate sufficient resources to scale up the street-lighting retrofits for the remaining streets</b>		
Action classification	Capital Investment Capacity building		
Objective	Integration of smart technologies in the street lighting network.		
Description	Develop a database and capacity assessment for enhancing the efficient lighting revolving fund with energy saving proceeds accumulating from both UNDP and EBRD/E5P funded projects (after EBRD loan repayment) to generate sufficient resources to scale up the street-lighting retrofits for the remaining streets		
Action owner	Development and investment programmes department		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
		X (x) cost of energy saving measures	operation costs are reduced by amount of energy saved
Calculation Method			
Savings and benefits	Annual reduction of the cost of exploitation and maintenance of the external lighting system, change in the volumes of energy consumption in accordance with the quality of lighting.		
	Improving the quality of outdoor illumination, comfort and safety conditions, exploitation and maintenance costs, EE investment financing from savings.		
Financing options	Municipality of Yerevan with support from donors & IFIs (e.g. EBRD, EIB, UNDP, R2E2, etc.)		
Recommended year of implementation	2020-2022		
Plan	Feasibility analysis, development of new framework, implementation by stages		
Key measures for tracking	Database developed on Yerevan street-lighting infrastructure		

<p><b>WsA1</b></p>	<p><b>Construction of the new sanitary landfill for MSW and operation of the facility (PPP Project) Closure and reclamation of existing dumpsites in Nubarashen and Ajapnyak</b></p>
<p>Action classification</p>	<p>Investment</p>
<p>Objective</p>	<p>To construct and operate a new sanitary landfill for the MSW disposal in order to reach EU environmental standards in waste disposal and waste treatment standards. To close the transformation process from officially organised dumping of MSW to the regional MSW landfilling concept. Closure and reclamation of the major operating dumpsites in Yerevan is the only way to avoid (un)controlled dumping of waste and littering and minimisation of damage to environment</p>
<p>Description</p>	<p>Sanitary landfill: To set up international standards like waste management system of the city (region), specific investments in the MSW disposal must be made. The basic municipal solid waste disposal facility is a sanitary landfill. The sanitary landfill can be described as a properly located waste disposal site which is provided with lining, water and gas inner drainage system, surface water drainage system, constructed and operated in a way assuring its stability and precluding any leakage of landfill leachates. The estimated capacity of the regional landfill serving Yerevan for MSW disposal is ca 300,000 t pa. The optimal location for the landfill has already been found, it is the site of operated Nubarashen dump. The landfill will be constructed in segments and provided with landfill gas treatment system for methane combustion and production of heat-electricity. It is recommended by the consultant that ca 5 - 10% of its capacity is designed for the disposal of hazardous waste.</p> <p>The project with the title: Yerevan solid waste project, had already been formulated covering construction of the new sanitary landfill for MSW . The project had already been launched and the first phase covering project design was completed. The private partner (operator of the landfill) would not participate in financing of the construction activities. The landfill facility is to be operated under a Design-Build-Operate arrangement. In 2017, the municipality launched the non-binding request for expression of interest aiming at companies interested in sustainable solid waste pre-treatment investment project via a Public Private Partnership.</p> <p>Closure of existing waste dumping sites There are several waste dumping sites in the territory of Yerevan operated officially for the MSW disposal. For future only the new Nubarashen sanitary landfill should serve as the only MSW disposal site for Yerevan region. It is important to avoid any further dumping of MSW on unofficially and officially operated sites including the Nubarashen, Ajapnyak, and other sites. The way to this objective goes through the closure of these dumping sites and their reclamation. The proper reclamation provided in accordance with international standards is important in order to minimise negative environmental impacts, to determine new possibilities of the resettled area use. Reclamation usually comprises concentration of the waste scattered around the site on the landfill body, reshaping of the landfill body to assure its stability (maximum slope inclination up to 1:2,5), installation of the landfill gas drainage system (depending on the landfill gas</p>

	<p>generation rate), insulation of the surface landfill body (plastic foil, mineral insulation), drainage layer, soil layer, vegetation, construction of the surface water drainage system, instalation of the landfill gas harnessing utility (biofilter/ flare). Smaller dumps (less than ca 1,000 m3 of waste) can be excavated, recyclables can be sorted out and the residual waste transported to the sanitary landfill for disposal. Reclamation usually comprises concentration of the waste scattered around the site on the landfill body, reshaping of the landfill body to assure its stability (maximum slope inclination up to 1:2,5), instalation of the landfill gas drainage system (depending on the landfill gas generation rate), insulation of the surface landfill body (plastic foil, mineral insulation), drainage layer, soil layer, vegetation, construction of the surface water drainage system, instalation of the landfill gas harnessing utility (biofilter/ flare). Smaller dumps (less than ca 1,000 m3 of waste) can be excavated, recyclables can be sorted out and the residual waste transported to the sanitary landfill for disposal. Reclamation process should start with the major dumpsites (Nubarashen, Ajapnyak, and continue to gradually clean all the territory of Yerevan. Firstly, a detailed mapping of dumping sites should be provided as a part of the GCAP activity LA10. Based on the results of mapping of such sites (position, size, composition, environmental assets in risk, estimated reclamation costs), prioritization of smaller sites reclamation will determine the following steps.</p> <p>For reclamation of mining waste disposal sites financial reserves allocated for this purpose should be effectively used to ensure adequate environmental protection including monitoring of environmental assets</p>		
Action owner	Communal services department		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Project	26 000	220
Calculation Method	<p>The source for the Project costs are taken from official documents (HYDRO INGENIEURE, RCE, KPC TRANSPROJECT (2012): Yerevan Solid Waste Project – Technical Feasibility Study, Preliminary Design, Technical Report) and other available information Expert judgment of costs for reclamation: 150,000-400,000 EUR/ha</p>		
Savings and benefits	<p>Investment into environmentally friendly means of waste disposal can be understood as savings in a prospective addressing of environmental burdens resulting from waste mistreatment. The sorting for recycling is a potentially profitable activity which depends on many factors, basically on an existing demand for commodities sorted. From EU perspective MSW sorting and recycling of ca 40% of recyclables of MSW can bring significant income to the Municipal (communal services) budget resulting in ca 20% decrease of waste collection and disposal fee.</p> <p>Dumpsites after closure and appropriate reclamation will generate substantial amounts of landfill gas which will be utilised for energy production (heat and/or electricity). Reduction of CO2, as a result of reclamation, can generate profit from emissions allowances sale. Estimated increase in value of the land around dumpsites (900 ha) after their reclamation is ca. 2,000,000 EUR. (HYDRO INGENIEURE, RCE, KPC TRANSPROJECT (2012): Yerevan Solid Waste Project – Technical Feasibility Study, Financial Analysis)</p> <p>This measure will also prevent citizens from dumping and littering.</p>		

Financing options	EBRD: EUR 8 mil. loan EIB: EUR 8 mil. loan EU: EUR 8 mil. grant E5P: EUR 2 mil. grant
Recommended year of implementation	
Plan	Assumed tendering procedure commencement for the sanitary landfill construction and operation: 2018 Assumed start of the procurement procedure - the Nubarashen and Ajapnyak dumpsite reclamation: 2018 Assumed commencement of operation of the new sanitary landfill, phase 1: 2019-2020 Assumed commencement of operation of the new sanitary landfill, phase 2: 2024-2025 Assumed commencement of operation of the new sanitary landfill, phase 3: 2029-2030 (modified : Yerevan solid waste project-technical feasibility study, Financial analysis, 2012)
Key measures for tracking	EU standards for landfilling Weight of MSW delivered to the new sanitary landfill Surface water quality improvement GHG emissions reduction (expected GHG emission reduction for Nubarashen: ca 45 kt CO2 eq. p.a.) Air quality improvement

WsA2	<b>Consider possibility of constructing a new MSW sorting and recycling plant in the framework of public-private partnership</b>		
Action classification	Investment		
Objective	To organize the waste sorting and recycling process within public-private partnership.		
Description	<p>Waste sorting and recycling process is considered the most important component of solid waste management, being a combination of different business processes and driven by the choice of product types and possibilities for their utilization. In this context, the Municipality considers waste sorting and recycling as a business plan and anticipates to organize this process within the framework of public-private partnership, which should lead to a decrease in waste levels and positive environmental impact, provide a maximum possible income (municipal budget), and leave the choice of technological solutions and resulting products to the investor's discretion.</p> <p>If no financially viable (i.e. not requiring a subsidy) business plan is presented to the given initiative, the initiative will be postponed until an appropriate new solution appears.</p>		
Action owner	Communal services department		
Stakeholders	Municipality, private investors		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
		Subject to evaluation by private investors	15,000 (operating costs for organizing and monitoring the tender)
Calculation Method	Expert's estimate		
Savings and benefits	Amount of sorted and processed waste The decrease in the HW emissions in the landfill Improvement of environmental indicators		
Financing options	Public-private partnership		
Recommended year of implementation	2018-2020 (allowing for a delay in case of lack of appropriate business plans)		
Plan	Tender in 2018 and summarize the results Upon availability of an acceptable programme, define a framework for a contract with the winner Construction and exploitation of sorting and processing plant in 2019-2020		
Key measures for tracking	Surface water quality improvement GHG emissions reduction (expected GHG emission reduction for Nubarashen: ca 45 kt CO2 eq. p.a.) Air quality improvement		

WsA3	Development of the Ten-Year Waste Management Plan for Yerevan
Action classification	Monitoring and data collection
Objective	To develop a waste management plan of Yerevan to set up a framework for systematic planning, development and monitoring of waste management system in Yerevan.
Description	<p>Waste management plan is a strategic planning document which is annually updated based on monitoring of waste streams and possible changes in legislation. It covers both municipal and private sector. The WMP typically consists of the following sections (EU Directive 98/2008 EC and European Commission, Directorate General - Environment: Preparing a Waste Management Plan - A Methodological Guidance Note, 2012):</p> <p><b>Background</b></p> <ol style="list-style-type: none"> <li>1 Overall waste problematic in a territory</li> <li>2 EU legislation</li> <li>3 National legislation</li> <li>4 Description of national waste policy and prevailing principles to address Point 1 above, in line with the waste hierarchy</li> <li>5 Description of objectives set in specific areas</li> <li>6 Inputs from the consultation process</li> </ol> <p><b>Status part</b></p> <ol style="list-style-type: none"> <li>1 Waste amounts, e.g.: waste streams, waste sources, waste management options</li> <li>2 Waste collection and treatment for the above</li> <li>3 Waste shipment</li> <li>4 Organisation and financing</li> <li>5 Assessment of previous objectives</li> </ol> <p><b>Planning part</b></p> <ol style="list-style-type: none"> <li>1 Assumptions for planning</li> <li>2 Forecast in terms of waste generation, total and per waste stream</li> <li>3 Determination of objectives for forecasted: waste streams, waste sources, waste management options</li> <li>4 Plan of action, including measures for achieving objectives: collection systems, waste management facilities, responsibilities, economy and financing</li> </ol> <p><b>The development of such waste management plan presumes:</b></p> <ul style="list-style-type: none"> <li>- <b>collection of statistical data on different types of waste generated in a municipal and private sector, treated, used and disposed of per year</b></li> <li>- collection of statistical data on existing other waste (industrial, agricultural) disposal facilities capacities (if existing).</li> </ul> <p><b>Special focus should be put on the planning of capacities for hazardous waste disposal facilities (including public and private sector).</b></p> <p>As one of the functional measures verified on international level (EU) is the policy of granting permission of operation to enterprises (for future and existing enterprises) under condition that waste disposal/treatment of individual enterprise will be ensured in accordance with environmental standards applicable in EU region. The waste could be disposed of on facility owned by the enterprise or the waste disposal services can be outsourced. Fulfilling this condition must be monitored and in case of noncompliance, sanctions will be applied, in the extreme case the permission to operation could be suspended.</p>

	<p>The waste management plan should be designed in cooperation with the Green City Awareness Center (see activity WsA10) and be based on the specific waste management data (see activity WsA9). Measures to enforce the sound waste management system of the city shall be harmonised with the national legislation applicable in the waste management sector, it is predictable that the current national legislation will necessitate certain amendments. The waste management plan of Yerevan should be based on basic principles: polluter pays and the principle of self-sufficiency and proximity. Extended producer responsibility is long-term goal. The following waste hierarchy shall apply as a priority order in waste prevention and management policy: (a) prevention; (b) preparing for re-use; (c) recycling; (d) other recovery, e.g. energy recovery; and (e) disposal.</p>		
Action owner	Communal services department, EBRD		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	The Municipality will facilitate 1 inhouse expert to coordinate and cooperate on the first waste management plan design, cooperation with the GCAC	na	15
Calculation Method	2 men-years, 600 EUR gross wage per month		
Savings and benefits	na		
Financing options	Municipality, grants		
Recommended year of implementation	2018-2019		
Plan	<p>Implementation of the activity will be divided into 3 stages:</p> <ul style="list-style-type: none"> <li>- collection of annual data on waste streams both from a households and a private sector as well as on existing capacities of waste treatment and disposal facilities (see activity WsA9)</li> <li>- based on the collected data and results of tendering procedure for selection of the sorting-for-recycling provider (should be completed by the end of 2017) to design the waste management plan for the next 10 year period following the above introduced structure to be adopted by 2019.</li> <li>- annual update of performance data and revision of goals of the waste management plan.</li> </ul>		
Key measures for tracking	<p>Percentage of MSW and other waste (including HW) landfilled is disposed of in EU-compliant sanitary landfills                  Share of the population with regular municipal solid waste collection                  Proportion of MSW that is sorted and recycled                  Total solid waste generation per capita                  Overcapacity issues in waste disposal sites are tackled through plans and investment</p>		

<b>WsA4</b>	<b>Delivery of regular awareness campaigns focused on the waste-disposal fee in cooperation with the Green City Awareness Centre</b>
Action classification	Awareness and education
Objective	To reach an overall understanding of the connection between modern waste management system of the city and costs on its operation.
Description	<p>Introduction of the modern waste management system for the city requires standardized waste disposal facilities. To acquire the facility the sound investment plan should always be prepared (as it is now for Yerevan). Although a significant part of the budget for the investment action is covered by the EU 8 mil. grant, the construction and operation of the new sanitary landfill (PPP Yerevan solid waste project) must be sustainable, generating adequate profit for the private landfill operating company. Similarly, the city is aiming at the balanced budget. The worlds´ best practice in the waste management sector endorses the "polluter pays" principle. Therefore, citizens generating waste should bear adequate but also socially acceptable costs linked with the proper waste disposal. This is the way to the sustainable modern waste management system. A well-developed waste management system generates a number of new jobs, new type of services, brings social, health and environmental benefits. The process of the introduction of sustainable waste management fee for citizens (see activity WsA5) must be smooth, done with respect to the related real waste management costs on one hand and a current economic situation and affordability mainly for the low-income groups on the other. There is a number of tools for mitigation of waste management fee impacts on the low-income groups which can be applied.</p> <p>Therefore, awareness campaigns will be delivered annually, in the period of introduction of the new landfill operating system campaign should be done even more frequently. It is necessary for us that citizens would understand the improvements as a result of united Municipality-EBRD-EIB-EU efforts and investments to waste management system. These improvements must be visible so that they would accept the correlation. Municipality together with the Green City Awareness Centre (GCAC) will develop and deliver campaigns. The GCAC will support municipality with expertise, will assist with activation of volunteers, NGOs, students, all participating in campaigns. Campaigns will also include media. The municipality will also make its efforts to introduce so called Pay-as-you-throw (PAYT) system in a long-term period. In this system citizens pay only for the amount of waste they generate - the system is non-solidary. The system works well in cities where the waste collection fee success rate is close to 100% and usually motivates people to generate less waste, to separate mixed municipal solid waste components (paper, glass, plastic, metals, biodegradable waste).</p>
Action owner	Communal Services Department)

	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
Resource Requirements	The Municipality will facilitate 1 person responsible for the organizing the campaign and 1 assistant. Each marzes of Yerevan will do the same.	na	55
Calculation Method	OPEX: advertising and promotional materials + distribution + field work, altogether 48 men-working-months p.a., 600 EUR (average gross wage), other operational costs (transport, communication)		
Savings and benefits	na		
Financing options	Municipality, grants		
Recommended year of implementation	2018-2022		
Plan	<p>Activities to be undertaken in cooperation with the GCAC:</p> <p>2018: campaign focused on progress made within the last period (waste collection system), changes to the future (new sanitary landfill, Yerevan solid waste PPP Project), introduction of the GCAP goals set for the waste management sector.</p> <p>2019: campaign focused on progress made within the last year,</p> <p>2020: campaign on waste management fee collection success rate, progress made within the last year,.</p>		
Key measures for tracking	<p>Share of citizens covered by awareness campaigns</p> <p>Increase of the success rate of the waste collection and disposal fee</p> <p>Decrease in littering</p>		

<b>WsA5</b>	<b>Review the applicability of international best practice for MSW collection and disposal fee</b>		
Action classification	Awareness and education		
Objective	To ensure that the Yerevan waste management system, undergoing substantial modernisation, is sustainable in terms of economy.		
Description	<p>Introduction of the modern waste management system for the city requires standardized waste collection system and disposal facilities. Review of the international best practice should be carried out to assess any need for adjustment of the current system.</p> <p>Special attention should be dedicated to prevention of waste generation and other pro-active measures on the part of the citizens.</p>		
Action owner	Communal Services Department		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	<p>The Municipality will facilitate 1 person responsible for and executing the waste management fee agenda. Consultations with Yerevan solid waste project, Ministry of Nature Protection and other stakeholders are expected.</p>	na	16
Calculation Method	OPEX: altogether 24 men-working-month per annum, 600 EUR (average bruto wage), + 1,600 EUR other operational costs (transport, communication)		
Savings and benefits	na		
Financing options	Municipality, grants		
Recommended year of implementation	2020		
Plan	<p>After a provider of landfill construction and operation will be contracted (2018), simultaneously with the preparatory works on the waste management plan for Yerevan (see activity WsA3), the preparatory works on the waste management fee adjustment will commence.</p> <p>In 2020 the strategy should be ready so that awareness campaign (activity WsA4) introducing the adjusted waste management fee can start.</p> <ol style="list-style-type: none"> <li>1. analysis of international best practices</li> <li>2. assessment of its applicability on Yerevan's situation</li> <li>3. development of measures to support waste generation reduction</li> </ol>		
Key measures for tracking	<p>Understanding of citizens of MSW collection and disposal and its impact on the disposal fee</p> <p>Willingness of citizens to pay the MSW collection and disposal fee</p>		

WsA7	Pilot project on biodegradable waste composting in Yerevan		
Action classification	Awareness and demonstration		
Objective	Demonstrate that composting of household green waste is worth doing.		
Description	<p>Households and markets generate substantial amount of organic waste (ca 30-50 wt% of MSW) that is fully compostable. Composting is a natural process of biodegradation of organic materials which can be provided by a very simple equipment - composter (perforated plastic/wooden box) and in conditions usual for common households. Its only condition is a piece of soil for the composter to be placed on. The composting process duration varies significantly, depending on various conditions. Usually every year one "harvest" of compost is generated. The product of composting can be used as fertilizer on a garden, in flowerpots, etc. Compost significantly improves the quality of degraded soil. Composting can substantially reduce amount of waste generated, transported and disposed of. Communal composting brings together condominium community, neighbourhood community, etc.</p> <p>Typical example of a pilot project focused on public composting works with the concept of communal composting, where one composter is placed on a green shady place close to the municipality/condominium/school and people who are interested in composting bring "organic waste" to the composter. One volunteer takes care of the composter to be wet and aerates the material by digging, if needed. After 3-12 months the compost is mature and can be sieved. Composters can also be distributed to individual houses with gardens. The volume of such composters varies from 0.4 to 1.2 m3. For one household (4 members) without a garden 0.4 m3 composter is proper.</p> <p>The Project must be accompanied by awareness campaign and training sessions for the public. Action on the level of selected marzes is the most important. The campaign will focus not just on:</p> <ul style="list-style-type: none"> <li>- recent changes in MSW management system of Yerevan, introduction of the GCAP, GCAC</li> <li>- the goal of the Project</li> <li>- basic terminology, principles of composting</li> <li>- how to grow my own compost</li> <li>- pros and cons of composting</li> <li>- how to participate</li> </ul> <p>The Project can be extended on other marzes in the following phase and updated based on the lessons learned.</p>		
Action owner	Communal Services Department		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Provision of information leaflets	na	5
	Purchase of 500 composters	30	
	Management of the project and training of public	na	25
Calculation Method	25 men-working-months, one composter: EUR 20-60		

Savings and benefits	The separation and composting of biodegradable waste can reduce the amount of waste collected, transported and disposed on landfill up to 50 wt%, which significantly reduces waste management costs.
Financing options	Municipality, grants
Recommended year of implementation	2018-2020
Plan	2018: Yerevan municipality together with the Green City Awareness Centre will start organising the project, awareness campaign, purchase of composters 2019: Implementation of the Project (distribution of composters, training) 2020: Implementation of the Project, evaluation of results of the first phase of the Project
Key measures for tracking	Decrease of MSW disposed of on the landfill Decrease in GHG emissions Satisfaction of participants in the project

<p><b>WsA9</b></p>	<p><b>Creation and operation of database of MSW generated, treated, used and disposed of, the same action for the other waste on a voluntary base</b></p>
<p>Action classification</p>	<p>Monitoring and data collection</p>
<p>Objective</p>	<p>To collect specific data on municipal solid waste (MSW) generated, treated, used and disposed of to be digitalised, used for the Yerevan waste management system evaluation and future planning, and published in the form of on-line database. The same objective is set for collection of specific data on other waste, in short term the reporting of enterprises is expected to be voluntary.</p>
<p>Description</p>	<p>Originators of waste in Armenia are obligated to report on the waste generated, used and disposed of to the Ministry of Nature Protection. Such data are processed, aggregated and published by the National Statistical Service of the Republic of Armenia annually. Waste management data do not cover Yerevan waste sector in a desired detail yet. Detailed waste management data means data on waste generated in tones (mixed municipal solid waste, plastic, paper, metals etc.), treated, used and disposed of following the national coding system. Collection of detailed waste management data is necessary for future waste management planning by the municipality and its publication helps potential investors and research organisations to study and plan their business activities, conduct surveys, research works. In case of other waste (waste from the industrial, agricultural, service and other sectors), the public availability of the waste management data is even more important, because of the higher amounts of waste generated in these sectors. It is also a transparency which enhances prestige of companies. Examples of the waste utilization according to EC Directive 2008/98: use principally as a fuel or other means to generate energy, solvent reclamation/regeneration, recycling/reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes), recycling/reclamation of metals and metal compounds, recycling/reclamation of other inorganic materials, regeneration of acids or bases, recovery of components used for pollution abatement, recovery of components from catalysts, oil re-refining or other reuses of oil, land treatment resulting in benefit to agriculture or ecological improvement, use of waste obtained from any of the operations mentioned above, etc.) Examples of waste disposal according to EC Directive 2008/98: deposit into or on to land (e.g. landfill, etc.), land treatment (e.g. biodegradation of liquid or sludgy discards in soils, etc.), surface impoundment (e.g. placement of liquid or sludgy discards into pits, ponds or lagoons, etc.) release into a water body, biological treatment, physic-chemical treatment, incineration, permanent storage (e.g. emplacement of containers in a mine, etc.), blending or mixing, repackaging, etc. according to EC Directive 2008/98). Although not all of the potential means of waste utilization and disposal are applicable to Yerevan now, it is important for future to develop the data collection system accordingly. In case of other waste data publishing it should be done on a voluntary base (in short-term period) - in practice, industrial companies can decide whether to refer their data on their waste management to the Municipality to be published or not. Their legal obligations are not affected. The current national waste coding system can be understood as a hurdle for massive publishing of waste management data of</p>

