

Green City Action Plan

Lviv

2020 – 2035



January 2020



EBRD **GREEN
CITIES**

**Ministry of Finance**
of the Czech Republic

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This report has been funded by the Ministry of Finance of the Czech Republic.



FOREWORD



Draft - The Lviv Green City Action Plan was developed with financial assistance of the European Bank for Reconstruction and Development (EBRD). The Project is focused on an improvement of the City's environment.

The City appreciates the consultancy support provided by EMPRESS and ENVIROS, Czech consultancy companies that collaborated with the local experts to successfully develop this Plan.

The Lviv officials along with the experts are eagerly working on the improvement of infrastructure and environment. The key areas of development include transport, waste management, air and water quality, industries and energy efficiency. Improvement of these sectors will guarantee the significant growth of the City's welfare.

Finally, our team believes that implementation of the Lviv Green City Action Plan will contribute to the long-term development of the environmental and infrastructural planning process, which will lead to improvement of the City's quality of life in the future.

EXECUTIVE SUMMARY

We at Lviv City Hall are proud to present this **Green City Action Plan (GCAP)** for our City. It has been prepared using the methodology developed by the European Bank for Reconstruction and Development (EBRD) as part of its Green Economy Transition Policy Dialogue Framework. The consultancy assistance required to develop the GCAP has been funded by the Government of the Czech Republic, to whom we wish to express our thanks.