	<p>enterprises because the coding can be seen as too revealing production technology (protection of intellectual property). This can be solved on the national level by introduction of the waste coding system applied in EU.</p> <p>In practice the Information System on Waste Management of Yerevan (ISWMY) would enable to search for each type of waste generation (including mixed municipal solid waste, plastic, paper, glass, etc.), ways of the waste treatment and disposal for the city as a whole and for individual marzes (where possible)</p>		
Action owner	Municipality of Yerevan (Communal Services Department)		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Monitoring and data collection	100	20
Calculation Method	Analogy with existing systems of similar extend (CAPEX), 10,000 p.a. for the technical support of the system, 10,000 p.a. for personnel of the municipality and MoNP at the inception phase of the digitization		
Savings and benefits	<p>Effectivity and sustainability of the waste management system can be reached only based on figures on current waste management performance. Collection of the detailed data will enable to plan the Yerevan waste management system (see activity WsA3) will help to develop sound strategy for waste management fee for citizens (see activity WsA5).</p> <p>Digitization of the processing of administrative data can save a few percent of costs p.a.</p>		
Plan	<p>2018: in cooperation with the GCAC (see activity WsA10) prepare the tender dossier for tender procedure to contract supplier of the database system.</p> <p>2019: selection of the supplier and completion of the database</p> <p>2020: trial operation</p>		
Key measures for tracking	<p>Number of other waste generators reporting on their waste to the municipality</p> <p>Number of visits of the database</p>		

WaA1	Launch of installation of metering devices within the water supply system		
Action classification	Surveying and water infrastructure data collection Investment Capacity building		
Objective	To ensure more detailed monitoring of local water supply system in order to identify problematic areas (districts) which contribute the most to high water losses.		
Description	In order to successfully implement and launch the district metering, the following actions are proposed: - based on water utility operational experience the plan for convenient placement of metering devices on the water supply network will be prepared - installation of metering devices will be done - information about devices and obtained data from metering will be interconnected with GIS database		
Action owner	State Committee of Water Economy, Water utility		
Stakeholders	Municipality, NGOs		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Purchase of metering devices	350	na
	Installation of metering devices	na	na
	2 experts for monitoring and processing of metered data	na	3,0
Calculation Method	Purchase of about 150 metering devices, estimated cost per device: EUR 2,300		
Savings and benefits	Savings will be related to the reduction of water leakage and thus higher efficiency of the water system		
Financing options	Government, water utility		
Recommended year of implementation	2019 - 2020		
Plan	The installation of metering devices will be carried out within three stages: 1. preparatory stage - preparation of the plan for placement of devices 2. installation stage - installation of devices and their control 3. implementation stage - data from metering will be interconnected with GIS database or internal database of Water Utility		
Key measures for tracking	Water Balance Method after IWA methodology Non-Revenue Water indicator Number of metering devices installed		

WaA2	Development of Leak Reduction Action Plan		
Action classification	Monitoring and data collection Cooperation and collaboration		
Objective	Based on previous District Metering stages data/information about water supply system will be available as input data for the implementation of Leak Reduction Action Plan.		
Description	<p>In order to develop the Leak Reduction Action Plan, the following actions are proposed:</p> <ul style="list-style-type: none"> <li>- input data/information will be processed, evaluated and checked</li> <li>- the whole water supply network will be assessed according to volume of leakages, within Metering Districts, and subsequently a gradual process of proper actions will be proposed</li> <li>- areas with the most severe leakages will be defined as key priorities for future rehabilitation works</li> </ul>		
Action owner	State Committee of Water Economy, water utility		
Stakeholders	Municipality, NGOs		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Development of LRAP	150	na
Calculation Method	na		
Savings and benefits	More effective investments in order to reduce water losses		
Financing options	Government, water utility, grants		
Recommended year of implementation	2020 - 2023		
Plan	<p>Development of the Leak Reduction Action Plan will be carried out within three stages:</p> <ol style="list-style-type: none"> <li>1. preparatory stage - metered data processing and evaluating</li> <li>2. assessment stage - areas with the most severe leakages will be defined</li> <li>3. proposal of measures - actions in order to reduce leakages will be proposed (e.g. pro-active measures, pressure management solutions, repair works etc.)</li> </ol>		
Key measures for tracking	LRAP time schedule as agreed between the City of Yerevan and the water utility		

<b>WaA3</b>	<b>Enforcement of the concession agreement between the Ministry of Energy Infrastructure and Natural Resources and the water utility</b>		
Action classification	Cooperation and collaboration		
Objective	Fulfilment of agreed investments under the lease agreement		
Description	The operation of the water infrastructure in Yerevan now falls under a 15 -year lease agreement between the Ministry of Energy Infrastructure and Natural Resources and Veolia. The lease agreement includes a pledge by the Ministry to implement a USD 200 mil. investment programme into water infrastructure. This provides an opportunity for the development of water infrastructure in Yerevan. The enforcement of this agreement should be monitored also by the Municipality.		
Action owner	State Committee of Water Economy, Water Utility		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	na	na	na
Calculation Method	na		
Savings and benefits	Benefits relate to the timely implementation of all water system enhancements defined in the concession agreement. This should ensure high quality of service and system efficiency.		
Financing options	na		
Recommended year of implementation	2017 - 2025		
Plan	Regular monitoring and discussion with the water utility		
Key measures for tracking	Indicator of Continuity in drinking water supply (hours per day, month, year)		

WaA4	Central inventory database on water infrastructure - GIS		
Action classification	Surveying and water infrastructure data collection Capacity building		
Objective	Establishing an asset inventory based on GIS technology. All ongoing studies and design documentation will get the benefit of using GIS.		
Description	In order to successfully implement an asset inventory, the following actions are proposed: - carry out geodetic surveying and data on water infrastructure topology collection - establish GIS Department within the Communal Service Department of Yerevan Municipality. - share this GIS with the Water Operator		
Action owner	State Committee of Water Economy, Water utility		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Development of GIS system for collecting, storage, processing and release of data, including interactive maps	180	tbd
	Installation of GIS system	tbd	
	2 experts for the GIS system, one for water supply system and one for sewerage	na	3
Calculation Method	Expert judgment		
Savings and benefits	Savings will relate to planning and concrete investments into the system enhancements thanks to better knowledge of the current system		
Financing options	Government, water utility, grants		
Recommended year of implementation	2018-2020		
Plan	The GIS system will be developed within three stages: 1. preparatory stage - evaluating of GIS possibilities, financing and tendering 2. deployment stage - implementation of the GIS system, staff training and testing 3. commissioning stage - GIS system is put into operation		
Key measures for tracking	Percentage of water supply and wastewater systems mapped and inserted into GIS database		

WaA5	Development of Master Plan for the Water Infrastructure (WIMP)		
Action classification	Surveying and water infrastructure data collection Capacity building Cooperation and collaboration		
Objective	To process and prepare data/information about water supply and wastewater system. Based on these data, the Master Plan will be elaborated to ensure long-term sustainable development of both systems.		
Description	In order to successfully develop the Master Plan for the water infrastructure, the following actions are proposed: - development and approval of the methodology for executing the Master Plan for water infrastructure - collection of all needed data (e.g. data from District Metering, reviewing of all field data measurement, available data on wastewater composition, documentation of hydraulic structures, checking the completeness of all topological data, etc.) - processing of collected data and their graphical representation in a form of thematic maps (interconnection with GIS database) - assessment of current state and operation of the water infrastructure - definition of key challenges and measures in order to achieve long-term objectives - identification of external funding		
Action owner	State Committee of Water Economy, Water utility		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Development of conceptual tools for managing the city water infrastructure	3,000	tbd
	Establishing a team responsible for using and upgrading of the Master Plan	na	tbd
	Training of the personnel in utilisation of the Master Plan for the water infrastructure	na	30
Calculation Method	Design documentation and bill of quantities will be based on real state of the art of the water infrastructure asset.		
Savings and benefits	All ongoing design and tender documentation will be based on the knowledge on water infrastructure assets and its operation. This will result in investment savings.		
Financing options	Government, Water utility		
Recommended year of implementation	2022-2025		
Plan	The Master Plan for the water infrastructure will be developed within three stages: 1. preparatory stage - preparing the Terms of references including methodology 2. execution stage - executing the Master plan for water supply system and for urban drainage (sewerage) 3. decision-making stage - Master plan is being used for city development projects		

Key measures for tracking	WIMP development time schedule Part of the city Urban Development Plan (Yes/No)
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WaA6	Repairing and rehabilitation of water supply system with the highest water leakages		
Action classification	Investment Monitoring and data collection		
Objective	To repair the most problematic parts of public water supply system where the highest water leakages were monitored.		
Description	<p>In order to decrease volume of drinking water losses during distribution the following actions are proposed:</p> <ul style="list-style-type: none"> <li>- based on conclusions raised from the Leak Reduction Action Plan and operational experience the rehabilitation of the water supply system will be defined in areas where repairing is the most needed</li> <li>- tender documentation for repair works will be prepared and used for the execution of the works</li> <li>- actual execution of the repair works will be updated into GIS database</li> </ul>		
Action owner	State Committee of Water Economy, Water utility		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Execution of tender documentation	3,500	na
	Construction works	35,000	na
Calculation Method	Expert judgement		
Savings and benefits	Reduction of leakages, lower operational costs and higher system efficiency		
Financing options	Government, water utility		
Recommended year of implementation	2018 - 2020		
Plan	<p>The repairing and rehabilitation of water supply system will be carried out in three stages:</p> <ol style="list-style-type: none"> <li>1. preparatory stage - preparation of technical documentation</li> <li>2. execution stage - construction works</li> <li>3. assessment stage - reflecting actual execution into GIS database</li> </ol>		
Key measures for tracking	Kilometres of repaired water supply system (Share of total)		

WaA7	Repairing of connections between sewage and storm sewers		
Action classification	Investment Monitoring and data collection		
Objective	To repair parts of sewerage system that are surcharged due to connections between sewage and storm sewers. The main aim is to guarantee the inflow of wastewaters to the Central WWTP.		
Description	<p>In order to repair parts of the sewerage system and to allow wastewaters to inflow to the Central WWTP the following actions are proposed:</p> <ul style="list-style-type: none"> <li>- certain places/connections for repairing will be defined based on preliminary mapping and monitoring of wastewater system</li> <li>- tender documentation for repair works will be prepared and used for the project execution</li> <li>- actual execution of the repair works will be reflected into GIS database</li> </ul>		
Action owner	State Committee of Water Economy, Water utility, Municipality		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Execution of tender documentation	500	na
	Construction works	5,000	na
Calculation Method	Expert judgement		
Savings and benefits	Savings will depend on the number of identified connections; benefits will relate to decreased pollution of the Hrazdan river from sewage		
Financing options	Water utility, grants		
Recommended year of implementation	2025		
Plan	<p>The repairing of connections between sewage and storm sewers will be carried out within three stages:</p> <ol style="list-style-type: none"> <li>1. preparatory stage - sewerage system mapping and preparation of technical documentation</li> <li>2. execution stage - construction works</li> <li>3. assessment stage - reflecting actual execution into GIS database</li> </ol>		
Key measures for tracking	Kilometres of repaired sewage supply system (Share of total)		

<b>WaA8</b>	<b>Public awareness campaigns and workshops about the best practices of water usage, urban drainage, wastewater treatment, irrigation, Green Infrastructure solutions</b>		
Action classification	Awareness and public relations campaigns Capacity building		
Objective	Improve public knowledge on the best practices in water usage.		
Description	<p>In order to improve the public knowledge on the water infrastructure in the City, the following actions are proposed:</p> <ul style="list-style-type: none"> <li>- improve a public knowledge on the Water Supply System and its development including irrigation.</li> <li>- improve a public knowledge on Urban Drainage, sewerage and wastewater treatment.</li> <li>- raise awareness about Green Infrastructure-based alternatives - coordinate the City Master Plan for all parts of the City infrastructure.</li> </ul> <p>These actions should be developed under BA1 (Green City Awareness Centre)</p>		
Action owner	Green City Awareness Centre		
Stakeholders	State Committee of Water Economy, Water utility		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	na	na	na
Calculation Method	Expenses will be realized within the framework of the BA1 (Green City Awareness Center)		
Savings and benefits	Savings will depend on the success of the public awareness campaigns and relate to water savings and higher system efficiency following changes in user behaviour		
Financing options	na		
Recommended year of implementation	2018-2020		
Plan	<p>Public awareness campaigns will be organized at 3 stages:</p> <ol style="list-style-type: none"> <li>1. Water Supply and drinking water usage including irrigation</li> <li>2. Urban Drainage + Green Infrastructure alternatives</li> <li>3. Wastewater treatment</li> </ol>		
Key measures for tracking	<p>Number of awareness campaigns and workshops per year</p> <p>Number of participants</p>		

WaA9	Introducing the monitoring of microbiological indicators of surface water		
Action classification	Cooperation and collaboration		
Objective	To ensure monitoring of possible health risk caused by microorganisms in surface water in order to better protect of human health.		
Description	The City of Yerevan will, in cooperation with representatives of the marzes, discuss with the Ministry of Nature Protection the possibility of introducing the monitoring of microbiological indicators of surface water as a legislative requirement. In the meantime, the City of Yerevan will receive a regular monthly analysis of the microbiological indicators directly from the Economonitoring Center.		
Action owner	Communal Service Department of Yerevan Municipality		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Laboratory tests of water samples	na	2
Calculation Method	Expert's estimate		
Savings and benefits	na		
Financing options	Municipality		
Recommended year of implementation	2018 (direct communication between the City and the Economonitoring Center)		
Plan	na		
Key measures for tracking	Preparation/adoption of a legislative proposal Monthly analyses of microbiological indicators in surface water		

LA1	Carry out an assessment of possible further construction limitations of the Yerevan City Centre		
Action classification	Feasibility study		
Objective	Revision of Master Plan in order for all new developments after 2022 to comply with specific mixed-use urban development criteria		
Description	The rapid growth, especially in the construction business, as of early 2000s has negatively impacted on the urban and public space of Yerevan's city centre and raised public concern about the city's further development. Legal and regulatory efforts have been undertaken at the national level to address these issues and enable the preservation of the cultural heritage of Yerevan as well as to ensure its sustainable development. Assessment of possible further construction limitations of the Yerevan City Centre presents a method to achieving compliance with specific mixed-use urban development criteria		
Action owner	Chief architect / Urban development dpt.		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Feasibility study	tbd	na
Calculation Method	na		
Savings and benefits	The establishment of framework for further urban development will support sustainable development of the City and higher quality of life for its citizens		
Financing options	Municipality, other state institutions, grants		
Recommended year of implementation	2018-20120		
Plan	<ol style="list-style-type: none"> <li>1. Execution of feasibility study</li> <li>2. Implementation of its recommendations</li> </ol>		
Key measures for tracking	Parameters included in the Master Plan regarding mixed-use urban development and other construction boundaries		

LA2	<b>Install green transport infrastructure in selected public buildings or their vicinity. (See also TA14)</b>		
Action classification	Feasibility study		
Objective	Commercial and residential buildings will offer robust green transport infrastructure		
Description	This action builds on the commitments described in the Transportation section and foresees the facilitation of development of green transportation infrastructure in Yerevan. This should be done through facilitated administrative procedures regarding the installation of green transport infrastructure, lease of public land for such installations, active cooperation between developers and the municipality .		
Action owner	Development and investment programmes dpt./ Real Estate management dpt.		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Feasibility study	tbd	na
Calculation Method	na		
Savings and benefits			
Financing options	Yerevan Municipality, other state departments, EBRD, EIB, ADB		
Recommended year of implementation	2018-2022		
Plan			
Key measures for tracking	Number of charging points in public buildings or their immediate vicinity. Number of bike stands in the public buildings or in their immediate vicinity.		

<b>LA3</b>	<b>Develop rules on the implementation of green transport infrastructure in new buildings and major renovations. (See also TA14)</b>		
Action classification	Establish framework for implementation of green transport infrastructure (alternative fuel infrastructure, esp. ESVE)		
Objective	The City will have put in place measures supporting implementation of green transport infrastructure in new buildings and major renovations		
Description	Real Estate management dpt./ Urban Development dpt		
Action owner	Establish framework for implementation of green transport infrastructure		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Feasibility study	25	na
Calculation Method	Expert judgment		
Savings and benefits	Benefits will relate to the establishment of clear framework for the future development of green infrastructure and hence support green mobility growth		
Financing options	Yerevan Municipality, other state departments, EBRD, EIB, ADB		
Recommended year of implementation	2020-2022		
Plan	<ol style="list-style-type: none"> <li>1. Development of feasibility study</li> <li>2. Implementation of recommended rules</li> <li>3. Enforcement of rules</li> </ol>		
Key measures for tracking	Rules on the implementation of green transport infrastructure in new buildings and major renovations		

<b>LA4</b>	<b>Incorporate transit-oriented planning in the development of new areas and destinations</b>		
Action classification	Feasibility study		
Objective	Transit-oriented development will have become an integral part of Yerevan's urban development.		
Description	Public consultation and the Green City indicators highlighted the need to significantly develop the public transport system and do so in an environmentally friendly way. Incorporation of transit-oriented planning in the development of new areas and destinations will lead to better traffic situation in the city and to a greener, more sustainable transportation network in Yerevan. A green, efficient and effective transport management system will indeed lead to reduced emissions of pollutant gases and particulate matter and improve the air quality.		
Action owner	Urban Development dpt		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Feasibility study	35	n.a.
Calculation Method	Expert judgement		
Savings and benefits	Transit-oriented planning supports development of public transport and its attractiveness for the citizens. Benefits will hence relate to improved air quality thanks to a reduced reliance on private transport and support towards social inclusion.		
Financing options	Municipality, other state institutions, NGOs		
Recommended year of implementation	2018-2020		
Plan	1. Development of feasibility study 2. Implementation of recommended actions		
Key measures for tracking	Rules for transit-oriented planning		

<b>LA5</b>	<b>Carry out a feasibility study for enhanced and effective greening of Yerevan</b>		
Action classification	Feasibility study		
Objective	Prepare path for revegetation and reforestation of Yerevan, to create natural dust barriers, carbon captures and prevent soil erosion		
Description	Carry out a feasibility study for enhanced and effective greening of Yerevan within the partnership with local universities. The feasibility study should review the current Master Plan in terms of suitability of areas earmarked for greening, identify other potential areas for greening, recommend suitable greening methods, incl. plant types and identify options for the way forward, within the current limitation of land quality, state of contamination, availability of irrigation, and multiples services to be provided by the green areas.		
Action owner	Nature protection department		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Feasibility study	60	na
Calculation Method	Expert judgement		
Savings and benefits	Ultimate benefits will relate particularly to better air quality due to the growth of green spaces. Better planning will also lead to lower operational costs. Greening of urban spaces also incentivizes alternative mobility such as walking and biking and hence contributes to better human health.		
Financing options	Municipality, EBRD, UNDP, GCF, E5P, EIB, other state institutions		
Recommended year of implementation	2018-2019		
Plan	<ol style="list-style-type: none"> <li>1. Setting up project team with local experts and universities</li> <li>2. Development of the feasibility study</li> <li>3. Follow up with revegetation programme (LA6)</li> </ol>		
Key measures for tracking	Feasibility study Time schedule for the plan development Open green space area ratio per capita		

LA6	Implement the development plan for re-vegetation of Yerevan		
Action classification	Capital Investment		
Objective	Revegetation and reforestation of Yerevan, to create natural dust barriers, carbon captures and prevent soil erosion		
Description	Based on the feasibility study (LA5)		
Action owner	Nature protection department, Development and investment programmes dpt.		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Tree planting	10 per hectare	tbd
Calculation Method	Expert judgement		
Savings and benefits	<p>Ultimate benefits will relate particularly to better air quality due to the growth of green spaces.</p> <p>Better planning will also lead to lower operational costs.</p> <p>Greening of urban spaces also incentivizes alternative mobility such as walking and biking and hence contributes to better human health.</p>		
Financing options	Yerevan Municipality, EBRD, UNDP, GCF, E5P, EIB, other state institutions		
Recommended year of implementation	2019 - 2022		
Plan	Implementation of planting projects by stages in accordance with the feasibility study recommendations		
Key measures for tracking	Number of projects implemented		

LA7	<b>Undertake a demonstration project to green a public area hotspot (such as a public transport hub)</b>		
Action classification	Investment Raising awareness		
Objective	Converting an existing public hotspot into open green space		
Description	Greening an existing public area hotspot and therefore raising awareness and working words the goal of open green space area ratio of > 8.5 m2 per inhabitant in Yerevan.		
Action owner	Nature protection department		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Tree planting	30	3
Calculation Method	Expert estimate		
Savings and benefits	Benefits will relate particularly to better air quality in the centre of the city. Greening of a public transport hub area will increase the attractiveness of public transport and hence lead to the reduction of private transport. The demonstration project will help inform future greening actions targeting the increase of public transport use.		
Financing options	Municipality, other state institutions, grants		
Recommended year of implementation	2018 - 2019		
Plan	1. based on the new bus network model, identify the public transport hub for the demonstration project 2. Implement the demonstration project		
Key measures for tracking	Time schedule for the demonstration project implementation		

LA8	Continue to execute programmes supporting local ecosystems through incentives		
Action classification	Investment		
Objective	Open green space area ratio is > 8.5 m2 per inhabitant		
Description	Carry on with programmes supporting local ecosystems through incentives leveraging grants for neighbourhood greening projects, financial support to innovative irrigation solutions, etc.)		
Action owner	Nature protection dpt.		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Tree planting	30	na
Calculation Method	Based on previous programmes		
Savings and benefits	Benefits will relate particularly to better air quality in the city and increase in real estate value.		
Financing options	Municipality, green loans, EBRD, UNDP, GCF, E5P, EIB, other state institutions		
Recommended year of implementation	2018 - 2022		
Plan	Implementation should follow the established processes.		
Key measures for tracking	Number of programmes and allocated funds		

LA9	Develop a GIS-based environmental map of Yerevan		
Action classification	Monitoring and data collection		
Objective	To obtain Geographic Information System (GIS)-based environmental application of Yerevan as a tool for urbanistic planning and research activities		
Description	<p>Total digitization of data in municipal governance is a realistic picture of the future. Nevertheless, digitalization is a time consuming process especially in case of digitalization of archive documents (maps, reports). Once digitalized, data can be processed, analysed and displayed via software very quickly and for various purposes. Outputs of digitization can be presented in a synoptical form, enabling user friendly way of control. For digitization of archive data special scanning/digitization equipment is needed. Working with the GIS-based application has also certain requirements on computer hardware capacity as well as software equipment.</p> <p>GIS-based environmental map will comprise a number of digital layers with different information content. Already digitized data and databases should be integrated in this system. The environmental map should consist especially of geological, hygrogeological and hydrological layer, old, recent and actual topographical maps, water resources, potentially contaminated sites (activity LA10), maps of protected areas, biodiversity map, map of water, soil and groundwater quality. These layers of basic maps can be supplied with special maps like digital terrain map, flood territory, landslide areas, satellite images, vulnerability map, etc. The number of layers is not limited but the GIS should be operated by a hardware with capacity adequate to the amount of data processed. Individual layers can be uploaded independently and gradually one by one as the digitization process proceeds.</p> <p>The whole process can be divided into following parts: collection of existing digitized data, collection of existing analogue data, creation of new layers with new information content in a digital form (vulnerability maps, potentially contaminated sites, etc.) digitization of analogue data, development of the GIS application. Digitization process and development of the GIS system could be a common activity of the Municipality, universities, private companies, NGOs and the Green City Awareness Center. It is expected that the development of the GIS application will be a subject of a public procurement procedure.</p> <p>This GIS application will become an effective tool for urbanistic planning, evaluation of changes made, research activities. Selected layers overlay can help with analysis of urban development features, multicriterial analysis or reveal unexpected correlations.</p> <p>It is intended that the GIS application during its development will be available only for the authorised Municipal staff and other involved stakeholders. Later the application can be available to the public.</p>		
Action owner	Municipality of Yerevan		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Development of the GIS application	60	18
	Digitization, upload, update of the system	na	18
Calculation Method	Expert estimate (based on analogy with similar GIS applications)		

Savings and benefits	Once data is digitized it can be used for many purposes and processed very quickly. Digital data is more accessible to users, it enables easy search and orientation, digitization means great space saving, digital data utilization reduce printing, copying and document search costs, documents threatened by paper degradation can be rescued by digitization. Synthesis of data by GIS reveals priceless and unique contexts. Data can be used by multiple people at once without copying.
Financing options	Municipality, academic institutions, grants
Recommended year of implementation	2018-2020
Plan	<ol style="list-style-type: none"> <li>1. Selection of GIS application provider (by the end of 2018)</li> <li>2. Implementation of a trial version of GIS application with at least 3 levels of different information content (for example: geology, hydrology, topography) (by the end of 2019)</li> <li>3. Full implementation of the application for operation of 5 levels of different information content (by the end of 2020)</li> <li>4. Continuation of of digitization, upload and update of the GIS application as required to cover all environmental aspects</li> </ol>
Key measures for tracking	<p>Time schedule of the GIS based database</p> <p>Levels of information content</p>

<b>LA10</b>	<b>Rehabitation of green spaces and forests</b>
<b>Description</b>	<b>See SEAP G.1</b>

<b>LA11</b>	<b>Develop a thorough inventory of Yerevan's potentially contaminated sites (brownfield sites)</b>		
Action classification	Monitoring and data collection Feasibility study		
Objective	To obtain and centralise information on the location and extend of potentially contaminated sites in Yerevan as well as information on quality of potential contamination of soil, water and construction elements.		
Description	<p>Potentially Contaminated Site (PCS) usually means site, where historical or recent activities contaminating construction elements, soil or water occur (waste disposal sites, industrial objects, warehouses of waste and chemicals, objects after the former Soviet army, objects of RA army, electric transformer stations, tailing ponds, fuel reloading stations, petroleum stations, bus and truck parks, dry cleaners, etc.). Such contamination typically caused by a former state enterprise creates a burden which always causes certain obstacles for future development of such site. In some cases these sites are abandoned, in other cases their functional utilisation is problematic. These sites also usually occur in attractive locations close to the city centre having high potential for future development and a potential economic value. If such burden should be removed, the original barren place can be turned into an attractive green zone or public amenity site or functional industrial zone or other object.</p> <p>To collect all data available on PCSs a desk study dedicated to inventory of PCSs should be conducted in cooperation with the Green City Awareness Centre (see the activity WsA10). Study of archive documents of locations, extend, period and character of operations as well as memories of witnesses can provide authors of the inventory with baseline data. The data will be extended with satellite pictures, topographical maps, geological maps. The result will be a study accompanied with a GIS based map of expected locations of historical and recent PCSs, extend and quality of the of potential contamination (to become a part of the activity LA 9 output).</p> <p>Once the inventory is completed, a feasibility study focused on selection of 2-3 PCSs to be turned into a green public amenity site (or industrial zone), will be prepared. Based on this study, future investment into the LA11 activity should be planned.</p>		
Action owner	Municipality of Yerevan		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Development of the inventory of PCS	40	20
	Development of the feasibility study for clean-up of 2-3 PCSs	40	10
Calculation Method	<p>Inventory CAPEX: will be a subject to the international public procurement procedures, OPEX: 600 EUR gross wage per month, 4-3 persons for ca 12 months.</p> <p>Feasibility study: will be a subject to the international public procurement procedures, OPEX: 600 EUR gross wage per month, 1 person for ca 12 months.</p>		
Savings and benefits	At this stage no savings are expected. For future savings see follow-up activity LA11.		

Plan	By the end of 2018 the inventory of PCSs will have been completed By the end of 2019 the study for identification of 2-3 PCSs to be remediated will have been completed
Key measures for tracking	Time schedule for the inventory development

<b>LA12</b>	<b>Pilot project of remediation of a contaminated site and its transformation to a public green area equipped with amenities</b>		
Action classification	Investment Awareness and demonstration		
Objective	Demonstrate on example of 1 contaminated site located close to the city centre of Yerevan how an unattractive place of the contaminated site (brownfield) can be transformed into a green site.		
Description	<p>The term Contaminated Site (CS) refers to a well-defined area where the presence of soil, surface water, groundwater or construction elements contamination has been confirmed and this presents a potential risk to humans, water, ecosystems or other receptors. Risk management measures, e.g. remediation, may be needed depending on the severity of the risk of adverse impacts to receptors under the current or planned use of the site. Sensitive areas, such as industrial zones and solid waste disposal sites, are typical contaminated sites. Such contamination, typically caused by former state enterprise, creates a burden which always causes certain obstacles for the future development of such site. In some cases these sites are abandoned, sometimes their owner does not have any motivation to invest to its remediation. On the other hand, these sites usually occur in attractive locations close to the city centre having a high potential for future development of the city and potential economic value. If such a burden should be removed, the originally barren place can be turned into an attractive green zone or public amenity site or industrial zone or other object.</p> <p>Identification and remediation of contaminated site is well defined and a systematic process established in an international procedures (for instance US EPA), covering a detailed contamination survey, assessment of risks that the contamination poses to human and environmental assets, study of feasibility of various remediation options, remediation project design, remediation itself and post-remedial monitoring of environmental assets. The process is time consuming and highly dependent on quality, quantity and spread of contamination. The remediation action should be planned in the context of the city master plan respecting the future use of the site. Originally partially or fully dysfunctional piece of a contaminated land, though situated in an attractive location, has reduced or zero market value. After its remediation such site is transformed into a valuable plot, site. The site can be transformed into the green public amenity site or functional industrial zone (depending on its location) or sold. The difference between the original market value of the contaminated plot together with the cost of remediation should not be higher than a final market value of the site after remediation.</p> <p>Derived from the results of the inventory of potentially contaminated sites and a related feasibility study, one site owned by the Municipality will be selected for transformation from a contaminated site to a public green area equipped with amenities (or eventually an industrial zone).</p>		
Action owner	Municipality of Yerevan		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Contamination survey and risk assessment	220	na
	Feasibility study	80	na
	Project design	100	na

	Remediation of the site (depends on the size of the site and type and spread of contamination)	2,000 - 6,000	400
Calculation Method	Remediation: EUR 300,000 per ha of moderately contaminated land (for example pollution caused by petroleum substances), excluding cost of construction of amenities, excluding the project administration costs, up to 20 ha site. CAPEX can be calculated only based on results of the contamination survey, risk assessment and feasibility study.		
Savings and benefits	Estimation of savings is uncertain and depends on a market value of land in different parts of Yerevan and especially on a cost of remediation process. Considering the contaminated site value before remediation is of zero market value while after its remediation the value is comparable to an average local value, it is the real cost for remediation which makes a difference. The site with a limited potential for use will be turned into usable plot with high value added.		
Plan	<p>In response to activity LA10 and in cooperation with the Green City Awareness Centre (see activity WsA10):</p> <ul style="list-style-type: none"> <li>- by the 2020 contamination survey and risk assessment will be commenced</li> <li>- by the 2021 contamination survey and risk assessment will have been completed</li> <li>- by the 2022 a feasibility study of the selected site remediation will have been completed</li> <li>- by the 2024 the project design of remediation of the site will have been completed</li> <li>- by the 2025 the remediation commenced</li> <li>- by the 2030 the remediation completed</li> </ul>		
Key measures for tracking	<p>Time schedule for the project implementation</p> <p>Contribution to open green space area ratio per capita</p>		

LA13	Create a hydroecological map of the Yerevan territory and design a groundwater (GW) monitoring system for Yerevan		
Action classification	Monitoring and data collection		
Objective	To obtain a digital hydrogeological map combined with relevant environmental aspects to be used for urban planning. The map should enable to design the GW monitoring system for Yerevan.		
Description	<p>Hydroecological map is a special map combining hydrogeological map and ecological map to sustain natural groundwater quality and quantity. It is an effective tool for urbanistic planning and solution of emergency situations.</p> <p>Hydrogeological map of the Yerevan territory will be developed on the basis of existing geological maps and will be provided in a digital form to become a part of the GIS-based environmental database (Activity LA 9) and potentially contaminated sites inventory (Activity LA 10). These activities together will create the hydroecological map of Yerevan.</p> <p>Once the hydroecological map is completed, the plan of Yerevan groundwater monitoring system will be designed in a close cooperation with the Hydrogeological Monitoring Centre and Ministry of Nature Protection. Results of the previous monitoring activities and experience of Hydrogeological Monitoring Centre and activities accomplished by the USAID programme and others will be considered, integrated and evaluated.</p>		
Action owner	Municipality of Yerevan/Ministry of Environmental Protection		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Development of a digital map	130	na
Update of a digital map	na	10	
Calculation Method	Based on analogy with similar applications in EU region		
Savings and benefits	<p>Potential savings can result from digitization process and prevention from devastation of local aquifers, water resources, natural disasters resilience.</p> <p>For digitization: once data is digitized, it can be used for many purposes and processed very quickly. Digital data is more accessible to users, it enables easy search and orientation, digitization means great space saving, digital data utilization reduces printing, copying and document search costs, documents threatened by paper degradation can be saved by digitization. Digitized data can be used by a number of people at once without copying.</p> <p>For prevention from devastation of local aquifers, water resources, natural disasters resilience: The map is a background for sustainable urbanistic planning, which can prevent groundwater contamination, groundwater sources depletion, increase natural disaster resilience (flooding, droughts, landslides, subsidence). Such savings are priceless.</p>		
Plan	2018: hydroecological map development 2019: hydroecological map development, Yerevan groundwater monitoring programme development		
Key measures for tracking	Contribution to urban planning		

<b>LA14</b>	<b>Revitalization and enlargement of groundwater (GW) monitoring system in Yerevan based on the LA 13 activity</b>		
Action classification	Investment, monitoring and data collection		
Objective	The object of the action is to set-up a basic technical and operational conditions necessary for provision of effective monitoring of groundwater in Yerevan territory.		
Description	<p>The action will develop results and recommendations of previous activities done within activity LA 13 - design of the groundwater monitoring system of Yerevan, and Hydrogeological Monitoring Centre and activities accomplished by the USAID programme. It is expected that this action will aim at revitalization of existing monitoring boreholes (up to 5) and installation of up to 10 new boreholes in total length of ca. 500 m. On these boreholes hydrodynamic tests will be carried out, consequently the yield and permeability will be calculated. Protection zones of boreholes will be estimated and the regime of groundwater level monitoring and sampling will be designed. It is recommendable to take samples of groundwater in a dynamic state twice per year. Samples will be sent to local laboratories for chemical analyses of selected parameters. Main chemical parameters will be estimated, accompanied by physical parameters (pH, conductivity, redox, temperature, oxygen), TOC, trace metals, in potentially contaminated sites also pesticides, PAH, phenols, chlorinated hydrocarbons, BOD and COD possibly other. Results of the one-year monitoring period together with inventory of potentially contaminated sites (Activity LA 10) will result in a Programme of groundwater monitoring for Yerevan. The programme will be designed in a close cooperation with the Ministry of Nature Protection and Hydrogeological Monitoring Centre. Recommendation of standards for groundwater quality and exploitation standards will be a part of the Programme. Along with the groundwater standards establishment, protected areas of infiltration zones of groundwater resources of Yerevan should be endorsed as well as enforcement of penalization of persistent GW contaminating activities (i.e. suspension of business licenses to enterprises which contaminate GW in contrary to applicable GW protection legislation). Results of the monitoring will be evaluated annually and compared with local applicable environmental standards and international standards and natural local niveau.</p> <p>These results will serve as a comparative basis for future legislative standards for groundwater quality on potentially contaminated sites and potentially contaminating activities (waste disposal installations, industrial enterprises, energy sector, agricultural activities, storages etc.).</p>		
Action owner	Municipality of Yerevan/Ministry of Environmental Protection, EBRD		
Resource Requirements	Description	Estimated CAPEX (EUR 000's)	Estimated annual OPEX (EUR 000's)
	Development of the GW monitoring program	200	20
Calculation Method	Based on analogy with similar applications in EU region		

<p>Savings and benefits</p>	<p>Potential savings can result from digitization process and prevention from devastation of local aquifers, water resources, natural disasters resilience.</p> <p>For digitization: once data is digitized it can be used for many purposes and processed very quickly. Digital data is more accessible to users, it enables easy search and orientation, digitization means great space saving, digital data utilization reduce printing, copying and document search costs, documents threatened by paper degradation can be rescued by digitization. Digitized data can be used by multiple people at once without copying.</p> <p>For prevention from devastation of local aquifers etc.: The data from the groundwater monitoring system serve as a background for sustainable urbanistic planning, which can prevent groundwater contamination, groundwater sources depletion, increase natural disaster resilience (flooding, droughts, landslides, subsidence). Such savings are priceless.</p>
<p>Plan</p>	<p>2020: revitalization of existing and installation of new monitoring boreholes                  2021: one-year groundwater monitoring period                  2022: design and adoption of the Groundwater monitoring programme for Yerevan</p>
<p>Key measures for tracking</p>	<p>Number of boreholes revitalized and installed Number of samples taken for chemical analyses</p>

## 6 Annex 6: Feedback from Public Consultations

Generally, the public consultation feedback confirmed the challenges identified through the technical analysis. Following comments and suggestions were presented and considered for the indicators assessment:

Comment/ Suggestions	Action taken	Justification
Identify the credibility of the sharp decline in NO <sub>2</sub> concentrations. If necessary, replace the suggested indicator with a more credible indicator (for example, the number of days with excessive pollution during the month).	A new indicator will be introduced measuring the number of exceedances of concentrations	The ratios of emissions and concentrations of NO <sub>2</sub> and SO <sub>2</sub> are incomparable. There is a dramatic fall in the NO <sub>2</sub> concentration time series while SO <sub>2</sub> emission levels increase.
Revise the lower threshold – 5 tons for CO <sub>2</sub> emissions per person, suggested by EBRD to 2 tons until 2050, in compliance with the obligation of Republic of Armenia (RoA) under the Paris Agreement.	Under revision	The lower threshold for CO <sub>2</sub> emissions per person suggested by EBRD methodology is 5 tons, whereas RoA has an obligation to reduce the CO <sub>2</sub> emissions per person to 2 tons by 2050.
Include the noise factor as an indicator.	Declined	Currently monitoring activities are not being conducted on the city level and no data is available.
Include the number of diseases resulting from air pollution in the list of indicators.	Declined	Currently no data is available on diseases, caused by air pollution. However air pollution is represented by the current indicators.
Divide emissions by fuel type: gas, diesel, gasoline.	Accepted	An important point which should be accounted for.
Divide emissions by type of transport: private and public, as well as subdivide the latter further into buses, minibuses, etc.	While the suggestion is important, due to unavailability of required data, it is not considered at this stage.	Such separation has been done under SEAP. GCAP aims to capture the impact of total transport fleet and the separation is not crucial for developing the necessary action recommendations.
Identify whether the construction of new roads and junctions will reduce the amount of emissions and increase the economic efficiency indicator.	While the suggestion is important, GCAP methodology does not include these types of indicators.	GCAP is a tool, which outlines the specific actions to be taken by the city to improve and make greener, among other things, its transportation modes, networks, and infrastructure. The economic/environmental assessment of specific sites and projects which is suggested cannot be effectively covered in a project like GCAP.
The average age of vehicle fleet indicator (total and by type) is wrong. The oldest buses in Yerevan are those from 2005, but	Accepted. The bus fleet will be further broken down to	Due to the circumstance, it is indeed important to make the distinction.

their age does not reach 15 years. Nevertheless, there are minibuses, which are registered, however they are not used, and recalculation is required.	private and public buses.	
The data regarding age and quantity of public transport is dated back to 2012 and many changes have been made since then. Around 1000 minibuses were replaced by buses, which use diesel fuel.	Accepted. It will be explained in the GCAP.	The impact of diesel fuel on the environment has not been established. Therefore, it is impossible to state, that the change has had a positive effect.
Kilometres of road dedicated exclusively to public transit per 100,000 population indicator has to be changed from "<10" to "0".	Accepted	"<10" is an indicator provided by EBRD, but as there are no roads dedicated exclusively to public transit in Armenia, it is preferable to replace the indicator with "0", in order to make it more accurate.
Indicator of interruption of public transport systems in case of disaster does not specify the volume or the types of the disaster.	Accepted	The indicator context will be expanded and the indicator will be further discussed with EBRD.
Replace the green buildings' certification indicator, which is included in GCAP, with certification indicator of the buildings based on the energy indicators.	Accepted	Certification indicator of the buildings is based on the energy indicators according to AST 362-2013.
Revise the upper and lower thresholds of the residential and public buildings' energy consumption indicators in GCAP, according to the energy consumption level, which ensures comfort of the users in the buildings.	Accepted, indicator value adjusted for comfort level	Current heat comfort levels are at 50%.
Indicator 21.1, which is connected to the interruptions in power supply, can be divided in energy and natural gas indicators, which will allow to apply quality and reliability indicators as well.	Accepted, new indicators added	The indicators of interruptions in power supply by energy and natural gas indicators will be included if the data is available in reports published by the Public Services Regulatory Commission of the Republic of Armenia. The inclusion of quality indicators will be discussed.
According to the Yerevan development program 2016 (Annex to the Yerevan city council decree N 432 of December 23, 2015), the green nurseries in Yerevan comprise 6,758.5 ha, out of which 852.3 ha is dedicated for general use, whereas green space per resident is 7.6 m <sup>2</sup> (2016)	Data noted for use in the GCAP	The ratio provided is an official up-to-date figure published by the Municipality and should be hence used for the respective green space indicator.
Include reptiles and scorpions as a new indicator	Declined	The use of the indicator is not recommended, as it can have dual interpretation: the increase in biodiversity of reptiles and scorpions is not always a positive indicator for

		improvement of the ecosystem conditions.
<p>Divide the indicators for birds as follows:</p> <ul style="list-style-type: none"> <li>a) Nesting</li> <li>b) Migrating</li> </ul>	<p>New proposed Indicator, reflecting bird population compositions</p>	<p>The increase in biodiversity of migrating birds during potential migrating season shows the level of their adaptation and the availability of food in the area. Nevertheless, this is not always a result of positive factors. For example, wintering of storks in Yerevan has become possible as a result of poor collection of waste and other “favourable” conditions, which are not appropriate for the green city. After improvements in the work of urban infrastructure, the “favourable” conditions can be eliminated. In addition, it is possible to regard the “adaptation” as a result of climate change, which is also not a positive factor.</p>

## 7 Annex 7: Public Consultation Summaries

### 7.1 Protocol of Public Hearing of GCAP Yerevan held on 8 December 2016

Yerevan

The public consultation launched with the welcoming speech by deputy mayor V. Nikoyan, who expressed contentment with the launch of activities in the framework of Yerevan Green City Action Plan. He mentioned that the aim of the consultation is to provide the local experts with opportunity to participate in the discussion of the solutions of environmental issues, which exist in Yerevan city. As mentioned by Mr. Nikoyan, on the agenda was the discussion of the environmental indicators, the proper choice of which will further enforce a more efficient and targeted approach towards activities of improving those indicators. It is important to keep the citizen-environment balance in the conditions of continuously developing urban community, economy and population. Mr. Nikoyan also mentioned that, as result of Action Plan implementation, they expect improvement of environmental impact, decrease in pollution level and more effective use of natural resources. The City also expressed expectations towards continuous cooperation between the private, public, non-governmental and scientific sectors.

Following this, Andrea Cirlicova introduced the goals, development stages and interim results of the Green City Action Plan. She also elaborated on the methodological basis, systematic principles of green development and sustainable urban system, all the areas, which should be integrated into this system, the directions of the activities, the prospective view of the documents with a flexible approach towards its adaptation to the changing environment, as well as further monitoring and reporting activities. Andrea introduced all the work done to the date, problems with data collection, the insufficient set and directions of available data and in some cases its absence. Data quality and composition can have a serious impact on the quality of results. The speaker expressed hope, that as result of a discussion with the stakeholders and experts, it will be possible to adjust the indicators and prioritize the challenges and to reflect the actual situation. During the second stage of the project based on the evaluated indicators, it will already be possible to develop political recommendations and further strategic goals and activities.

Following this, the consultation participants were divided into three thematic working groups, including:

1. Transport, air quality, solid waste management land use
2. Ecosystems and biodiversity, water resources and wastewater
3. Energy, energy efficiency of buildings and industry

Each group was introduced with the corresponding indicators, collected data, results of calculations, existing problems and limitations, based on the applicable methodology. Below is the summary of the main suggestions and comments by thematic groups as discussed during the consultation.

After the discussion, each group summarized the results of consultation, the team leaders answered to questions raised. The meeting was concluded with an invitation to discuss any uncovered opinions during the second public consultation, which will be held on December 19, 2016.

### 7.1.1 Summary of recommendations and issues discussed during the GCAP Yerevan public hearing held on 8 December 2016

	Suggestion/comment by Author (name, organization)	Suggestion/comment	Changes / revisions made	Justification
	1	2	3	4
<b>Energy and building's energy efficiency</b>				
1	A. Gulkanyan, UNDP Urban green lighting project	Include the lighting indicator in GCAP, which will be based on the lighted streets, their compliance to the norms and the amount of electricity used per kilometer.	Accepted	GCAP methodology does not include outdoor lighting, which is preferable to be added. The indicator will allow to identify inefficient energy consumption of the urban lighting system, as well as set targets and measures.
2	T. Sekoyan, Improving Energy Efficiency in Buildings program, UNDP	Replace the green buildings' certification indicator, which is included in GCAP, with certification indicator of the buildings based on the energy indicators.	Accepted	Certification indicator of the buildings is based on the energy indicators according to AST 362-2013.
3	A. Tsughunyan, Improving Energy Efficiency in Buildings program, UNDP	Revise the upper and lower thresholds of the residential and public buildings' indicators in GCAP, according to the energy consumption level, which ensures comfort of the users in the buildings.	Accepted	The threshold indicators will be multiplied by the comfort indicators.
4	T. Sekoyan, A. Tsughunyan, Improving Energy Efficiency in Buildings program, UNDP	Indicator 21.1, which is connected to the interruptions in power supply, can be divided in energy and natural gas indicators, which will allow to apply quality and reliability indicators as well.	Accepted	The indicators of interruptions in power supply by energy and natural gas indicators will be included if the data is available in reports published by the Public Services Regulatory Commission of the Republic of Armenia. The inclusion of quality indicators will be discussed.

	Suggestion/comment by Author (name, organization)	Suggestion/comment	Changes / revisions made	Justification
	1	2	3	4
<b>Biodiversity and ecosystems</b>				
1	A. Gulkanyan, UNDP urban green lighting project	Include the lighting indicator in GCAP, which will be based on the lighted streets, their compliance to the norms and the amount of electricity used per kilometer.	Accepted	GCAP methodology does not include outdoor lighting, which is preferable to add. The indicator will allow to identify inefficient energy consumption of the urban lighting system, as well as set targets and measures.
2	K. Danielyan, "For Sustainable Human Development" NGO	According to the Yerevan development program 2016 (Annex to the Yerevan city council decree N 432-Ն of December 23, 2015), the green nurseries in Yerevan comprise 6758,5 ha, out of which 852,3 ha is dedicated for general use, whereas green space per resident is 7,6 m <sup>2</sup> (2016)	Accepted, the indicator table has been revised, see the slide #29 in PPT	The proposed data is important and has to be included in the indicators.
3	K. Danielyan, "For Sustainable Human Development" NGO	Include reptiles and scorpions	The suggestion is under discussion; it will be accepted and included in case the required data availability and efficiency of the suggestion is confirmed.	The use of the indicator is not recommended, as it can have dual interpretation: the increase in biodiversity of reptiles and scorpions is not always a positive indicator for improvement of the ecosystem conditions.
	L. Harutyunyan, Armenian Society for the Protection of Birds	Divide the indicators for birds as follows: a) Nesting b) Migrating	The suggestion is under discussion; it will be accepted and included in case the required data availability and efficiency of the suggestion is confirmed.	The increase in biodiversity of migrating birds during potential migrating season shows the level of their adaptation and the availability of food in the area. Nevertheless, this is not always a result of positive factors. For example, wintering of storks in Yerevan

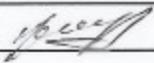
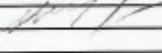
				has become possible as a result of poor collection of waste and other “favorable” conditions, which are not appropriate for the green city. After improvements in the work of urban infrastructure, the “favorable” conditions can be eliminated. In addition, it is possible to regard the “adaptation” as a result of climate change, which is also not a positive factor.
<b>Air quality and greenhouse gas emissions</b>				
4	M. Tsarukyan, GCAP team member G. Shahnazaryan, Armmonitoring	Identify the credibility of the sharp decline in NO2 concentrations. In case necessary, replace the suggested indicator with more credible indicator (for example, the number of days with excessive pollution during the month).	Accepted	The ratios of emissions and concentrations of NO2 and SO2 are incomparable. There is a dramatic fall in the NO2 concentration time series with increase in emission levels.
5	M. Tsarukyan, GCAP team member	Revise the lower threshold – 5 tones for CO2 emissions per person, suggested by EBRD to 2 tones until 2050, in compliance with the RA obligation under Paris Agreement.	Accepted	The lower threshold for CO2 emissions per person suggested by EBRD methodology is 5 tonnes, whereas RA has an obligation to reduce the CO2 emissions per person to 2 tones by 2050.
6	A. Iskoyan, Yerevan State University	Include the noise factor as an indicator.	While the suggestion is important, due to unavailability of required data, it was not considered at this stage.	Currently monitoring activities are not being conducted on the city level and no data is available.
7	N. Harutyunyan, Regional Environmental Centre for Caucasus	Include the number of diseases resulting from air pollution in the list of indicators.	While the suggestion is important, due to unavailability of required data, it was	Currently no data is available on diseases, caused by air pollution. It was mentioned that the impact of the air pollution on human health is

			not considered at this stage.	not neglected, as the presented indicator is the maximum permissible concentration, which is also a health indicator.
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	Suggestion/comment by Author (name, organization)	Suggestion/comment	Changes / revisions made	Justification
	1	2	3	4
<b>Transport and mobility</b>				
1	H. Navasardyan, Head of Transport Department of Staff of Yerevan Municipality	Divide emissions by fuel type: gas, diesel, gasoline.	Accepted	This is an important note which should be accounted for.
2	N. Martirosyan, "Yerevan Urban Development Investment Programs Implementation Agency"	Divide emissions by type of transport: private and public, as well as the latter should be subdivided into buses, minibuses, etc.	While the suggestion is important, due to unavailability of required data, it was not considered at this stage.	Such separation has been done under SEAP. As A. Cirlicova has mentioned, in the framework of GCAP the impact of total public transport fleet is being discussed, therefore no separation is necessary.
3	N. Martirosyan, "Yerevan Urban Development Investment Programs Implementation Agency"	Identify whether the construction of new roads and junctions will reduce the amount of emissions and increase the economic efficiency indicator.	While the suggestion is important, GCAP methodology does not include these types of indicators.	GCAP is a tool, which outlines the specific actions to be taken by the city to improve and make greener, among other things, its transportation modes, networks, and infrastructure. What is being asked is economic/environmental assessment of specific sites and projects, which cannot be effectively covered in a project like GCAP.
4	H. Navasardyan, Head of Transport Department of Staff of Yerevan Municipality	The indicator for average age of car fleet (total and by type) is wrong. The oldest buses in Yerevan are those from 2005, but their age does not reach 15 years. Nevertheless, there are minibuses, which are	Accepted. We will also try to disaggregate private and public buses.	Important to make the distinction.

		registered, however they are not used, and recalculation is required.		
5	H. Navasardyan, Head of Transport Department of Staff of Yerevan Municipality	The data regarding age and quantity of public transport is dated back to 2012 and many changes have been made since then. Around 1000 minibuses were replaced by buses, which use diesel fuel.	Accepted. We will explain this in the GCAP narrative.	The impact of diesel fuel on the environment has not been established. Therefore, it is impossible to state, that the change has had a positive effect.
6	H. Navasardyan, Head of Transport Department of Staff of Yerevan Municipality	Kilometres of road dedicated exclusively to public transit per 100,000 population indicator has to be changed from "<10" to "0".	Accepted	"<10" is an indicator provided by EBRD, but as there are no roads dedicated exclusively to public transit in Armenia, it is preferable to replace the indicator with "0", in order to make it more accurate.
7	A. Cirlicova, GCAP team leader	Indicator of interruption of public transport systems in case of disaster does not specify the volume or the types of the disaster.	Accepted	Discuss with EBRD the possibility of changing the indicator or ask to delete it.

## 7.1.2 List of participants

Name	Organization	Signature
Arevik Hovsepyan	Head of environmental protection department in JINJ Ltd. Sustainable Water Environment NGO, Board Member	
Nune Sarukhanyan	President of "Green Lane" Agricultural Assistance NGO	
Karine Danielyan	President of the Association "For Sustainable Human Development"	
Nune Darbinyan	Director of Ecoglobe NGO	
Susanna Hakobyan	President of "Environmental survival" NGO	
Aram Gabrielyan, President	Khazer NGO, National focal point for climate change	
Tamara Babayan, Director	Renewable Resources and Energy Efficiency Fund (R2E2)	
Hovhannes Karapetyan	Young Engineers Association NGO	
Nune Harutyunyan	Regional Environmental Center - Armenia	
Hayk Harutyunyan	Deputy Minister, Ministry of Energy and Natural Resources	
Yevgenia Atayan	State Committee on Urban Development	
Artashes Bakshyan	Ministry of Territorial Administration	
Vahan Davtyan	Head of Water Resource Management Agency, Ministry of Nature Protection	
Asya Muradyan	Head of environmental protection division, Ministry of Nature Protection	
Sasun Sahakyan	Director of Environmental Impact Monitoring Centre, Ministry of Nature Protection	
Haykanush Parsamyan	Advisor to the Ministry of Nature Protection	
Head of Departments for:	Yerevan Municipality	
Development & Investment Programs	Yerevan Municipality	
Transport,	Yerevan Municipality	
Communal Services,	Yerevan Municipality	
Environment,	Yerevan Municipality	
Construction,	Yerevan Municipality	
Chief Architect's Office	Yerevan Municipality	
Aida Iskoyan	Environmental Public Advocacy Centre, Faculty of Law	
Sirakan Ohanyan	Yerevan Design Institute	
Grigor Azizyan	ArmDesign Institute	
Rudik Tadevosyan	MEI officer	
Hoa Bihn Adjemian	Head of Cooperation Section	
Armen Gulkenyan	UNDP Green Urban Lighting Project	
Gagik Minasyan	Builders Union	
Gagik Makaryan	Employers' & Entrepreneurs' Union	
Mikhail Martirosyan	ESCO Association	
Sarhat Petrosyan	UrbanLab Yerevan	
Lerun Galst'yan	Pan-Armenian Environmental Front	
Artur Grigoryan	EcoRight NGO	
Inga Zarafyan	EcoLur	
Sona Ayyazyan	Transparency International	
Ruben Khachatryan	Fund for Preservation of Wildlife and Cultural Assets	
Sara Anjargolian	Impact Hub Yerevan	
Nicolas Tawil	Founder and CEO of Sanitek LLC	
Lucineh Kassarjian	Armenia Tree Project	
Sargis Aghayan	Young Biologists Association NGO	
Narineh Mirzaeian	AUA College of Science and Engineering + Impact Hub Yerevan	
Erik Grigoryan	Association of Young Environmental Lawyers and Economists	



11.45	Transport and mobility, Solid waste management	Wastewater treatment, Biodiversity and ecosystems,	Street lighting, Buildings' EE, Industrial EE
12.00		Urban green space  Natural disasters	
12.15	Coffee Break		
12.30	Wrap-up from each group: short (10 min) presentation by each group		
12.45	Q&A (10 min)		
	Conclusion of the meeting		

## 7.2 Protocol of Public Hearing of GCAP Yerevan held on 19 December 2016

Ք Երևան

Երևանի քաղաքապետարանի աշխատակազմի բնապահպանության վարչության գլխավոր մասնագետ-էկոլոգ Դիանա Գրիգորյանը ողջունեց ներկաներին և գոհունակություն հայտնեց, որ սկսվել են Երևանի Կանաչ քաղաքի գործողությունների ծրագրի մշակման աշխատանքները: Տ-ն Գրիգորյանը նշեց, որ ծրագրի շրջանակներում մանրամասն ուսումնասիրվելու են Երևան քաղաքի կենսաբազմազանությունը, կանաչ տարածքների առկայությունը, ջրային ռեսուրսները, շենքերի ու շինությունների էներգաարդյունավետությունը և տրանսպորտը հասկանալու համար քաղաքի ամենախոցելի խնդիրները և լուծումներ առաջարկելու դրանք շտկելու համար: Այնուհետև Տ-ն Գրիգորյանը խոսքը փոխանցեց «Շրջակա միջավայրի վրա ազդեցության փորձաքննական կենտրոն» ՊՈԱԿ մասնագետ Հերիքնազ Մկրտչյանին, ով իրականացնում է Երևանի Կանաչ քաղաքի գործողությունների ծրագրի փորձաքննական աշխատանքները: Տ-ն Մկրտչյանը ողջունեց ներկաներին և նշեց, որ Երևանի Կանաչ քաղաքի գործողությունների ծրագիրը, համաձայն «ՀՀ Շրջակա միջավայրի վրա ազդեցության փորձաքննության մասին» օրենքի, ենթակա է ռազմավարական գնահատման և փորձաքննության, որի ընթացքում կգնահատվեն ծրագրի բոլոր բաղադրիչները և դրանց ազդեցությունը շրջակա միջավայրի վրա: Տ-ն Մկրտչյանը նշեց, որ սույն հանրային քննարկման նպատակն է ներկայացնել ծրագրի նպատակները, մեթոդաբանությունը և հավաքագրված տվյալները, ինչպես նաև ստանալ առաջարկություններ և դիտողություններ շահառուների կողմից:

Տ-ն Աստղինե Պասոյանը ողջունեց ներկաներին և շնորհակալություն հայտնեց հանրային քննարկմանը մասնակցության համար: Տ-ն Պասոյանը ներկայացրեց Կանաչ քաղաքի ծրագրի նպատակները և միջանկյալ փուլի նվաճումները: Այնուհետև՝ ներկայացրեց Կանաչ քաղաքի գործողությունների ծրագրի մեթոդաբանական հենքը, կանաչ զարգացման և կայուն քաղաքային համակարգի սկզբունքները և այն բոլոր ոլորտները, որտեղ դրանք պետք է ինտեգրվեն, միջոցառումների ուղղությունները, ինչպես նաև հետազայում մշտադիտարկման և հաշվետվայնության գործընթացները:

Զեկուցողը նշեց տվյալների հավաքագրման հետ կապված խնդիրները, տվյալների անբավարար կազմը, ուղղվածությունը, իսկ որոշ դեպքերում դրանց բացարձակ բացակայությունը, ինչը կարող է լուրջ ազդեցություն ունենալ արդյունքների որակի վրա: Տ-ն Պասոյանը հույս հայտնեց, որ շահառուների և փորձագետների հետ քննարկման արդյունքում հնարավոր կլինի ուղղումներ կատարել և գնահատվող ցուցանիշները ուղղել կամ փոփոխել: Իսկ երկրորդ փուլում արդեն հնարավոր կլինի, հենվելով գնահատված ցուցանիշների վրա, մշակել քաղաքական ուղղությունները, որոնց հիման վրա արդեն կմշակվեն ռազմավարական նպատակներն ու միջոցառումները:

Տ-ն Պասոյանը նաև ներկայացրեց մինչ օրս կատարված աշխատանքները, ըստ ոլորտների՝

1. Տրանսպորտ
2. Օդի որակ
3. Կոշտ թափոնների կառավարում և հողօգտագործում
4. Էկոհամակարգեր և կենսաբազմազանություն
5. Ջրային ռեսուրսներ և կեղտաջրեր
6. Էներգետիկա, շենքերի էներգաարդյունավետություն և արդյունաբերություն

Յուրաքանչյուր ոլորտի համար ներկայացվեցին գործածված ցուցանիշները, հավաքագրված տվյալները, հաշվարկների արդյունքները, առկա խնդիրներն ու սահմանափակումները՝ ելնելով կիրառված մեթոդաբանությունից: Ստորև ներկայացված են քննարկումների արդյունքում ամփոփված հիմնական առաջարկություններն ու դիտողությունները՝ ըստ ոլորտների:

7.2.1 Summary of recommendations and issues discussed during the public hearing regarding GCAP Yerevan held on 19 December 2016

	Առաջարկող/ ղիտողության հեղինակ (անուն, կազմակերպություն)	Առաջարկությունը	Կատարված փոփոխությունը	Հիմնավորումը
	1	2	3	4
1	Լուսինե Վարդանյան, ԱԶՀ ՀԿ խորհրդի անդամ	Բացի թռչուններից ընդգրկել սողուններին, կարիճներին, թիթեռներին	Նման առաջարկ քննարկվել է նախորդ դեկտեմբերի 8-ի հանրային քննարկումների ժամանակ:  Առաջարկը քննարկման փուլում է և կներառվի, եթե հաստատվի արդյունավետությունն ու տվյալների առկայությունը	Ցուցանիշը անցանկալի է, քանի որ կարող է երկակի մեկնաբանվել սողունների և կարիճների կենսաբազմազանության աճը միջոց չէ, որ դրական ցուցանիշ է էկոհամակարգային պայմանների բարելավման տեսանկյունից:
2	Հերիքնազ Մկրտչյան, «Շրջակա միջավայրի վրա ազդեցության փորձաքննական կենտրոն» ՊՈԱԿ մասնագետ	Հաշվետվությունում ընդգրկել մոնիթորինգի ղիտակետերի քարտեզը	Ընդունված է	Նոր քարտեզագրում չի կատարվելու, սակայն բոլոր առկա տվյալները կտրամադրվեն:

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3	Հերիքնազ Մկրտչյան, «Շրջակա միջավայրի վրա ազդեցության փորձաքննական կենտրոն» ՊՈԱԿ մասնագետ	Ընդգրկել կլիմայի փոփոխության բաղադրիչ	Մույն բաղադրիչն արդեն ընդգրկված է հաշվետվությունում	Մույն բաղադրիչն արդեն ընդգրկված է հաշվետվությունում
4	Հերիքնազ Մկրտչյան, «Շրջակա միջավայրի վրա ազդեցության փորձաքննական կենտրոն» ՊՈԱԿ մասնագետ	Ցուցանիշների կազմում առանձնացնել ոռոգելի ջրի համակարգը խմելու ջրի համակարգից	Ընդունված է	Նման տարանջատումը կարևոր է ճիշտ պատկեր ստանալու համար:

7.2.2 List of Participants

Երևանի կանաչ քաղաքի գործողությունների ծրագրի նախնական արդյունքների քննարկում շահառուների հետ Երևանի Քաղաքապետարան 19.12.2016թ.					
	Անուն, ազգանուն	Կազմակերպություն	Հեռախոս	Էլ. փոստ	Մտորագրություն
1.		Բնապահպանական փորձաքննության գործակալություն, ՀՀ բնապահպանության նախարարություն			
2.					
3.					
4.					
5.					
6.					
7.	Աիլա Բսկոյան	Էկոլոգիական հասարակական շահերի պաշտպանության կենտրոն, Իրավագիտության ֆակուլտետ			
8.	Անի Էլբակյան	Հայաստանի ազրարային համալսարան		anietkanyan@rambler.ru	Անի
9.	Անի Սարիբեկյան	Հայաստանի ազրարային համալսարան			
10.	Աննա Մատուրյան			annat@sat.wybor.ru	Աննա
11.	Աննա Մխիթարյան				
12.	Ասյա Մուրադյան	Կլիմայի փոփոխության և մթնոլորտային օդի պահպանության քաղաքականության բաժնի պետ, Բնապահպանության նախարարություն			
13.	Աստղիկ Գրիգորյան				
14.	Աստղիկ Հարությունյան				
15.	Աստղինե Պատյան	ԷԿ ընկերության ԿՔԳՄ ծրագրի խորհրդատու		astghine@gmail.com	Աստղինե
16.	Ավետ Մարտիրոսյան	Բնապահպանության վարչության պետ, Երևանի քաղաքապետարան			
17.	Արամ Գաբրիելյան	Խազեր ՀԿ, կլիմայի փոփոխության առանցքային խմբի նախագահ			
18.	Արևիկ Հովսեփյան	ՋԻՆՋ ՀԿ			

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19.	Արթուր Մուղունյան	ՄԱԶԾ Շինություններում էներգաարդյունավետության բարելավման ծրագիր		
20.	Արմեն Ասատրյան	ATC		armen.asatryan@yamil.com
21.	Արմեն Բալկյան			
22.	Արմեն Գուլկանյան	ՄԱԶԾ «Քաղաքային կանաչ լուսավորություն» ծրագիր		
23.	Արմինե Միքայելյան	ATC		Armine1995@Hh.ru
24.	Արտաշես Բախչյան	Տարածքային կառավարման նախարարություն		
25.	Բերուսա Բայան			
26.	Գագիկ Խաչատրյան	ATC		gabeg-555@mail.ru
27.	Գագիկ Մակարյան	Գործարարների և գործատուների միություն		
28.	Գագիկ Մինասյան	Շինարարների միություն		
29.	Գևորգ Գրիգորյան	Զարգացման և մոնիթորինգի վարչության պետի տեղակալ, ՀՀ Հանրային ծառայությունները կարգավորող հանձնաժողով		
30.	Գրիգոր Ազիզյան	ArmDesign Ինստիտուտի տնօրեն		diana.guizoryan@yerevan.am
31.	Դիանա Գրիգորյան	Բնապահպանության վարչություն, Երևանի քաղաքապետարան		
32.	Դիանա Հարությունյան			
33.	Դշխուհի Մահակյան	Գովկասի ՏԲԿ		
34.	Էլեն Դադայան	ATC		
35.	Թամարա Բաբայան	R2E2 տնօրեն		
36.	Ինեսսա Ավագյան			
37.	Լիանա Դավթյան	ATC		
38.	Լիդյա Չերքեզյան	EY ընկերություն		
39.	Լուսինե Նավասարդյան			
40.	Լուսինե Վարդանյան	ԱԶՀ ՀԿ խորհրդի անդամ		cwp.armenia@gmail.com
41.	Կարինե Դանիելյան	«Հանուն մարդկային կայուն զարգացման» ՀԿ տնօրեն		

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42.	Հայկ Կարապետյան			
43.	Հայկանուշ Պարսամյան	Նախարարի իրավախորհրդատու, Բնապահպանության նախարարություն		
44.	Հասմիկ Հայրապետյան			hasmik.hayrapetyan1996@gmail.com
45.	Հովհաննես Կարապետյան	Երիտասարդ ճարտարագուսների միություն ՀԿ		H. Karapetyan@enginereer.s.am
46.	Մարիկա Հարությունյան	ԷԿ ընկերություն		marika.karutyunyan@ec.am
47.	Մարինե Հակոբյան	ATC		marina1985.hakobyan@atc.am
48.	Մարտիրոս Ծատուկյան	ԷԿ ընկերության ԿՔԳԾ ծրագրի խորհրդատու		martiros@arukyan.yoboc.com
49.	Մերի Մկրտչյան			
50.	Միխայիլ Մարտիրոսյան	Էներգետիկ ծառայություններ մատուցող ընկերությունների ասոցիացիայի նախագահ		
51.	Նադեժդա Մկրտչյան			
52.	Նաթելլա Միրզոյան	Հայաստանի ամերիկյան համալսարան		nmirzoyan@gmail.com
53.	Նարեկ Խաչատրյան			
54.	Նարինե Դավեյան			
55.	Նունե Դարբինյան	Էկոլոգի ԷԿ		
56.	Նունե Հարությունյան	Տարածաշրջանային բնապահպանական կենտրոն ՀԿ տնօրեն		
57.	Նունե Մականյան	Երևանի քաղաքապետարան		
58.	Նունե Մարուխանյան	Կանաչ ճանապարհ ՀԿ		
59.	Ռազմիկ Սիմոնյան			
60.	Ռուդիկ Թադևոսյան	ՎՋԵԲ Համայնքային և բնապահպանական ենթակառուցվածքներ		
61.	Մասուն Սահակյան	Երջուկա միջավայրի վրա ազդեցության գնահատման կենտրոնի տնօրեն,		

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		Բնապահպանության նախարարություն		
62.	Սերգեյ Աղինյան	Զարգացման և մոնիթորինգի վարչության պետ, ՀՀ Հանրային ծառայությունները կարգավորող հանձնաժողով		
63.	Միրելյան Օհանյան	Երևանի նախագծային ինստիտուտ		
64.	Սոնա Գրիգորյան	<i>կոորդինատոր ասոցիացիա (ՈՇ)</i>	<i>sona.gri@352@gmail.com</i>	<i>[Signature]</i>
65.	Սուսանա Հակոբյան	Բնապահպանական գոյատևում ՀԿ		
66.	Սուրեն Աղամյան			
67.	Ստեփան Իվանյան		<i>stepanivanyan2@gmail.com</i>	<i>[Signature]</i>
68.	Վահան Դավթյան	Ջրային ռեսուրսների կառավարման գործակալության պետ, Բնապահպանության նախարարություն		
69.	Վարդուհի Ենգիբարյան		<i>varduhya.gibaryan@gmail.com</i>	<i>[Signature]</i>
70.	Վաղիմիր Մանուկյան	<i>կոորդինատոր ասոցիացիա կոլեկտիվ</i>		<i>[Signature]</i>
71.	Տաթև Գևորգյան			
72.	Տաթև Խարատրյան			
73.	Տիգրան Սարգսյան	Զարգացման և ներդրումային ծրագրերի վարչության պետ, Երևանի քաղաքապետարան		



### 7.3 Protocol of Public Hearing of GCAP Yerevan Public held on 16 June 2017

The third GCAP public hearing was launched with the opening remarks of S. Maksapetyan, Deputy Head of the Nature Protection Department of Yerevan Municipality Staff. The meeting was attended by the representatives of the EBRD, the EY Office in Czech Republic, EY Yerevan Office, as well as Yerevan GCAP technical experts representing Sweco, Seven and GEOTest companies in Czech Republic, independent experts from different sectors and various public groups of Yerevan. Ms. Astghine Pasoyan, Project Expert and Coordinator of the Armenian Expert Group, welcomed the participants and thanked them for attending the public hearing. Ms. Pasoyan introduced the format of the public hearing that individually shed light on the activities carried out within the framework of the GCAP and the strategic environmental impact assessment conducted by the latter, as well the logical links between those two works.

Andrea Cirlicova, Project Manager, briefly reported on the activities performed, in particular, on the sectoral strategic framework, expecting to receive public feedback and comments on the plan. Andrea Cirlicova mentioned that the project is currently at the second stage, during which strategic frameworks have been developed to tackle the problems identified at the first stage based on their priorities. Further actions will be aimed at collecting comments from the public and relevant ministries in order to respond them under the GCAP and submit the GCAP's final draft report to the Council of Elders for approval. As soon as the Council of Elders approves the document, it should be included in the city's Strategic Development Action Plan, after which the completed actions should be assessed in a three to four year period and a corresponding report to be published.

Afterwards, each expert reported on the analysis of the strategic objectives of the individual sector, the proposed long-term vision and the short-term actions necessary to achieve the vision. The reported sectors are as follows:

1. Transport
2. Air Quality
3. Solid Waste Management and Land-Use
4. Ecosystems and Biodiversity
5. Water Resources and Waste Water
6. Energy, Energy Efficiency in Buildings and Industry

Each sector's strategic objectives, the vision and short-term actions were presented and summarized with a Q&A session during which the experts made clarifications on the issues raised by the public. The main motions and observations summarized on the basis of the discussions are listed below by sectors. Annex 2 also sets out the conclusions of the authorised relevant national authorities including remarks from the RA Ministry of Healthcare, the RA Ministry of Emergency Situations, the RA Ministry of Nature Protection, the RA Ministry of Energy Infrastructures and Natural Resources, the RA Ministry of Territorial Administration and Development.

Summary of recommendations and issues discussed during the public hearing regarding GCAP Yerevan held on June 16, 2017

### 7.3.1 Summary of recommendations and issues discussed during the GCAP public hearing held on 16 June 2017

	Mover of motions and observations	Motions	Amendment made	Justification
1		2	3	4
1	Shushanik Asmaryan, the Center for Ecological-Noosphere Studies of the National Academy of Sciences	Taking into consideration that the strategic objectives have common features with the Horizon 2020 Programme, motion to establish cooperation within the framework of the Horizon 2020 Scholar Programmes	The motion is considered to be of great importance. Nevertheless, it is possible to take additional steps only after obtaining further information in that regard.	The experts requested to provide a written statement on the program through the Development and Investment Programs Department of Yerevan Municipality
2	Diana Harutyunyan, UNDP	Reformulate authorized connections to electricity by reaching 100% actual connections, given the fact that unauthorized energy consumption has no direct link to the availability of connections	Motion passed	The observation is well justified, and a clearer comment will be made on the given formulation.
3	Diana Harutyunyan, UNDP	Regarding HPPs, include not only small but also large hydropower in the RE resources. According to EU norms, only SHPPs are included in the RE resources. On top of that, by adding large hydropower in RER limits, according to the GCAP methodology, the need for RER investments is artificially eliminated since over 20% availability of RER in the city is classified as "green" in the field of energy consumption and is not intended for the measures. It is suggested to add the accessibility indicator in the indicators.	The motion is considered to be of great importance. However, the EBRD indicators do not include the suggested indicator since they are based on the EU indicators.	The suggested indicator is not included in the EBRD indicators, therefore, the need for its inclusion should be additionally assessed and observed.

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4	Armen Gulkanyan, UNDP Green Urban Lighting Project	Discuss the inclusion of lighting indicators/lux/ in the external lighting indicators along with the installed capacity which is available in the UNDP Green Urban Lighting Project	Motion passed	The observation is well justified and acceptable, however, since averaging at municipal level without the lighting level is accepted in the international practice, the intensity of illumination expressed in lux is recommended in case if the UNDP Green Urban Lighting Project provides the data.
5	Gevorg Tepanosyan, the Center for Ecological-Noosphere Studies of the National Academy of Sciences of the RA	Include the updated soil pollution map	The motion is passed, however, the inclusion of the updated map will be possible in case of receiving it from the Center for Ecological-Noosphere Studies of the National Academy of Sciences	Request the updated soil pollution map of the city from the Center for Ecological-Noosphere Studies of the National Academy of Sciences. In case of providing them, the maps will be updated.
6	Hamlet Melkonyan, Advisor to the Director of Hydromet Service	Update the climatic data of Yerevan	Motion passed	The updated data have been provided by the UNDP; the data have been included
7	Hamlet Melkonyan, Advisor to the Director of Hydromet Service	Make climate change and pollution predictions	The motion is considered to be of great significance. Nonetheless, the EBRD methodology does not envisage predictions.	The EBRD methodology does not envisage predictions. However, the predicting function can be recommended as a necessary step in further actions.
8	Hamlet Melkonyan, Advisor to the Director of Hydromet Service	Consider the reintroduction of trams and trolleybuses as an action	Motion passed	The circulated draft of the GCAP already envisaged introduction of efficient transport, in particular, use of trams and trolleybuses as well.
9	Hasmik Hovhannisyanyan, Center for Ecological-Noosphere Studies of the National Academy of Sciences of the RA	Use the most up-to-date information which is available in the National Academy of Sciences in R&D form	Motion passed	The possessed materials have also been considered in the materials published in the website of the Ecocenter of the National Academy of Sciences. The soil contamination data have not been updated; only the data on the pollution of tree leaves with heavy metals are available. The

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				findings of the research on the contamination of soil in the vicinity of kindergartens provide information only for one kindergarten, which cannot act as a representative sample.
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7.3.2 Summary of recommendations and questions discussed during the GCAP public hearing held on 16 June 2017

	Mover of motions and observations	Motion	Amendment made	Justification
	1	2	3	4
1	Nelson Zuloyan, Chief of Staff of the Ministry of Healthcare of the RA	In the section "Human Health Issues" (page 189) of the Strategic Environmental Assessment of Green Yerevan Project (hereinafter "the Project") it is mentioned that neoplasms are often directly or indirectly related to the high level of harmful pollutants found in food, soil and atmospheric air through potable and irrigation water. However, according to the World Health Organization, "Cancer is one of the leading causes of death worldwide." In case of cancer formation, changes occur in the human organism in the result of the person's genetic factors and the influence of 3 categories of external agents. External agents include physical carcinogens (cancerogenes) - ultraviolet and ionizing radiation; chemical carcinogens – certain components of tobacco smoke, aflatoxins; biological carcinogens – infections from certain bacteria, viruses or parasites. Moreover, the emergence of cancer in the world is associated with tobacco use, alcohol abuse, unhealthy diet and physical inactivity. They are also the 4 major risk factors not only for cancer, but also for other more common infectious diseases.	Motion passed	The project was amended.

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		Tobacco use is responsible for approximately 22 % of cancer-related deaths. Between 30–50% of cancer cases can currently be prevented by avoiding risk factors and implementing evidence-based prevention strategies."		
2	Nelson Zuloian, Chief of Staff of the Ministry of Healthcare of the RA	Outline Paragraph 4 of the same section (page 189) as follows: "Climate change will contribute to increase in the number of the vectors of infectious diseases and in arthropod densities in populated areas, shortening the cycle of infection, and eventually, more rapid spread of the infection. Alongside malaria vector mosquitoes and visceral leishmaniasis vector sand flies, the spread of other unrecorded arthropods in populated areas, as well as their range expansion is also possible."	Motion passed	The project was amended.
3	Nelson Zuloian, Chief of Staff of the Ministry of Healthcare of the RA	Paragraph 1 of the same section (page 190) states that in 2014 Measurements of Atmospheric Noise Levels were carried out at 186 observation points of urban highways, in 177 cases of which the outcome did not meet hygienic norms. I move to mention the name of the organization that made the measurements and the hygienic norms it compared with.	Motion passed	The project was amended.
4	Nelson Zuloian, Chief of Staff of the Ministry of Healthcare of the RA	In the section " Waste Management" of the project to provide provisions on waste sorting, in particular, setting out that the sorting should be done by population at the time of waste collection which is a globally accepted method and facilitates further waste management. Moreover, it is considered a safer method in waste disposal as regards the population health.	Motion passed	The project was amended.
5	Gagik Hayrapetyan, Chief of Staff of the Ministry of Emergency Situations of the RA	The last two formulations under Paragraph 2 of Section 3.1.2 Natural Disaster Risk of the draft Yerevan's Green City Action Plan need adjustment.  Please clarify the following: " The coordination body for Yerevan is the Yerevan Crisis Management Centre which falls under the MoES and develops a Disaster	Motion passed	The project was amended.

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		Risk Management Programme for the City of Yerevan in coordination with the MoES” and “Since the inception of the new emergency governance structure the emergency plans and systems have not been subject to a serious test yet.”		
6	Gagik Hayrapetyan, Chief of Staff of the Ministry of Emergency Situations of the RA	<p>Consider the acquisition of automatic meteorological stations and their installation in the administrative districts of the city by using the financial resources of Yerevan's Green City Action Plan, as well as connecting it to the RA MES RS Crisis Management National Center and the Hydrometeorological Service. If necessary, the RA MES Hydrometeorological Service is ready to provide relevant professional advice.</p> <p>The data will also contribute to increasing the degree of accuracy of climate change assessment in Yerevan City, as well as improving hydrometeorological service delivered to stakeholders.</p>	Motion passed	Such a measure is already envisaged in the project.
7	Gagik Hayrapetyan, Chief of Staff of the Ministry of Emergency Situations of the RA	<p>Include action planning for e-vehicle development in Yerevan City in the measures aimed at reducing the amount of harmful emissions under the section “Transport” of the chapter “Mitigation of Environmental Pressures by sectors” of the Yerevan's Green City Action Plan.</p> <p>We consider it appropriate to increase the number of trolleybuses and routes, as well as the gradual return of trams in Yerevan public transport.</p> <p>The return of the trams will considerably improve the municipal transport service quality and may become a locomotive for the further steps aiming at Yerevan City's air basin treatment.</p>	Motion passed	Such a measure is already envisaged in the project.
8	The RA Ministry of Nature Protection	<p>N/A</p> <p>Wrongly, the documents being circulated in the Ministry of Nature Protection were not inscribed to the proper departments. During the consultation on the GCAP held on June 14 of the present year, Mr. A.Gharabekyan, the Advisor to Minister, requested</p>		

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		additional time in order to get acquainted with the document and provide observations, which will be done in parallel with the SEA assessment, and the leadership of the Center of Expertise for Environmental Impact Assessment SNCO will be informed accordingly.		
9	The RA Ministry of Energy Infrastructures and Natural Resources	N/A		
10	Mr. Artashes Bakhshyan, Head of the International Department of the RA Ministry of Territorial Administration and Development	Consider the issue of groundwater pollution through the wastewaters from landfills	Motion passed	Relevant amendment was made in the project.
11	The RA Ministry of Territorial Administration and Development, D. Lokyan	Replace the words "Ministry of Territorial Administration and Emergency Situations of the RA" with the words "Ministry of Territorial Administration and Development of the RA" in the table "Key stakeholders of the Green City" under the section "Institutional and Legal Analysis" and edit the column "Interest" as follows: "Coordination of the Plan's Implementation"	Motion passed	Relevant amendment was made in the project.
12	The RA Ministry of Territorial Administration and Development, D. Lokyan	<p>In the Paragraph 7 under the Subsection "Waste Management" of the Section "Waste" edit the text after "planning follows" as follows: "The RA Development Strategy for Solid Household Waste Management System for 2017-2036 approved by the RA Government Protocol Decision N49 of December 08, 2016.</p> <p>The aforementioned strategy aims at establishing an integrated solid household waste management system in the whole territory of the republic which will meet the EU standards and will include waste disposal and landfills commissioning. In parallel with the introduction of the new system, the other landfills operating within the territory of the republic will be closed (in case if their modernization is not considered appropriate). The sanitary landfill to be constructed in Nubarashen will</p>	Motion passed	Relevant amendment was made in the project.

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		effectively serve as a regional landfill for waste disposal.”		
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7.3.3 List of Participants of the GCAP public hearing held on 16 June 2017

#	Name, surname	Entity	Tel.	Email
1	Victoria Burnazyan	"ECOLUR" INFORMATION		<a href="mailto:vicaburnazyan@gmail.com">vicaburnazyan@gmail.com</a>
2	Karine Danielyan	"SUSTAINABLE DEVELOPMENT INITIATIVE" Public Organization		<a href="mailto:karined@web.am">karined@web.am</a>
3	Eugenia Atayan	State Urban Development Committee		
4	Tanya Arzumanyan	State Urban Development Committee		
5	Lianna Manukyan	Armenian State Pedagogical University		
6	Shushan Kirakosyan	Armenian State Pedagogical University		
7	Hamlet Melkonyan	Hayhydromet		
8	Aida Iskoyan	EPAC ՀԳ		
9	Gevorg Guloyan	The Fests go Green Project		
10	Diana Harutyunyan	UNDP		
11	Karine Taslakyanyan	Ministry of Territorial Administration and Development		
12	Narine Avetyan	Operational Programs support and investment policy unit		
13	Armen Gulkanyan	UNDP Urban green lightning project		
14	Karine Movsisyan	International Association for Impact Assessment, RA MONP		
15	Mkhitar Avetisyan	ISSD NGO		
16	Shushanik Asmaryan	Armenian National Academy of Sciences, CENTER FOR		

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		ECOLOGICAL- NOOSPHERE STUDIES		
17	Hasmik Hovhannisyan	Armenian National Academy of Sciences, CENTER FOR ECOLOGICAL- NOOSPHERE STUDIES		
18	Gevorg Tepanosyan	Armenian National Academy of Sciences, CENTER FOR ECOLOGICAL- NOOSPHERE STUDIES		
19	Lidya Cherkezyan	EY Yerevan office		
20	Andrea Cirlicova	Project manager		
21	Astghine Pasoyan	GCAP expert		
22	Martiros Tsarukyan	GCAP expert		
23	Boris Urbanek	GCAP expert		
24	Thomas Machas	GCAP expert		
25	Dskhuhi Sahakyan	GCAP expert		
26	Rudik Tadevosyan	EBRD		
27	Artak Saghatelyan	Yerevan municipality		
28	Tigran Sekoyan	Expert		
29	Suren Maksapetyan	Deputy head of nature protection department, municipality		
30	Hamlet Melkonyan	Hayhydromet		
31	Sona Grigoryan	ATC		
32	Ani Saribekyan	ATC		
33	Lusine Simonyan	Ministry of Territorial Administration and Development		
34				

## 7.4 Protocol of GCAP Public Hearing held on 3 August 2017

ԿՔԳԾ ՌԷԳ հասարակական քննարկումների չորրորդ փուլ

Ք Երևան

2017թ. օգոստոսի 3-ին կայացան Կանաչ Քաղաք Գործողությունների Ծրագրի թվով չորրորդ հանրային լուսմները: Մանակիցների ոչ պաշտոնական ներկայացումից հետո՝ Երևանի համայնքի ներկայացուցիչ, բնապահպանության վարչության դենդրոլոգ պ-ն Արսեն Հազարապետյանը՝ Երևանի քաղաքապետարանի անունից, ողջունեց մասնակիցներին, ներկայացրեց միջոցառման նպատակը՝ Երևանի «Կանաչ քաղաքի» գործողությունների ծրագրի ռազմավարական բնապահպանական գնահատման նախագծի հասարակական քննարկումների չորրորդ փուլը:

Հաջորդիվ, յուրաքանչյուր փորձագետ ներկայացրեց առանձին ոլորտի ռազմավարական նպատակների վերլուծությունը, առաջարկվող երկարաժամկետ տեսլականը և տեսլականին հասնելու համար անհրաժեշտ կարճաժամկետ գործողությունները: Ներկայացվող ոլորտները հետևյալն էին՝

1. Օդի որակ
2. Տրանսպորտ
3. Կոշտ թափոնների կառավարում և հողօգտագործում
4. Էկոհամակարգեր և կենսաբազմազանություն
5. Ջրային ռեսուրսներ և կեղտաջրեր
6. Հողային ռեսուրսներ
7. Էներգետիկա, շենքերի էներգաարդյունավետություն և արդյունաբերություն

Յուրաքանչյուր ոլորտի համար ներկայացվեցին ռազմավարական նպատակները, տեսլականը, կարճաժամկետ գործողությունները, որոնք ամփոփվեցին հանրության կողմից հնչեցրած և փորձագետների կողմից պարզաբանված հարց ու պատասխանի փուլով: Ստորև ներկայացված են քննարկումների արդյունքում ամփոփված հիմնական առաջարկություններն ու դիտողությունները՝ ըստ ոլորտների: Հավելված 2-ով ներկայացված են նաև օրենքով սահմանված համապատասխան պետական մարմին՝ ՀՀ բնապահպանության նախարարության ուշացումով ստացված դիտողությունների արձագանքը: Ներկաների կողմից բարձրացվեցին Երևանի հետ կապված մի շարք այլ բնապահպանական, սոցիալ-անտեսական խնդիրներ, ինչպես օրինակ՝ Նուբարաշենի աղբավայրում բնակվող աղբը սորտավորող ընտանիքների խնդիրը, մայրաքաղաքի հետնախորշերի խնդիրը, մետրոյի համակարգի ընդլանման անհրաժեշտությունը և այլն: Այնուամենայնիվ, հիմնականում դիտողությունների պատճառը այն էր, որ մասնակիցները քննարկման օրվանից վաղորոք շրջանառված փաստաթղթերի նախագծերին չէին ծանոթացել: Տրված հարցերի և արված դիտողությունների ամփոփ տարբերակը ներկայացված է ստորև.

Կ Դանիելյանը խնդրեց պարզաբանել, թե արդյոք ներկայումս իրականացվում են մերձգետնյա օգոնի չափումները, որոնք նախկինում Երևանում չափվում էին և նշվում էր ֆոտոքիմիական բարձր ցուցանիշներ: Այս հարցին արձագանքեց ՄԾառուկյանը, ԿՔԳԻՄԻ թիմի փորձագետը՝ պատասխանելով, որ չափումները արվում են, և արժեքները զարմանալիորեն նորմայի մեջ են:

Կ Դանիելյան նշեց, որ Երևանի կենտրոնում և մերձերևանյան հատվածում գործում է 21 հանք, որը պետք է արգելվի, քանի որ դրանք աղտոտում են միջավայրը, սակայն համաձայն դրան տրված պարզաբանմանը՝ գործող հանքերից և ոչ մեկը մետաղական չէ, հետևաբար՝ դրանց հիմնական ազդեցությունը շրջակա միջավայրի վրա փոշու տեսքով է:

SUDIP ԾԻԳ ներկայացուցիչ ՄՊողոսյանը նշեց, որ ԾԻԳ-ի ջանքերով արդեն 2017թ հուլիսին ստեղծվել է [transportyerevan.am](http://transportyerevan.am) կայքը (փորձարկման փուլում է), որը ստեղծում է այն տեղեկատվական հարթակը, որը հետագայում կարող է ապահովել GCAP-ի տեղեկատվական միջոցառումների իրականացումը, տրանսպորտային հավելվածի մշակում, և այլն:

Նազիկ Մկրտչյանը նշեց, որ ՀՀ Քափոնների կառավարման մասին օրենքով տրվել է՝ նոր դասակարգման ձևակերպումներ ընդերքօգտագործման թափոնների մասով և անհրաժեշտ է տալ համապատասխան ձևակերպումներ: Առաջարկը ընդունելի է համապատասխան ձևակերպումները կստուգվեն և կճշտագրվեն:

Առաջարկվեց նաև դիտարկել Էրեբունու հատուկ պահպանվող տարածքի համար միջոցառումների ընդգրկում, որը, սակայն, նպատակահարմար չէ, քանի որ այն ոչ միայն գտնվում է համայնքի վարչական սահմաններից դուրս, այլև հանդիսանում է Բնապահպանության նախարարության տարածք, որի վրա ՏԻՄ-ը որևէ իրավասություն չունի:

Ստորև բերվում են քննարկման, ինչպես նաև պաշտոնական շրջանառության արդյունքում ստացված բանավոր և գրավոր ստացված դիտողությունների արձագանքները, մասնավորապես

- Հավելված 1 ՌԷԳ հասարակական քննարկումների չորրորդ փուլում ստացված դիտողությունների արձագանքների ամփոփաթեթը
- Հավելված 2 ՇՄԱԳ ՊՈԱԿ-ի փորձաքննության արդյունքում տրամադրված դիտողությունների արձագանքի ամփոփաթեթը
- Հավելված 3. ՌԷԳ հասարակական քննարկումների երկրորդ փուլից հետո Բնապահպանության նախարարությանը, որպես շահագրգիռ ոլորտային գորատեսչություն կարծիքի ներկայացված ԿՔԳԾ և ՌԷԳ հաշվետվության միջանկյան նաձագծերի ուշացումով ստացված դիտողությունների արձագանքի ամփոփաթեթը

7.4.1 Summary of recommendations and issues discussed during the GCAP public hearing held on 16 June 2017

No	Առաջարկող/ դիտողության հեղինակ (անուն, կազմակերպությ ուն)	Առաջարկությունը	Կատարված փոփոխությու նը	Հիմնավորումը
	1	2	3	4
1.	ՆՄկրտչյան, Շրջակա միջավայրի վրա ազդեցության գնահատման ՊՈԱԿ	Թափոնների բաժնում օգտագործված դիտողությունները ներդաշնակեցնել 2015 թվականի հունիսի 22-ին «Թափոնների մասին» ՀՀ օրենքում փոփոխություններ և լրացումներ կատարելու մասին օրենքի համաձայն	Ընդունված է	Խմբագրված է
2.	Ն Մկրտչյան, ՇՄԱԳ ՊՈԱԿ	6-րդ (Ծանր մետաղների պարունակությունը և կուտակման դինամիկան տեխնածին աղտոտված հողերում (0-20 սմ)) աղյուսակը նպատակահարմար է ներկայացնել 35- 38-րդ էջերում՝ «Հողի աղտոտում» բաժնում, քանի որ Երևանի տարածքում չկան մետաղական հանքավայրեր, լեռնահարստացուց իչ ձեռնարկություններ և, հետևաբար,	Ընդունված է	Խմբագրված է

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		ուղղակիորեն կապել ծանր մետաղներով հողերի աղտոտումը ընդերքօգտագործման հետ հնարավոր չէ,		
3.	ՀՀ ԳԱԱ Էկոկոնսերոն	ՌԷԳ-ում Թարմացնել ԾՄ-ներով հողերի աղտոտվածության ցուցանիշները ԱԳԳ-ով	Ընդունված է	Խմբագրվել է, թարմացվել լե Նկար 14. Հողերի ծանր մետաղներով աղտոտվածության գումարային գնահատման (ԱԳԳ) քարտեզային տեսքը
4.	ՀՀ ԳԱԱ Էկոկոնսերոն	ԿՔԳԾ նախագծում Հանել հղում 120-ը՝ փոխարինելով տեքստային մասում լրացմամբ	Ընդունված է	Խմբագրված է «ՀՀ Գիտությունների Ազգային Ակադեմիայի Էկոլոգանոսֆերային հետազոտությունների կենտրոնը (Էկոկենտրոնը) վերջին շրջանում շահել է Եվրամիության Հորիզոն 2020 շրջանակային ծրագրի կողմից ֆինանսավորվող Հայաստանում «Բնության հետ համատեղ քաղաքների զարգացման, իննովացման և կառավարման համար արտադրություն» նախագիծը: Նախագիծը կկենտրոնանա բնահեն Էկոլոգիական լուծումների վրա, որոնք ուղղված են քաղաքների կայուն զարգացման և իննովացիոն կառավարման հարցերին: Նախագիծը մեկնարկել 2017թ. հունիսի և կտևի 5 տարի: ՀՀ ԳԱԱ Էկոկենտրոնը հանձն է առել հետևորդի դերում առանձնացնել եվրոպական գործընկերների կողմից առաջարկվող և Երևան քաղաքի տարածքի համար կիրառելի բնահեն լուծումները (ֆունկցիոնալ կանաչապատում, կանաչ ենթակառուցվածքներ և այլ բնաճարտարագիտական լուծումներ)՝ պարտավորվելով հետևողական լինել, դրանց հաջող իրականացմանը Երևան քաղաքի տարածքում»
5.	Էկոկենտրոն	Ավելացնել սեյսմիկ ակտիվության հետ	Ընդունված է	Քանի որ Էկոկենտրոնի վերլուծական նյութերում ներկայացված են ռադոնի

		<p>կապված ռադոնի արտանետումների ռիսկը՝ ֆիզիկական վտանգների շարքում: Տրամադրվել է տպագիր նյութ</p>	<p>չափումերը, որոնք միայն մեկ կետում են արվել, իսկ այլ քաղաքների համար նման հետազոտությունների ներկայացուցչական ընտրանքը շատ ավելի մեծ է լինում (1/1000, 1/2000, 1/2400 շինություն), հետևություններ կատարելու համար անհրաժեշտ են հազարավոր դիտակետեր: Երևանի պարագայում ռադոնի գնահատման հուսալի գնահատումը կհիմնվեր առնվազն 500-700 կացարաններում կատարված չափումների վրա: Նմանապես, ներկայացված ռադոնի և առողջական խնդիրների վիճակագրական շարքերը ներկայացված են զուտ վիզուալ և դրանց մեջ վիճակագրական կորելացիան այդքան էլ ակնառու չէ՝ ընդհանուր անալիզ արված չէ:</p> <p>Այսպիսով, հաշվի առնելով Էկոկենտրոնի կողմից բացահայտված հնարավոր ռիսկի առկայությունը, այդ ռիսկի հուսալի գնահատականներ տալու համար ՌԷԳ-ում ավելացվել է հետևյալ ձևակերպումը</p> <p>«ՀՀ ԳԱԱ Էկոլոգոնոսֆերայի կողմից Երևանի մեկ կետում 2000-2005 թթ կատարվել է ռադոնի հետևողական չափումներ, որոնք բացահայտել են շինության ներսում սանիտարական նորմերը բազմակի անգամ գերազանցող ռադոնի կոնցենտրացիաների աճը՝ կապված սեյսմիկ ակտիվության հետ (ներառյալ՝ բարձր և միջին ուժգնության, փոքր խորության և տարածաշրջանային սեյսմիկ ակտիվության հետ): Այսպիսի միտումների դեպքում գետնամերձ և նկուղային հարկերում ռադոնի բարձր կոնցենտրացիաները կարող են կապված լինել բնակչության առողջական խնդիրների հետ, ինչպես օրինակ՝ քաղցկեղի, շնչառական, մտավոր հիվանդությունների առաջացման, և այլն: Կատարված հետզոտությունները հիմք են տալիս</p>
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				ենթադրելու, որ Երևանը կարիք ունի լայնամասշտաբ և ներկայացուցչական ընտրանքով հետազոտության, որը թույլ կտա վերհանված ռիսկին տալ հուսալի գնահատական, ստեղծել այս ոլորտում քաղաքական միջամտության անհրաժեշտության մասին տվյալների արժանահավատ հենք»
6.				

7.4.2 Summary of feedback received from the Environmental Impact Assessment Center SNCO Expert Examination of 7 August 2017

No	Առաջարկությունը	Կատարված փոփոխությունը	Հիմնավորումը
	2	3	4
1)	ռազմավարական էկոլոգիական գնահատման 39-րդ էջում ներկայացված 6-րդ (Շանր մետաղների պարունակությունը և կուտակման դինամիկան տեխնածին աղտոտված հողերում (0-20 սմ)) աղյուսակը նպատակահարմար է ներկայացնել 35-38-րդ էջերում՝ «Հողի աղտոտում» բաժնում, քանի որ Երևանի տարածքում չկան մետաղական հանքավայրեր, լեռնահարստացուցիչ ձեռնարկություններ և, հետևաբար, ուղղակիորեն կապել ծանր մետաղներով հողերի աղտոտումը ընդերքօգտագործման հետ հնարավոր չէ,	Ընդունված է	Խմբագրված է
2)	ռազմավարական էկոլոգիական գնահատման 50-րդ էջի առաջին պարբերությունը (բնապահպանական միջոցառումների Դ. կետ) շարադրել հետևյալ խմբագրությամբ. «Դ. Երևան քաղաքի վարչական տարածքում բնության հատուկ պահպանվող տարածքների և բնության հուշարձանների տարածքների սահմանագատումը և օգտագործման ռեժիմների սահմանումը: □	Ընդունված է	Խմբագրված է
3)	ռազմավարական էկոլոգիական գնահատման 50-րդ էջի երրորդ պարբերությամբ Ջ. կետով նախատեսված բնապահպանական միջոցառումների մեջ ներառել նաև ծանր մետաղներով աղտոտված տարածքների վերականգնման նպատակային ծրագրերի մշակումը,	Ընդունված է	Խմբագրված է
4)	խմբագրել ռազմավարական էկոլոգիական գնահատման նախագծի 71-րդ էջում նկար 23-ից հետո ներկայացված պարբերությունը, քանի որ Երևանի վարչական տարածքում, ինչպես նաև Երևանին հարակից տարածքներում պոչամբարներ չկան,	Ընդունված է	Խմբագրված է
5)	ՌԷԳ 98-րդ էջի «Թափոններ» և 102-րդ էջի «Թափոնների կառավարման ոլորտի հիմնական մարտահրավերները» բաժիններում ներառել տեղեկատվություն Երևանի վարչական տարածքում օգտակար հանածոների հանքավայրեր մշակող կազմակերպությունների ընդերքօգտագործման թափոնների վերաբերյալ (հիմք՝ 22.06.2015թ.-ի ՀՕ-105-Ն օրենք, 18.10.2016թ.-ի ՀՕ-161-Ն օրենք)	Ընդունված է	Տեղեկությունները ավելացվել են թեմային ավելի համապատասխան «Ընդերքագործման» բաժնում՝ համապատասխան ոչ-մետաղական հանքերի և դրանց բնապահպանական ազդեցության մասով:

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			Թափոնների բաժնում և ավելիացվել է հասապատասխան պարբերություն
6)	Երևանի կանաչ քաղաք գործողությունների ծրագիր 2017թ.՝ նախագծի 135-րդ էջում 28-րդ գծապատկերից հետո ներկայացված «Աղբահանության գործելակերպ» բաժնի 1-ին պարբերության վերջին նախադասությունը՝ շարադրել հետևյալ խմբագրությամբ՝ «Ընդերքօգտագործման թափոնների տեղադրման կամ պահման տարածքների կառավարման համար հատկացված ֆինանսական ռեսուրսները պետք է արդյունավետ կերպով օգտագործվեն՝ ապահովելով շրջակա միջավայրի համապատասխան պաշտպանությունը, ներառյալ՝ շրջակա միջավայրի ակտիվների մշտադիտարկումը:	Ընդունված է	Խմբագրված է
7)	Պարզաբանման կարիք ունի Երևանի «Կանաչ քաղաք» գործողությունների ծրագրի ռազմավարական էկոլոգիական գնահատման էջ 34 –ի աղյուսակում «5. Հատուկ պահպանվող տարածքներ»-ի 5.1.3 տողը՝ ազգային պարկեր 79.3 հա (որ ազգային պարկի մասին է խոսքը և որտեղ է այն գտնվում),	Ընդունված է	Քանի որ Երևանի տարածքում ազգային պարկ չկա (հավանաբար հին տվյալ էր), աղյուսակը փոխարինվել է Երևանի հողային ֆոնդի այլ աղյուսակով
8)	«Կենսաբազմազանություն» բաժնի 4-րդ պարբերության (էջ56) «35439.6 հա» թիվը փոխարինել «35469.35 հա» -ով, իսկ էջ 61-ի 4-րդ պարբերության «90 հա» թիվը փոխարինել «118.75 հա»-ով՝ հիմք ընդունելով ՀՀ կառավարության 2015թ.հոկտեմբերի 1-ի N 1119-Ն որոշումը,	Ընդունված է	Խմբագրված է
9)	«Կենսաբազմազանություն» բաժնի 3-րդ պարբերությունը (էջ 56)՝ «Երկրի տարածքում հայտնի են շուրջ 3600 տեսակի բարձրակարգ բույսեր, 4700 տեսակի սնկեր, ավելի քան 17500 տեսակի կենդանիներ, այդ թվում՝ շուրջ 540 ողնաշարավոր և դեռևս չճշգրտված մեծաթիվ ստորակարգ բույսեր և մանրէներ», խմբագրել հետևյալ կերպ՝ «Երկրի ոչ մեծ տարածքում (մոտ 30 հազ. կմ <sup>2</sup> ) աճում են շուրջ 3800 տեսակի անոթավոր բույսեր, 428 տեսակի հողային և ջրային ջրիմուռներ, 399 տեսակի մամուռներ, 4207 տեսակի սնկեր, 464 տեսակի քարաքոսեր, բնակվում են 549 ողնաշարավոր և շուրջ 17200 տեսակի անողնաշար կենդանիներ» (Հիմք՝ Հայաստանի	Ընդունված է	Խմբագրված է

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	կենսաբազմազանության հինգերորդ ազգային զեկույց 2014թ.),		
10)	նույն բաժնի «Երևան քաղաքի բուսական բազմազանությունը» ենթակետում ներկայացված՝ Երևանում հանդիպող ՀՀ բույսերի Կարմիր գրքում գրանցված 15 տեսակը փոխարինել 33 տեսակով (հիմք՝ ՀՀ կառավարության 2010թ. հունվարի 29-ի N72-Ն որոշում) և աղյուսակ 12-ը լրացնել սույն որոշմանը համաձայն	Ընդունված է	Խմբագրված է, մինչև Աղյուսակ 12-ը ավելացված է տեսակների ամբողջական ցանկի հղում <a href="http://www.arlis.am/Annexes/3/PT6.1_10bujser.rar">www.arlis.am/Annexes/3/PT6.1_10bujser.rar</a>
11)	«Կենսաբազմազանության կորուստ» ենթակետում ներառել տեղեկատվություն նաև բուսատեսակների կորստի վերաբերյալ:	Ընդունված է	Խմբագրված է
12)	Միննույն ժամանակ հայտնում եմ, որ Երևան քաղաքում է գտնվում ՀՀ կառավարության 2008 թվականի օգոստոսի 14-ի «Հայաստանի Հանրապետության բնության հուշարձանների ցանկը հաստատելու մասին» N 967-Ն որոշմամբ հաստատված բնության 2 հուշարձան՝	Ընդունված է	Խմբագրված է, հուշարձանները ավելացված են
13)	Կենսաբազմազանություն» բաժնի 3-րդ պարբերությունը (Էջ 56)՝ «Երկրի տարածքում հայտնի են շուրջ 3600 տեսակի բարձրակարգ բույսեր, 4700 տեսակի սնկեր, ավելի քան 17500 տեսակի կենդանիներ, այդ թվում՝ շուրջ 540 ողնաշարավոր և դեռևս չճշգրտված մեծաթիվ ստորակարգ բույսեր և մանրէներ», խմբագրել հետևյալ կերպ՝ «Երկրի ոչ մեծ տարածքում (մոտ 30 հազ. կմ <sup>2</sup> ) աճում են շուրջ 3800 տեսակի անոթավոր բույսեր, 428 տեսակի հողային և ջրային ջրիմուռներ, 399 տեսակի մամուռներ, 4207 տեսակի սնկեր, 464 տեսակի քարաքոսեր, բնակվում են 549 ողնաշարավոր և շուրջ 17200 տեսակի անողնաշար կենդանիներ» (Հիմք՝ Հայաստանի կենսաբազմազանության հինգերորդ ազգային զեկույց 2014թ.),	Ընդունված է	Խմբագրված է

7.4.3 Feedback received from the Ministry of Nature Protection of 1 August 2017

No	Առաջարկությունը	Կատարված փոփոխությունը	Հիմնավորումը
	1	2	3
1.	Ներկայացված փաստաթուղթը իրենից ավելի շուտ ներկայացնում է Երևան քաղաքի իրավիճակի նկարագիր, քան ռազմավարությունների, առաջարկությունների, գործողությունների, ակնկալվող արդյունքների մասին փաստաթուղթ:	Չի ընդունվել	Քաղաքի նկարագիրը և գնահատումը կազմում է ԿԲԳԾ մեթոդաբանության կարևոր մասը առանց ներկայիս վիճակը քարտեզագրելու և խնդիրները վերհանելու միջոցառումների ցանկը կլինե՞ր քաղաքի կարիքներին անհամապատասխան: Ի դեպ՝ այդ իսկ պատճառով համաձայն չենք դիտողություններ 24-ի և 25-ի հետ
2.	Քաղաքի հետ կապված խնդիրները ներկայացված են տարբեր փաստաթղթերից, սակայն նախագծում բացակայում է օգտագործված գրականության ցանկը:	Չի ընդունվել	Տվյալ փաստաթղթում օգտագործվում է հղումների տողատակի տարբերակը՝ ֆուտնոթ (footnote), այդ իսկ պատճառով գրականության ցանկ նախատեսված չէ
3.	Նախագծում անհասկանալի են շարադրված գործողությունների կատարման համար նախատեսված ֆինանսավորման աղբյուրները:	Ընդունվել է	ԿԲԳԾ նախկինում միայն անգլերեն հավելվածում, իսկ հիմա նաև հայերեն տարբերակում առկա են ներդրումային միջոցառումների անհատական ամփոփագրեր, որոնցում, որտեղ հնարավոր է, նշված են ներդրումների գնահատականները, հնարավոր ֆինանսական աղբյուրները ևն: Հարկ է նշել, որ, որոշ դեպքերում, նախքան ներդրումային

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			գնահատականներ տալը, առաջարկվել է տեխնիկատնտեսական գնահատումների իրականացում, այդ իսկ պատճառով ներդրումային գնահատականները հնարավոր չեն այս փուլում:
4.	2005 թվականին ՄԱԶԾ-ի աջակցությամբ և մի խումբ փորձագետների կողմից կատարվել է Երևան քաղաքի Գլխավոր հատակագծի Ռազմավարական էկոլոգիական գնահատումը և ցանկալի է, որ «Երևանի կանաչ քաղաք գործողությունների ծրագիրը» համահունչ Երևան քաղաքի Գլխավոր հատակագծի հետ:	Ընդունված չէ	ԿԲԳԾ-ն բազմակի ընդգծվում է գործող գլխավոր հատակագծի վերանայման անհրաժեշտությունը՝ ԿԲԳԾ ընդգրկմամբ, քանի որ գործող գլխավոր հատակագիծը, ԿԲԳԾ թիմի կարծիքով, համահունչ չէ «Կանաչ քաղաքի» սկզբունքներին:
5.	Գործողությունների ծրագիրը վերաբերում է քաղաքին, սակայն առաջարկվող միջոցառումների իրավական հենքերը չեն կարող մշակվել մեկ քաղաքի համար, օրինակ՝ տեխնոլոգիաների ներդրումը մոլիբդենի արտադրողի կողմից: Բացի այդ իրական տեխնոլոգիա և դրա ներդրման համար անհրաժեշտ գումարները հաշվարկված չեն և անհասկանալի է, ինչպես քաղաքը կարող է պարտավորություն կրել արտանետումների կրճատման համար, եթե արտադրողը ինքը չի: Այդ իմաստով առաջարկվող միջոցառումները դեկլարատիվ բնույթ են կրում:	Մասնակի ընդունելի	Համապատասխան ՏԻՄ օրենքի 12րդ հոդվածի համայնքի պարտադիր խնդիրները ներառում են նաև գործարար միջավայրի բարելավումը և ձեռնարկատիրության խթանումը, թեև համայնքը սակավ լծակներ ունի արդյունաբերության բնապահպանական ազդեցությունը նվազեցնելու: Քանի որ ԿԲԳԾ մեթոդաբանությունը պարտադիր ներառում է արդյունաբերության ոլորտը, փորձ է արվել հանրային-մասնավոր գործակցության, տեխնիկական աջակցության ծրագրերի խրախուսմամբ հիմք դնել միջազգային լավագույն փորձի կիրառությանը, որը հետագայում կբերի

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			կամավոր համաձայնագրերի, իրազեկման բարձրացման և մաքուր արտադրության սկզբունքների լայն տարածման՝ ԳՀԻ-ների և դոնորային ծրագրերի հետ համագործակցությամբ:
6.	Մշտադիտարկումների մասով անհասկանալի է ԱՀԿ չափանիշներին օդի որակի համապատասխանեցման նպատակը, քանի որ ՀՀ ունի օդի որակի ստանդարտներ: Համապատասխանեցնելու նպատակի հետ մեկտեղ անհրաժեշտ էր նաև նախատեսել օդի որակի չափանիշների համապատասխանեցում ԱՀԿ-ի չափանիշներին, սակայն դա արդեն քաղաքի գործառույթը չի:	Ընդունված չէ	Սա ԵՄ պահանջ է և չի հակասում ՀՀ պահանջներին
7.	Տրանսպորտից արտանետումների նվազեցման համար և որպես այդ բնագավառում հիմնախնդիր դիտարկվում են միայն փոխադրամիջոցների և վառելիքի նկատմամբ միջոցառումները: Սակայն չեն դիտարկվում երթևեկության և բեռնափոխադրումների, (այդ թվում մարդկանց) կառավարման օպտիմալացման հարցերը, ինչը զգալիորեն կարող է կրճատել արտանետումները:	Ընդունված չէ	Տե՛ս Տրանսպորտային ոլորտի միջոցառումներ TS3, TA7, TA13, TA19
8.	Նախագիծը խմբագրման կարիք ունի, մասնավորապես՝ <ul style="list-style-type: none"> <li>• 114-րդ էջում նշված է, որ քաղաքի խոշոր ճյուղերից են քիմիական և նաֆթաքիմիական արդյունաբերությունը: Նշված ճյուղի կազմակերպությունները քաղաքում չեն գործում,</li> <li>• 42-րդ էջում աղյուսակ 4-ում «թունավոր մետաղներ» արտահայտությունը սխալ է</li> <li>• անհասկանալի է «օդի որակի ճշգրտման համակարգ» արտահայտությունը:</li> <li>• բացակայում են նախագծի ֆինանսական ամփոփ գնահատականը և հիմնավորումները,</li> </ul>	Ընդունված է մասնակի <ul style="list-style-type: none"> <li>• ընդունված</li> <li>• չընդունված</li> <li>• ընդունված</li> <li>• ընդունված</li> </ul>	Խմբագրվել է հետևյալ կերպ <ul style="list-style-type: none"> <li>• հանվել է «քիմիական և նավթաքիմիական արդյունաբերությունը»</li> <li>• թունավոր (տոքսիկ) մետաղ արտահայտությունը գիտական սահմանմամբ վերաբերվում է բոլոր այն մետաղներին (ներառյալ ծանր մետաղներին), որոնք կարող են բացասական ազդեցություն ունենալ մարդու առողջության</li> </ul>

YEREVAN'S GREEN CITY ACTION PLAN 2017

			<p>վրա: Ներառում են Արսենը, Բերիլիումը, Կադմիումը, Կապարը, Հեքսավալենտ Քրոմը, Մերկուրին:<sup>6</sup></p> <ul style="list-style-type: none"> <li>• Խմբագրվել է՝ «Ստեղծել օդի որակի սովյալների ճշգրտման համակարգ (մշտադիտարկման սեփական համակարգի սովյաների և «Հայէկոմոնիթորինգի» սովյալների համադրմամբ)»</li> <li>• Ընդգրկված է ներդրումային ամփոփագրերով հավելված, տես արձագանք դիտողություն 3-ին</li> </ul>
9.	Նախագծում բերված մի շարք հասկացություններ անհրաժեշտ է համապատասխանեցնել օրենսդրությամբ նախատեսված սահմանումներին, մասնավորապես, «թափոնների արտանետման և աղբանետման վճարներ», «պարտադիր վճար աղբի հավաքման և հեռացման համար» «ավտոմեքենաների տարիքի հետ մաքսերն աճում են» և այլն:	Ընդունված է	Խմբագրված է
10.	Հողի վիճակն ու միջոցառումները դիտարկված են միայն աղտոտվածության ու բուսածածկից զրկվածության տեսակետից: Սակայն կլիմայի փոփոխության հիմնախնդրի տեսակետից ոչ պակաս կարևոր է հողոգտագործման փոփոխությունը, որը կապված է քաղաքաշինության հետ (օր. հողաշերտի հեռացում, շինարարական աղբի տեղադրում, կանաչապատման համար այլ վայրերից բնական հողաշերտի տեղափոխում Երևան և այլ փոփոխություններ):	Ընդունված չէ	<p>Աշխատանքներն իրականացվել են ըստ ԵՄ/ՎԶԵԲ/ԵԱՀՄ կողմից մշակված մեթոդաբանության (տես Գլուխ 1 և 2), որը նման դիտարկում չի նախատեսում:</p> <p>Սակայն կլիմայի փոփոխության հիմնախնդրի տեսակետից</p>

<sup>6</sup> Տե՛ս օրինակ՝ <https://www.osha.gov/SLTC/metalsheavy/>

		<p>հողօգտագործման փոփոխության մասով կարևորագույնը թերևս կանաչ տարածքների ավելացումն է, ինչը կնպաստի թե կլիմայի փոփոխության մեղմման և թե հարմարվողականության բարձրացման խնդիրների լուծմանը:</p> <p>ԿՔԳԾ համապատասխան աղյուսակում (էջ 167, Հողօգտագործման փոփոխություն բաժին) սահմանված են կանաչ տարածքների հստակ ցուցանիշներ՝ 2030թ-մեկ բնակչի հաշվով &gt;10 մ2, 2022թ- մեկ բնակչի հաշվով &gt;8,5 մ2, ինչը հնարավորություն կտա ԿՓՇԿ ազգային հաղորդակցությունները մշակելիս կատարել ՋԳ անհրաժեշտ հաշվարկներ և օգտագործել այս տվյալները հարմարվողականության միջոցառումներ մշակելիս</p>
<p>11.</p>	<p>Օգտագործվում է «բնապահպանական ակտիվ» բառակապակցությունը, որը տնտեսագիտական երանգ ունի, սակայն իմաստն անհասկանալի է:</p>	<p>Ընդունված է «Բնապահպանական ակտիվը» ավանդական «բնական ռեսուրս» տերմինի ավելի ընդլայնված եզրույթ է, որը ոչ միայն ներառում է նյութական բարիքների ստացումը, այլև բնապահպանական ֆունկցիաների և ծառայությունների մատուցումը, ներառյալ տնտեսական արժեք չունեցող, բայց այլ առավելություններ, այլընտրանքներ, և օգուտներ բերողները, կամ</p>

			<p>զուտ իրենց գոյությամբ առավելություն ունեցող անկախ իրենց դրամական արտահայտության հնարավորությունից:</p> <p>Համապատասխան մեկնաբանություն տրվել է տեղատակով</p>
<p>12.</p>	<p>Կենսաբազմազանություն” ու “կանաչ տարածքներ” հասկացությունները միախառնված են ու տպավորություն է, որ երկուսն էլ դիտարկվում են որպես բնապահպանական տարածքներ ու դա այն դեպքում, երբ քաղաքում լայնորեն տարածված են կենսաբազմազանության պահպանման համար խիստ վտանգավոր ինվազիվ բուսատեսակներ (օր. “այլանդ” ծառատեսակը), որոնց նկատմամբ ուշադրություն չի հատկացվում:</p>		<p>Աշխատանքներն իրականացվել են ըստ ՎՋԵԲ/ԵԱՀԿ կողմից մշակված մեթոդաբանության, որը դիտարկում է կանաչ տարածքները որպես կենսամիջավայր:</p> <p>Հարցադրման երկրորդ մասովտե՛ս ստորև</p>

Քանի որ ՀՀ ԿԵՆՍԱԲԱԶԱՆԱԿԱՆ ԲԱԶՄԱԶԱՆՈՒԹՅԱՆ ՊԱՀՊԱՆՈՒԹՅԱՆ, ՕԳՏԱԳՈՐԾՄԱՆ ԵՎ ՎԵՐԱՐՏԱԴՐՈՒԹՅԱՆ ՌԱԶՄԱՎԱՐՈՒԹՅՈՒՆ ԵՎ ԳՈՐԾՈՂՈՒԹՅՈՒՆՆԵՐԻ ՊԵՏԱԿԱՆ ԾՐԱԳԻՐ ( Ե Ր Ե Վ Ա Ն 2 0 1 5) փաստաթղթի չորրորդ՝ «ՀԱՅԱՍՏԱՆԻ ԿԵՆՍԱԲԱԶՄԱԶԱՆՈՒԹՅԱՆ ՎԻՃԱԿԸ» գլխում մանրամասն վերլուծված է խնդիրը և որպես Ազգային նպատակային խնդիր, որի 1.3. ունի նախատեսված գործողություններ..

4.1. Հայաստանի կենսաբազմազանության վիճակի վրա ազդող գործոնները և միտումները

4.1.1. Կենսաբազմազանության բաղադրիչներին սպառնացող հիմնական վտանգները, դրանց պատճառներն ու ազդեցության մեխանիզմները

Մասնավորապես «Օտարածին տեսակների ազդեցությունը» բաժնում նշվում է, որ Հայաստանի ինվազիվ և էքսպանսիվ բուսատեսակների ժամանակակից տարածման վերլուծությունը ցույց է տալիս, որ դրանցից որոշները վերջին տարիներին զգալիորեն ընդլայնել են իրենց տարածման սահմանները (հավանաբար կապված կլիմայական պայմանների փոփոխման և խախտված բնակմիջավայրերի տարածքների ընդլայնման հետ): Բարձրացել է այդ տեսակների պոպուլյացիաների խտությունը, սկսվել է բնական էկոհամակարգեր դրանց ներթափանցումը և հաստատումը: Վերջին տարիներին հանրապետությունում կատարվել է ինվազիվ և էքսպանսիվ բուսատեսակների տարածման ընդհանուր գնահատում: Արդյունքում նշվել է 77 օտար ինվազիվ և տեղական էքսպանսիվ տեսակներ, որոնք ներկայումս տարածվում են խախտված բնակմիջավայրերում և արդեն ներխուժել են բնական էկոհամակարգեր՝ վտանգելով վայրի կենսաբազմազանությունը: Ինվազիվ տեսակների տարածումը բնական էկոհամակարգերին և կենսաբազմազանությանը սպառնացող հիմնական վտանգներից է, որը մարդու ուղղակի ազդեցության հետևանք է: Հայաստանի ինվազիվ բուսատեսակների վերաբերյալ տարվում են համեմատաբար ինտենսիվ ուսումնասիրություններ, ապա օտարածին կենդանատեսակների ի հայտ

բերման, դասակարգման և բնական էկոհամակարգերի վրա դրանց ազդեցության վերաբերյալ աշխատանքներ գրեթե չեն տարվել: Հետևաբար անհրաժեշտ է որոշել ինվազիվ կենդանիների տեսակային կազմը և բացահայտել դրանց ներթափանցման մեխանիզմներն ու գնահատվի ազդեցությունը բնական էկոհամակարգերի վրա:

Ազգային նպատակային խնդիր 1.3. Ստեղծել իրավական և կառավարման հիմքեր օտարածին տեսակների ներթափանցման ու բնական էկոհամակարգերի վրա դրանց ազդեցության որոշման, մոնիթորինգի կազմակերպման համար

1.3.1. Ստեղծել ինվազիվ տեսակների հարցերով զբաղվող համակարգող միջգերատեսչական հանձնաժողով և հաստատել դրա գործունեության շրջանակները:

1.3.2. Մշակել բույսերի և կենդանիների ինվազիվ տեսակների ներթափանցման և տարածման մոնիթորինգի իրականացման ուղեցույց:

1.3.3. Մշակել և ներդնել էքսպանսիվ և ինվազիվ տեսակների տարածումը և ազդեցությունը կանխարգելող միջոցառումների պլան:

Անցկացնել ինվազիվ տեսակների գույքագրում, դրանց Հայաստանի տարածք ներթափանցելու ուղիների բացահայտում և բնական էկոհամակարգերում տարածվածության աստիճանի գնահատում:

Հաշվի առնելով վերոհիշյալ ընդգրկուն ազգային մոտեցումը՝ նպատակահարմար չենք գտնում Երևանի տարանջատումը, որը նաև նպատակահարմար չէ Երևանի քաղաքապետարանի ՏԻՄ օրենքով նախատեսված լիազորությունների շրջանակներում:

<p>13.</p>	<p>Տրանսպորտի ու էներգետիկայի բաժիններում որոշակի տեղ է հատկացված ջերմոցային գազերի արտանետումների կրճատմանը, սակայն դրանք սովորաբար դիտարկվում են որպես միջոցառումների կողմնարդյունք: Անհրաժեշտ է հստակեցնել միջոցառման ուղղվածությունը, ի նկատի ունենալով, որ ըստ Փարիզյան համաձայնագրի 13-րդ հոդվածի երկիրն իր հաշվետվություններում պետք է հստակ նշի կլիմայի փոփոխության մեղմման նպատակային ֆինանսակալորմամբ միջոցառումների արդյունավետությունը:</p>	<p>Չի ընդունվել</p>	<p>Քանի որ Երևանի քաղաքապետարանը ունի նպատակային ծրագիր, որի առաջնային և հիմնական թիրախը հենց ջերմոցային գազերի արտանետումների կրճատումն է (ԿԷԶԳԾ), տրանսպորտի և էներգետիկայի, ինչպես նաև կանաչ տարածքների և թափոնների ոլորտների մեղմման ազդեցությունը գնահատված է որպես առաջնային արդյունք: ԿԲԳԾ նպատակը բնապահպանական ակտիվների բոլոր, այդ թվում ածխածնի երկօքսիդի, ցուցանիշների բարելավումն է: Ի դեպ Փարիզյան համաձայնագրի պահանջները արտացոլված են մեկ շնչի հաշվով CO2-ի տարեկան արտանետման</p>
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YEREVAN'S GREEN CITY ACTION PLAN 2017

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14.	4.1 բաժնում Երևան քաղաքի մթնոլորտային օդում փոշու վերաբերյալ արված դիտողությունը շտկման կարիք ունի: ՇՄՏԿ-ի կողմից որոշվող փոշին իր մեջ ներառում է նաև PM10, այնինչ տեքստում ասվում է՝ PM10-ից մեծ փոշի:	Ընդունվել է, խմբագրվել	Բնֆորմացիան ստացվել էր Հայէկոմոնիթորինի մասնագետների հետ հանդիպումների ժամանակ: Այս պնդումը հիմք ընդունելով՝ նշված նախադասությունը խմբագրվել հետևյալ կերպ՝ «Այդ պատճառով սույն հաշվետվության մեջ PM10-ի և PM2.5-ի կոնցենտրացիաների մշտադիտարկումը և գնահատումը փոխարինված են ընդհանուր փոշու կոնցենտրացիաներով:»
15.	15.4.3 բաժնում ստորերկրյա ջրերի վերաբերյալ եզրահանգումը մասնագիտորեն սխալ է, առաջարկում եմ վերանայել:/Պապյան/	Ընդունվել է	Խմբագրվել է Հեռացվել է հետևյալ նախադասությունը “Այդուհանդերձ, կարելի է ենթադրել, որ մակերևութային ջրերի որակը արտացոլում է նաև ստորգետնյա ջրերի որակը:”
16.	Նախագծի 4.4 «Կենսաբազմաբանություն և կանաչ տարածքներ» ենթաբաժինն ընդհանուր առմամբ խմբագրման և լրամշակման կարիք ունի, մասնավորապես՝ կատարվել է ուղղակի և ոչ մասնագիտական թարգմանություն անգլերեն տեքստից, ինչի արդյունքում խեղաթյուրվել են բազմաթիվ բառակապակցությունների և հասկացությունների իմաստը, Օրինակ՝ «կենսաբազմաբանության բարձր մակարդակ», «բնապահպանական ակտիվների որակ», «բուսականության ամեն տեսակի ծածկեր» և այլն,  • ենթաբաժնի առաջին պարբերությունում պարզաբանման և խմբագրման կարիք ունի «կարևորագույն բուսաբանական տարածք» հասկացությունը և դրա ձևակերպումը,		Վերլուծության նախնական՝ հիմնական տարբերակը գրված է հայերեն լեզվով և թարգմանության մասին խոսք չի կարող լինել: Ծրագիրը քննարկման չորրորդ փուլից առաջ խմբագրվել է:  Ինչ վերաբերվում է օգտագործված տերմիններին  • «բնապահպանական ակտիվներ» տերմինը մեկնաբանվել է 11-րդ դիտողության հետ կապված,  • «կարևորագույն բուսաբանական

			<p>տարածք» տերմինը օգտագործվում է հետևյալ իմաստով- հազվագյուտ և էնդեմիկ բուսատեսակների պոպուլյացիաներ կրող կամ/և առանձնահատուկ ֆլորիստիկ հարստություն ներկայացնող տարածքներ - բացատրությունը վերցված է «Հայաստանի հազվագյուտ և վտանգված բնակմիջավայրերի տեսակները ներկայացնող Կարևորագույն Բուսաբանական Տարածքները» վերտառությամբ գրքից</p>
<p>17.</p>	<p>Անհրաժեշտ է ենթաբաժնի վերնագիրը և բովանդակությունը համապատասխանեցնել միմյանց, հաշվի առնելով որ ենթաբաժնում բացակայում է տեղեկատվությունը Երևան քաղաքի կենսաբազմազանության (հատկապես ֆլորայի), այդ թվում նաև հազվագյուտ և անհետացման եզրին գտնվող տեսակների վերաբերյալ:</p>	<p>Չի ընդունված</p>	<p>Մեթոդաբանությամբ դիտարկվող ցուցանիշները չեն ընդգրկում ամբողջ կենսաբազմազանությունը, այլ միայն թռչունները, որոնք քաղաքային էկոհամակարգի առողջության լավագույն ցուցանիշն են: Մնացած մանրամասները ընդգրկված են ՌԷԳ հաշվետվության մեջ:</p>
<p>18.</p>	<p>Աերացիա» ԿՄԿ համակարգի վերականգնումից և արդիականացումից հետո Հրազդան գետ հեռացվող ջրերի որակը անհրաժեշտ է համապատասխանեցնել ՀՀ կառավարության 2011թ.-ի հունվարի 27-ի N75-Ն որոշմաման N11 հավելվածում նշված I որակի դասի նորմերին:</p>	<p>Ընդունված է</p>	<p>Խմբագրվել է, ավելացվել է հետևյալ ձևակերպումը «Աերացիա» ԿՄԿ համակարգի վերականգնումից և արդիականացումից հետո Հրազդան գետ հեռացվող ջրերի որակը անհրաժեշտ է համապատասխանեցնել ՀՀ կառավարության 2011թ.-ի հունվարի 27-ի N75-Ն</p>

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			որոշմաման N11 հավելվածում նշված I որակի դասի նորմերին:
19.	Նախագծում «քաղաքային կոշտ թափոններ» և «թափոնների արտանետում» հասկացությունների փոխարեն օգտագործել «կենցաղային կոշտ թափոններ» և «թափոնների տեղադրում» հասկացությունները,	Ընդունված է	Խմբագրված է, թեև «քաղաքային կոշտ թափոններ» տերմինը լայն կիրառում ունի ու չի հակասում որևէ գիտական սահմանման (municipal solid waste - MSW)
20.	«Անհրաժեշտ է հստակեցնել նախագծի «Արդյունաբերության ճյուղեր» 8-րդ բաժնի վերջին պարբերությունը հաշվի առնելով ՀՀ կառավարության 2017 թվականի հունիսի 15-ի «Լավագույն հնարավոր տեխնոլոգիաներին ներկայացվող չափորոշիչները սահմանելու մասին» N666-Ն որոշումը:»	Ընդունվել է	Խմբագրված է, տեղեկատվությունը հատնվել է նախագծի մշակումից հետո, այնուհանդերձ խմբագրված է
21.	Բացակայում են նախագծի ֆինանսական ամփոփ գնահատականը և հիմնավորումները:	Ընդունված է	Տե՛ս արձագանքը դիտողություն 3-ին:
22.	Նախագծում բերված մի շարք հասկացություններ անհրաժեշտ է համապատասխանեցնել օրենսդրությամբ նախատեսված սահմանումներին, մասնավորապես, «թափոնների արտանետման և աղբանետման վճարներ», «պարտադիր վճար աղբի հավաքման և հեռացման համար» «ավտոմեքենաների տարիքի հետ մաքսերն աճում են» և այլն: /ԲՈՄՄՎ/	Կրկնություն է	Տես արձագանքը դիտողություն 9-ին
23.	Ներկայացվող գործողությունները «կանաչ» որակելու համար չկան ներկայացված գործողությունները կանաչ որակելու չափորոշիչները և ռազմավարական անվանված փաստաթղթում յուրաքանչյուր գործողություն կապվում է «կանաչ» հասկացության հետ, մասնավորապես, «կանաչին» ոչ շատ վերաբերելի գործողություններն որակվել են և ամրագրվել որպես կանաչ գործողություններ: Չի տրվում «կանաչ» գործողությունների հասկացությունը: Պարզ չէ, թե ինչ չափորոշիչներ են այդ գործողությունները որակելու որպես կանաչ:	Տրվում է պարզաբանում	Տե՛ս Բաժին 1. «Կանաչ քաղաք» գործողությունների ծրագրի (ԿՔԳԾ) մեթոդաբանությունը, և Բաժին 2 Ինչպես կարդալ այս ԿՔԳԾ-ը  Մեջբերելով «Ցուցանիշների վերլուծությունը հիմնված է եռաստիճան սանդղակի վրա, որտեղ Երևանի առաջ ծառացած ամենից հրատապ բնապահպանական խնդիրները նշված են «կարմիր» գույնով, այն ոլորտները, որոնք չունեն

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			<p>հրատապ առաջնահերթություն, սակայն, այնուամենայնիվ, պահանջում են բարելավում, նշված են «դեղին» գույնով, և ոլորտները, որոնք ցուցադրում են բարձր համապատասխանություն «կանաչ» քաղաքի բնութագրերին, նշված են «կանաչ» գույնով:»</p> <p>«Կանաչ» հասկացությունը, այսպիսով, վերաբերվում է բերված քանակական ցուցանիշների համապատասխանությանը, որոնք ամեն ոլորտային մարտահրավերների գնահատման դեպքում տարբեր են: Հետևաբար՝ «կարմիր» կամ «դեղին» գնահատված իրավիճակներին համապատասխան միջոցառումներով արձագանքելը միտված է իրավիճակի բարելավմանը՝ մինչև «կանաչ» շեմի նվաճումը:</p>
<p>24.</p>	<p>Որպես ռազմավարական փաստաթուղթ այն ավելի կենտրոնացված է իրավիճակի նկարագրերի, քան ռազմավարությունների, առաջարկությունների, գործողությունների, ակնկալվող արդյունքների, դրանց գնահատման չափորոշիչների վրա: Ընդհանուր առմամբ բավականին ծավալուն փաստաթուղթ է, որից, սակայն, շատ դժվար է դառնում ըմբռնել այն կոնցեպտուալ, արդյունքային նվաճումները, որ ռազմավարությունն առաջարկում է Երևան քաղաքի համար:</p> <p>Որպես ռազմավարական փաստաթուղթ հատկապես պետք է երևար, որ այն պատրաստվել է Երևան քաղաքի համար՝ հաշվի առնելով քաղաքի առանձնահատկությունները, սակայն,</p>	<p>Չեն ընդունվել</p>	<p>Մեկնաբանության համար՝ տես Դիտողություն 1-ի արձագանքը</p>

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	այս փաստաթուղթը կարող է վերաբերվել ցանկացած քաղաքի:		
25.	Առաջարկվում է այդ փաստաթուղթը լրամշակել, հատկապես ցույց տալով ծրագրի իրականացման նպատակակետերը, գործողություններից յուրաքանչյուրի համապատասխանությունն այդ նպատակակետերին, չափորոշիչները՝ արդյունքները գնահատելու, մոնիտորինգը, հետ անդրադարձի մեխանիզմները՝ արդյունքների անհամապատասխանություն հայտնաբերելու դեպքում:	Չի ընդունվել	Տե՛ս Գծապատկեր 1 և Բաժին 12
26.	Նախագծի որոշ բաժինները շարադրված են թույլ անգլերենով ու նրանք կարիք ունեն վերաշարադրման/ տես առդիր		Թեև նախագծի անգլերեն տարբերակը տրամադրվել է նախարարության ոչ պաշտոնական խնդրանքով, Երևանի Ավագանու ընդունման ենթակա փաստաթուղթը հայերեն տարբերակն է, որն էլ ներկայացվել էր պաշտոնական կարծիքի: Այնուհանդերձ, գնահատում ենք անգլերեն տարբերակին ներկայացված խմբագրական բնույթի դիտողությունները, որոնք մասամբ ընդունելի են:
27.	Կան նաև խնդիրներ ներկայացված տեղեկատվությունների մասին՝ հակասություններ տվյալների վերաբերյալ որոնք ներկայացվել են զեկուցի տարբել բաժիններում, տվյալերի ու թվերի ներկայացում առանց նրանց հիմնավորելու, գաղափարների ներկայացում, որոնք ինքնուրույն մի գուցե լավ գաղափարներ են, բայց նրանք գործնական չեն Երևանի համար և այլն:	Ընդունված չէ	Հաշվի առնելով, որ նախագծերը ներկայացվել են նախարարություն կարծիքի ս/թ մայիսի 29-ին, այդպիսով տալով ավելի քան բավական ժամանակ կոնկրետ և որոշակի դիտողությունների համար, հաշվի առնելով նաև, որ նախարարության մասնագետների հետ նաև է կացվել երեք մասնագիտական քննարկում, ինչպես նաև տեղի է ունեցել չորս հասարակական քննարկում, որտեղ կարելի

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			Էր նման ընդհանրական դիտարկում մանրամասնեցնել՝ նման դիտողությունը համարում ենք անօգտակար և անընդունելի:
28.	Տրանսպորտի հետ շահակապված հարցերը Էական են որևէ քաղաքի մթնոլորտի բարելավման համար: Այս զեկույցի տրանսպորտի բաժնի պատրաստելու մեջ նկատի չի առված Երևանի յուրահատկությունները, որը ակնհայտ է ներկայացված առաջարկներից որոնք ուներ ընդհանուր բնույթ:	Ընդունված չէ	Երևանի քաղաքապետարանի տրանսպորտի վարչությունը և Կայուն քաղաքային զարգացման ԾԻԳ-ը Ձեր հետ համակարծիք չէ: Խնդրում ենք հաշվի առնել, որ որոշ միջոցառումների մասով առաջարկվում են նոր տեխնիկա-տնտեսական հիմնավորումների անցկացում՝ նախքան ներդրումը:
29.	Հայերեն ու անգլերեն զեկույցները ունեն յուրջ վերանայման կարիք՝ կարգավորելու տվյալները, գիտական հարցերը ու առաջարկները, նաև անգլերեն տարբերակը կարիք ունի լեզվական բարեփոխումների	Ընդունված չէ	Տես մեկնաբանությունները դիտողություն 27 և 28-ին:

7.4.4 The list of participants of the 4th public hearing on 3 August 2017

*Նիսանակային չքանակ  
1759 - 4890 հոգի հասնաբանական լինելուց հետո*

N	ԱԱՀ	Կազմակերպություն	Հեռ.	email	Ստորագրություն
1	Շուշանիկ Ասմարյան	ՀՀ Գիտությունների Ակադեմիայի Էկոլոգանոսֆերային հետազոտությունների կենտրոն	57-29-24	shushanik.asmaryan@cens.am	<i>Shushanik</i>
2	Գևորգ Տեխանյան	ՀՀ Գիտությունների Ակադեմիայի Էկոլոգանոսֆերային հետազոտությունների կենտրոն	57-29-24	info@cens.am; ecocentr@sci.am	<i>Gevorg</i>
3	Նազիկ Մկրտչյան				
4	Կարինե Դանիելյան	"Կեռնակ ԿՆԳ" ԸՄՄ-ի Կենտրոնի Կենտրոն Երևանի քաղաքապետարան, Բնապահպանության վարչություն	035-57-22-22	karinedan@am	<i>Karine</i>
5	Արսեն Հազարապետյան				
6	Ալեն Ամիրխանյան				
7	Նարեկա Միրզոյան	<i>Օնոլոգի Կարյա ԳԿԿ</i>	091284161	amir@yan.dan.am	<i>Narek</i>
8	Դիլիսի Մանակյան	<i>Տրանս Ինժե</i>	031528554		<i>Dilys</i>
9	Վահրամ Ջալալյան				
10	Տիգրան Մելիքյան				
11	Մարտիրոս Օստոյան				
12	Մարիկա Հարությունյան	EY			
13	Աստղիկե Գասոյան	<i>Օնոլոգի Կարյա ԳԿԿ</i>			
14	Արտակ Մաղաբեյան	Yerevan SUDOP PIU	09301619	artem@piu.am	<i>Artak</i>
15	Ռուզաննա Ոսկանյան	Yerevan SUDOP PIU	085005315		
16	Արտաշես Մարգարյան	ՀՀ Էկոլոգիա			
17	Կարոյան Կարոյան	UNDP	09443109	hakobyan@undp.am	<i>Karoyan</i>
18	Կարեն ԱՌԻՆԵ	ԴՊՈՒՀ-Երևանի քաղաքի ԿՊՄ-ի Կենտրոն	09117188	kar@armin.am	<i>Karen</i>
19	Պարուհի Գրիգորյան	ՄԱԴՐ Կենտրոն	014204269	paruhi@madr.am	<i>Paruhi</i>
20	Վահրամ Զեյնալյան	Արտաշես Երևանի քաղաքի ԿՊՄ-ի Կենտրոն	09656334	van@vazir.am	<i>Vahram</i>
21	Նինա Կարյա Գևորգյան	ԸՄՄ-ի Կենտրոնի Կենտրոն (Գրանցում)	09398598	gina@ecocentr.am	<i>Nina</i>
22	Երվանդ Հարությունյան	Երևանի քաղաքապետարանի Բնապահպանության վարչություն	091-450-180	er@ecocentr.am	<i>Yervand</i>
23	Նուբե Կարյա Գևորգյան	ԿՏԿՎ - RBC Caucasus	093 300266	nube@rbc.am	<i>Nube</i>
24	Պրակտիկական ՊՆԿԻ	ԿՏԿՎ-ի Կենտրոնի Կենտրոն, Բնապահպանության վարչություն	099 99908	prakt@prakt.am	<i>Prakt</i>
25	Պրակտիկական ՊՆԿԻ	ԿՏԿՎ-ի Կենտրոնի Կենտրոն, Բնապահպանության վարչություն	099 351430	prakt@prakt.am	<i>Prakt</i>
26	Պրակտիկական ՊՆԿԻ	ԿՏԿՎ-ի Կենտրոնի Կենտրոն, Բնապահպանության վարչություն	093 709937	ecoteam.kg@ecocentr.am	<i>Prakt</i>
27					



ՊԵՏԱԿԱՆ ՓՈՐՁԱՔՆՆԱԿԱՆ ԵԶՐԱԿԱՑՈՒԹՅՈՒՆ  
ՇՐՋԱԿԱ ՄԻՋԱՎԱՅՐԻ ՎՐԱ ԱԶԴԵՑՈՒԹՅԱՆ ՓՈՐՁԱՔՆՆՈՒԹՅԱՆ

թիվ ԲՓ 77

<<21>> 08 2017թ.

**Երևանի «Կանաչ քաղաք» գործողությունների ծրագրի շրջակա միջավայրի ազդեցության ռազմավարական գնահատման հաշվետվություն**

Ձեռնարկող՝

<<Էրնստ Էնդ Յանգ>> ՓԲԸ

Փաստաթղթի տեսակը՝  
իրականացման վայրը՝

Հիմնադրության փաստաթուղթ  
Երևան քաղաք



Երևան քաղաքի համար «Կանաչ քաղաք» գործողությունների ծրագիրը (ԿԲԳԾ) մշակվել է Վերակառուցման և զարգացման եվրոպական բանկի (ՎԶԵԲ) աջակցությամբ Երևանի քաղաքապետարանի Քաղաքային կայուն զարգացման ներդրումային ԾԻԳԻ և Էրնսթ Էնդ Յանգ խորհրդատվական ընկերության մասնակցությամբ: «Կանաչ քաղաք» գործողությունների ծրագիրը բնապահպանական միտվածության ռազմավարական փաստաթուղթ է՝ մինչև 2030թ.-ը կանաչ գործողությունների իրականացման համար: ԿԲԳԾ-ում նախատեսված բոլոր միջոցառումները ուղղված են Երևան քաղաքի շրջակա միջավայրի վիճակի բարելավմանը:

Ծրագրում ուրվագծվում են երկարաժամկետ ռազմավարական նպատակները, ինչպես նաև առաջարկվում են միջնաժամկետ թիրախներ և կարճաժամկետ գերակա գործողություններ՝ բնապահպանական մարտահրավերները հաղթահարելու նպատակով: Փաստաթուղթի 1-ին փուլի գործընթացում ուշադրություն է դարձվում առկա տեղեկությունների ու տվյալների բացահայտմանը, հավաքմանը, մշակմանը և վերլուծությանը, որի հիման վրա մշակվել են հեռանկարային տեսլականը և դրա իրագործման գործողությունները: 2-րդ փուլի գործընթացում սահմանվում է հեռանկարային ռազմավարական նպատակները՝ միջնաժամկետ թիրախներով և կարճաժամկետ գործողություններով:

ԿԲԳԾ գլխավոր խոչընդոտներից մեկը տվյալների բացակայությունն է կամ դրանց ցածր որակը, ինչը վերաբերում է փաստաթղթում դիտարկված գրեթե բոլոր ցուցանիշներին: Դրանք ընդգրկում են, բայց չեն սահմանափակվում հետևյալ ոլորտներով՝ մթնոլորտի աղտոտվածության կախված մասնիկների՝ PM 2.5 և PM 10 մոնիտորինգը, ստորգետնյա ջրերի քանակի և որակի մասին պարբերական մշտադիտարկման և ռեսուրսի գնահատման բացակայություն, քաղաքային տնտեսության գործունեության արդյունքում առկա ֆիզիկական ներգործությունների մշտադիտարկումը, վառելիքի և ճանապարհատրանսպորտային ոլորտի համայնքային մակարդակի մանրամասն վիճակագրության բացը, աղտոտված տարածքների հաշվառումը և այլն: ԿԲԳԾ-ն առաջարկում է այնպիսի գործողություններ, որոնք կհանգեցնեն արդիականացված մշտադիտարկմանը և տվյալների մշակմանը: Ծրագրի մշակման ընթացքում ընդգրկվել են շահագրգիռ կողմեր՝ տվյալների բացերը նվազագույնի հասցնելու նպատակով և կօգնեն իրականացնել ԿԲԳԾ-ը:

Երևանը գտնվում է Արարատյան դաշտի հյուսիսարևելյան մասում, Հրազդան գետի երկու ափերին՝ ծովի մակերևույթից 850-1300 մ բարձրության վրա, հյուսիսային լայնության 40° և արևելյան երկայնության 44° շրջանում: Տեղանքը կազմված է երիտասարդ հրաբխային և նստվածքային ապարներից և գտնվում է 7-8 բալանոց երկրաշարժային գոտում: Քաղաքի ընդհանուր տարածքը կազմում է 223 կմ<sup>2</sup>, Երևան քաղաքի վարչական տարածքը կազմում է 22.328 հա, այդ թվում՝

1. պետական սեփականության հողեր՝ 3396.8.
2. համայնքային սեփականության հողեր՝ 10763.2.
3. քաղաքացիների և իրավաբանական անձանց սեփականություն 5473. 6
4. օտարերկրյա պետությունների սեփականություն՝ 14.9:

ԿՔԳԾ-ի համատեքստում դիտարկվում է քաղաքի բնապահպանական վիճակի զարգացման երեք տարբերակներ, այդ թվում՝ 1. բազային՝ առկա իրավիճակի պահպանությամբ, 2. զարգացման՝ նախանշված համայնքային ծրագրերի իրականացմամբ, և 3. կանաչ արահետ՝ համայնքի «Կանաչ քաղաք» ծրագրի իրականացմամբ: ԿՔԳԾ-ի շրջանակներն ընդգրկում է Երևանի ամբողջ վարչական տարածքը, ներառյալ հետևյալ ոլորտները.

- Օդի որակ և կլիմայի փոփոխություն
- Հողային ռեսուրսներ և կանաչ տարածքներ
- Ջուր և կեղտաջրեր
- Կենսաբազմազանություն և էկոհամակարգեր:

Շրջակա միջավայրի բաղադրիչների վիճակը, /այդ թվում՝ օդ, հող, ջուր և կենսաբազմազանություն/ կրում է մարդու գործունեության ազդեցությունը՝ սկսած տրանսպորտից ու արդյունաբերությունից մինչև էներգետիկա, ջրամատակարարում և ջրօգտագործում, թափոնների գոյացում:

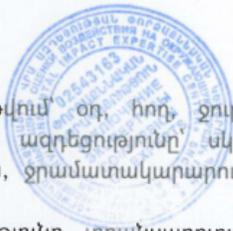
Արագ զարգացող արդյունաբերությունը, գյուղատնտեսությունը, տրանսպորտային միջոցների ինտենսիվ շահագործումը և ուրբանիզացիայի ներկա ծավալները հողային ռեսուրսների վրա վնասակար ազդեցության հիմնական պատճառներն են: Հողաշերտի դեգրադացման ու կենսաբանական արտադրողականության նվազման հիմնական պատճառներից են՝ հողի էրոզիան, աղակալումը, քիմիական, կենսաբանական ու ռադիոակտիվ աղտոտումը և այլն:

Երևան քաղաքի հողերը և մթնոլորտն աղտոտված են տարբեր վնասակար նյութերով, այդ թվում՝ ծանր մետաղներով (Pb, Cu, Zn, Ni, Mo, Ag, Co): Աղտոտվածության հետազոտության արդյունքները վկայում են, որ ըստ աղտոտման գումարային գործակցի արժեքի մեծության, Երևանի բոլոր շրջանների հողերը հատում են աղտոտման բարձր մակարդակի շեմը (ԱԳԳ=32-128): Քաղաքի խիտ բնակեցված հատվածներում ակնառու են հիմնականում կապարի կետային բնույթի ինտենսիվ կարգաշեղումներ, սահմանային թույլատրելի կոնցենտրացիաների գերազանցումներ արձանագրվում են քաղաքի տարածքի մոտ 15%-ում: Հողում՝ Cd, Pb, Zn, Ni, Cr ծանր մետաղների պարունակությունը ուղիղ համեմատական է ծյան ծածկույթում դրանց պարունակության հետ: 2005-2012թթ. Երևան քաղաքի մթնոլորտային տեղումներում պղնձի պարունակությունը միշտ գերազանցել է ՍԹԿ-ն: Առաջնային աղտոտիչներ են համարվում նաև ցինկը և բարիումը:

Հողի աղտոտման հիմնական պատճառներից են նաև շարունակաբար ավելացող տրանսպորտային միջոցները: Հանրապետության հողերի դեգրադացման և աղտոտման հիմնական աղբյուրներից մեկը ընդերքօգտագործումն է:

Հողի որակի համար վնասակար գործոններ են համարվում.

1. Ճարտարագիտական աշխատանքները, որոնք ստեղծում են բարձր թեքության լանջեր և հողային տարածքներ, որոնք ենթարկվում են հեղեղումների և սողանքների,



2. Ոռոգումը, որն էրոզիայի է ենթարկում հողը,
3. Անտառազրկումը, ծառահատումները և հողային մակերեսների անբավարար անտառածածկը,
4. Արհեստական պարարտանյութերի և թունաքիմիկատների օգտագործումը, որոնք նպաստում են հողի աղտոտմանը,
5. Կենցաղային կոշտ թափոնները, որոնք տեղադրվում են ոչ սանիտարական աղբավայրերում,
6. Ոչ մետաղական հանքավայրերը և դրանցից առաջացող ընդերքօգտագործման թափոնները
7. Արդյունաբերական կոշտ և հեղուկ թափոնները, ինչպես նաև արտանետումները մթնոլորտ (հատկապես՝ ծանր մետաղների):

Ելնելով Երևան քաղաքի գլխավոր հատակագծի իրականացման սկզբունքներից ընդունված են մի շարք փաստաթղթեր, որոնք ոչ միայն միտված են պահպանելու քաղաքի դիմագիծը, այլ նաև զարգացման հնարավորությունները: Կանաչ տարածքների զարգացումը և պահպանությունը Երևանի գերակա խնդիրներից մեկն է: Մայրաքաղաքի մեկ բնակչին հասնող ընդհանուր օգտագործման կանաչ տարածքը՝ 2012թ. դրությամբ կազմում էր 7,5 քմ/մարդ, որը 2 անգամ պակաս է նորմատիվայինից:

Երևանում ընդհանուր օգտագործման կանաչ տարածքը կազմում է 832.3 հա, որից փողոցների կանաչապատ տարածքը՝ 145.83 հա, զբոսայգիները՝ 146.22 հա, պուրակները՝ 34.47 հա, անտառ-պուրակները՝ 505.77 հա:

2012 թ. դրությամբ սահմանափակ օգտագործման և հատուկ նշանակության կանաչ տարածքները գրավում են համապատասխանաբար 3.664 հա և 2.135 հա մակերես: Այդ մակերեսից 497 հա բաժին է ընկնում անտառ-պուրակ կարգավիճակով կանաչ տարածքներին, 148 հա՝ սիզամարգերին և այլն:

Երևան քաղաքի անբարենպաստ տեխնածին և կլիմայական գործոնների ազդեցության պայմաններում բացակայում են պաշտպանիչ տնկարկները և դրանց էկոլոգիապես կայուն տեսակները:

Քաղաքային իշխանությունները զգալի ջանքեր են գործադրել՝ վերականգնելու և պահպանելու հանրային կանաչ տարածքները: Սակայն գոյություն ունեն սահմանափակող գործոններ՝ հողի բերրիություն, ոռոգման կարիքներ և ենթակառուցվածքների առկայություն:

Մայրաքաղաքի կանաչապատման ոլորտի անբաժան, կարևորագույն մասն է կազմում ոռոգման ցանցի առկայությունը: Տարվա կտրվածքով յուրաքանչյուր 1 հա կանաչ զանգվածի ոռոգման համար պահանջվում է առնվազն 7000 խմ ջուր, առանց որի անհնարին կլինի ապահովել կանաչ մակերեսների պահպանումը և զարգացումը:

Վերջին տարիների ընթացքում Երևանի քաղաքապետարանի ծրագրով իրականացվել են ոռոգման ցանցի ընդլայնման, նորերի ստեղծման լայնածավալ աշխատանքներ, որոնք իրենց հերթին նպաստեցին կանաչ տարածքների բարելավմանը, վերականգնմանը և ավելացմանը: 2010-2012 թթ. ոռոգման ցանցի ընդլայնման և վերանորոգման ծրագրին զուգընթաց փողոցներում, այգիներում, պուրակներում և անտառ-պուրակներում իրականացվել են կանաչապատման (ծառատնկման) և գեղագիտական ծաղկապատման աշխատանքներ:

Նորատունկ բուսականությունն ունի այլ կառուցվածք (տեսակների ու հասունության բազմազանություն)՝ նախկինի համեմատած, և ունի գազի կլանման ավելի ցածր կարողություններ: Ավելին, դեռ պետք է ստեղծել փոշու բնական պատնեշ, ինչպիսին գոյություն ուներ մինչև 1990-ականները:

Երևանի Գլխավոր հատակագիծը նախատեսում է 876 հա կանաչ պատնեշի (բուֆերային գոտու) վերստեղծում քաղաքի շուրջը, ինչը համապատասխանում է

միջազգային նորմերին, որոնք պահանջում են անտառապատ օդակ՝ 50 կմ շառավղով: Գլխավոր հատակագծով այդ նպատակի համար սահմանված բոլոր տարածքներում որոշ հողամասեր այլևս հասանելի չեն, մյուսները՝ կամ աղտոտված են կամ էրոզիայի ենթարկված: Արդյունքում, 2020 թ.-ի նպատակակետը հասանելի չէ և կանաչ տարածքների ստեղծման համար տրամադրվող տարածքները և կանաչ տարածքների ստեղծում հասկացությունը հարկ է վերագնահատել և վերածնակերպել: Այս թիրախի ձեռքբերման գործում իրենց կարևոր ավանդը պետք է բերեն նոր առևտրային (կոմերցիոն) զարգացումները, որի պարագայում կառուցապատողները օրենքով պարտավորված կլինեն իրենց նախագծերում ունենալ առնվազն 30% կանաչապատված տարածքներ:

Բացի նոր կանաչ տարածքների ստեղծումից, քաղաքային իշխանությունները մշակել են միջոցառումների փաթեթ՝ պահպանելու քաղաքում գոյություն ունեցող կանաչ խոտը և բույսերը: Սա ներառում է, օրինակ, գոյություն ունեցող զբոսայգիների ու կանաչ տարածքների, այդ թվում՝ բնակելի հատվածներում բակերի վերականգնում: Սրանք չեն նպաստում հանրային կանաչ տարածքների մակերեսի մեծացմանը, սակայն բարելավում են դրանց վիճակը, խնամքը և գեղագիտական տեսքը: Ավելին, «Երևան» նախագծային ինստիտուտը մշակել է որոշ այգի-պուրակների վերակառուցման նախագծեր, որոնց թվում թվում են՝

- Գոյություն ունեցող ջրավազանների ու շատրվանների ավազանների նորոգում, սիզամարգերի թվի մեծացում և Երևանի կլիմայական պայմաններին համապատասխանող ծառերի տնկում,
- Պանթեոնին հարակից՝ 7 հա հանգստի տարածք ունեցող զբոսայգու վերակառուցում, ինչպես նաև քաղաքային զբոսայգու՝ 80 հա մակերեսի ընդարձակում՝ շուրջ 25 հա-ով:

Երևանում կանաչապատման համար հիմնականում օգտագործվել են ծառատեսակներ ու թփեր, որոնք օժտված են փոշեպաշտպան, ծխապաշտպան և աղմկապաշտպան հատկություններով: Այդ տեսակները խիստ անհրաժեշտ են գերբնակեցված քաղաքներում և արդյունաբերական շրջաններում՝ տեղի միկրոկլիմայական և սանիտարահիգիենիկ պայմանների բարելավման համար: Ուստի Երևանում ստեղծվել են ծառայգիներ, որոնք ունեն ոչ միայն գիտական, գործնական, գեղագիտական, այլ նաև բնապահպանական նշանակություն:

«Կանաչ քաղաք» գործողությունների ծրագիրը (ԿԲԳԾ) ԿԲԳԾ-ը միտված է մինչև 2030 թ. բնապահպանական ոլորտում հետևյալ արդյունքների ապահովմանը, այդ թվում՝

- Քաղաքի բնապահպանական ճնշումների (մթնոլորտային օդի, ջրի, հողերի, կենսաբազմազանության, էկոլոգիական վիճակի և այլ վտանգների) մշտադիտարկման և տվյալների հավաքագրման համակարգի բարելավում, տվյալների թարմացվող բազայի հիմնում,
- Մթնոլորտային օդի որակի վրա ճնշումների նվազեցում, վնասակար նյութերի արտանետումների կրճատում,
- Մեկ մարդուն բաժին ընկնող կանաչ տարածքների ավելացում, կենսաբազմազանության և էկոհամակարգերի պահպանություն, աղտոտված տարածքների այլընտրանքային օգտագործման կազմակերպում, կառուցապատման մեջ «կանաչ շինարարության» և «կանաչ ճարտարապետության» սկզբունքների կիրառում,
- Ջրային ռեսուրսների արդյունավետ կառավարում, աղտոտման նվազեցում, կեղտաջրերի կառավարման համակարգի արդյունավետության բարձրացման,



- Շենքերի, լուսավորության, արդյունաբերության և տրանսպորտի ոլորտներում վառելիքաէներգետիկ ռեսուրսների սպառման նվազեցում, էներգասպառման մեջ վերականգնվող էներգիայի օգտագործման մասնաբաժնի ավելացում,
- ջերմոցային գազերի արտանետումների կրճատում, կլիմայի փոփոխության մեղմում,
- Տրանսպորտային համակարգի արդյունավետության և հարմարավետության բարձրացում, երթուղիների օպտիմալացում և տրանսպորտի էկոլոգիապես մաքուր տեսակների խթանում (հեծանիվներ, էլեկտրամոբիլներ), հետիոտնային տեղաշարժի խթանում, ուղևորափոխադրումներում հանրային տրանսպորտի մասնաբաժնի ավելացում,
- Թափոնների կառավարման արդյունավետության բարձրացում, թափոնների տեղադրման, տարանջատման և մշակման համակարգի ստեղծում, աղբավայրից մեթանի օգտագատման մակարդակի բարձրացում,
- Մթնոլորտային օդի և հողերի գերնորմատիվային աղտոտման, գերնորմատիվային աղմուկի նվազեցման միջոցով մարդու առողջության վրա բացասական ազդեցության նվազեցում,
- Բնակելի ոլորտում էներգետիկ ծախսերի նվազեցման և հանրային տրանսպորտի համակարգի հասանելիության բարձրացման, և ծայրամասային համայնքների արտաքին լուսավորության համակարգի ստեղծման միջոցով բնակչության սոցիալական ռիսկերի մեղմում,
- Կայուն էներգիայի, առողջ ապրելակերպի, կանաչ տնտեսության, շրջակա միջավայրի պահպանության մասին հանրային իրազեկման մակարդակի բարձրացում:

Փաստաթուղթը ներառում է նաև 2030 թ.-ը ԿՔԳԾ իրականացման արդյունքում շրջակա միջավայրի բոլոր բաղադրիչների վրա ակնկալվող արդյունքները, որոնք ըստ ոլորտների ընդգրկում են հետևյալ բաղադրիչները՝ մթնոլորտային օդ, հողային և ջրային ռեսուրսներ, կենսաբազմազանություն և կանաչ տարածքներ, տրանսպորտ, էներգամատակարարում, էներգաօգտագործման արդյունավետություն շենքերում և արտաքին լուսավորություն, արդյունաբերություն թափոններ և այլն: Փաստաթղթում գնահատվել է նաև ԿՔԳԾ իրականացման ազդեցությունը հանրային առողջության վրա:

ԿՔԳԾ-ով նախատեսված մշտադիտարկումը, որը կներառի բնապահպանական բոլոր ցուցանիշները (հողի, ջրի, օդի առանցքային չափորոշիչները, առողջապահական ցուցանիշները, շրջակա միջավայրը) կհանդիսանա ԿՔԳԾ իրականացման գործընթացի առանցքային գործառույթներից մեկը: Մշտադիտարկման ապահովման համար ԿՔԳԾ-ն մեծ կարևորություն է տալիս տվյալների հավաքագրման բացերը վերացնելուն, ներառյալ՝ ազգային բնապահպանական մոնիտորինգի ծառայության գործառույթներում, ինչպես նաև համայնքային բնապահպանական մշտադիտարկման և տվյալների բազայի ստեղծման և թարմացման միջոցով:

Փաստաթղթում բացահայտվել և ամփոփվել են ԿՔԳԾ-ի շրջանակներում ըստ ոլորտների բոլոր գործողությունների համար նախատեսված կապիտալ ներդրումների գնահատված արժեքները՝ երեք ներդրումային շրջանի համար /կարճաժամկետ, միջնաժամկետ, երկարաժամկետ/:

«Օրենսդրությամբ սահմանված կարգով, Երևանի քաղաքապետարանում մշակված փաստաթղթի գնահատման և փորձաքննության փուլերում անցկացվել են հանրային քննարկումներ: Քննարկումների ընթացքում հանրության կողմից առաջ քաշված դիտողությունները և առաջարկությունները փորձաքննության գործընթացում հաշվի են առնվել: Փաստաթղթի լրամշակման ժամանակ հաշվի են առնվել նաև փորձաքննական գործընթացում ընդգրկված պետական լիազոր մարմինների և բնապահպանության նախարարության համապատասխան կառույցների կարծիքները:

**Եզրահանգում:** Ամփոփելով հաշվետվության գնահատման և փորձաքննության արդյունքները պետք է նշել, որ ծրագրի իրականացումը կունենա կարևոր ռազմավարական բնապահպանական նշանակություն Երևան քաղաքի համար: Այն միտված է խթանելու Երևան քաղաքի տնտեսական աճը և սոցիալական զարգացումը՝ առկա բնապահպանական հիմնախնդիրների լուծման միջոցով: «Կանաչ քաղաք» գործողությունների ծրագրի համապարփակ իրականացման արդյունքում շրջակա միջավայրի և մարդու առողջության վրա հնարավոր ազդեցությունները կհասցվեն նվազագույնի, իսկ ակնկալվող փոփոխությունները բնապահպանական տեսանկյունից իրենց դրական ազդեցությունը կունենան ոչ միայն մայրաքաղաք Երևանի, այլ հանրապետության համար:

**Փորձաքննական պահանջ**

Հիմնադրությամբ փաստաթղթի շրջանակներում նախատեսվող գործունեությունների ծրագրային և նախագծային փաստաթղթերը՝ մինչև իրականացումն անհրաժեշտ է ՀՀ օրենսդրությամբ սահմանված կարգով ներկայացնել ՀՀ բնապահպանության նախարարություն՝ շրջակա միջավայրի վրա ազդեցության փորձաքննության:

**ԵԶՐԱԿԱՑՈՒԹՅՈՒՆ**

«Էրնստ Էնդ Յանգ» ՓԲԸ կողմից ներկայացված Երևանի «Կանաչ քաղաք» գործողությունների ծրագրի շրջակա միջավայրի ազդեցության ռազմավարական գնահատման հաշվետվության վերաբերյալ տրվում է դրական եզրակացություն, վերը նշված փորձաքննական պահանջի պարտադիր կատարման պայմանով:



Գլխավոր մասնագետ

Հ. Մկրտչյան

## 8 Annex 8: List of GCAP stakeholders

<b>Institutional stakeholders</b>
Environmental Monitoring Agency
Ministry of Emergency Situations
Ministry of Energy and Natural Resources
Ministry of Nature Protection
Ministry of Territorial Administration and Development
Ministry of Urban Development
National Center for Disease Control and Prevention, Ministry of Health
Renewable Resources and Energy Efficiency Fund (R2E2)
State Committee on Urban Development
UNDP Green Urban Lighting Project
International Association for Impact Assessment, RA MONP

<b>NGOs</b>
Armenia Tree Project
Association "For Sustainable Human Development" NGO
Ecoglobe NGO
EcoRight NGO
EcoLur NGO, New Informational Policy in Ecology
"Environmental survival" NGO
Environmental Public Advocacy Centre (EPAC)
"Environmental survival" NGO
Fund for Preservation of Wildlife and Cultural Assets
"Green Lane" Agricultural Assistance NGO
ISSD NGO
Khazer NGO, National focal point for climate change
Sustainable Development Initiative Public Organization
Sustainable Water Environment NGO
Pan-Armenian Environmental Front
Transparency International
Young Biologists Association NGO
Young Engineers Association NGO

<b>Academia</b>
American University of Armenia
AUA College of Science and Engineering
Armenian Agrarian Academy
Armenian State Pedagogical University
Armenian National Academy Of Sciences, Center For Ecological-Noosphere Studies

<b>Private Sector</b>
ArmDesign Institute
JINJ Ltd.
Sanitek LLC

<b>Associations and Foundations</b>
Association of Young Environmental Lawyers and Economists
Builders Union
Employers' & Entrepreneurs' Union

YEREVAN'S GREEN CITY ACTION PLAN 2017

UrbanLab Yerevan
Yerevan Design Institute

Environmental Law Resource Centre, Faculty of Law
ESCO Association
Regional Environmental Center (REC Caucasus), Armenia
Communities' Association of Armenia (CAA)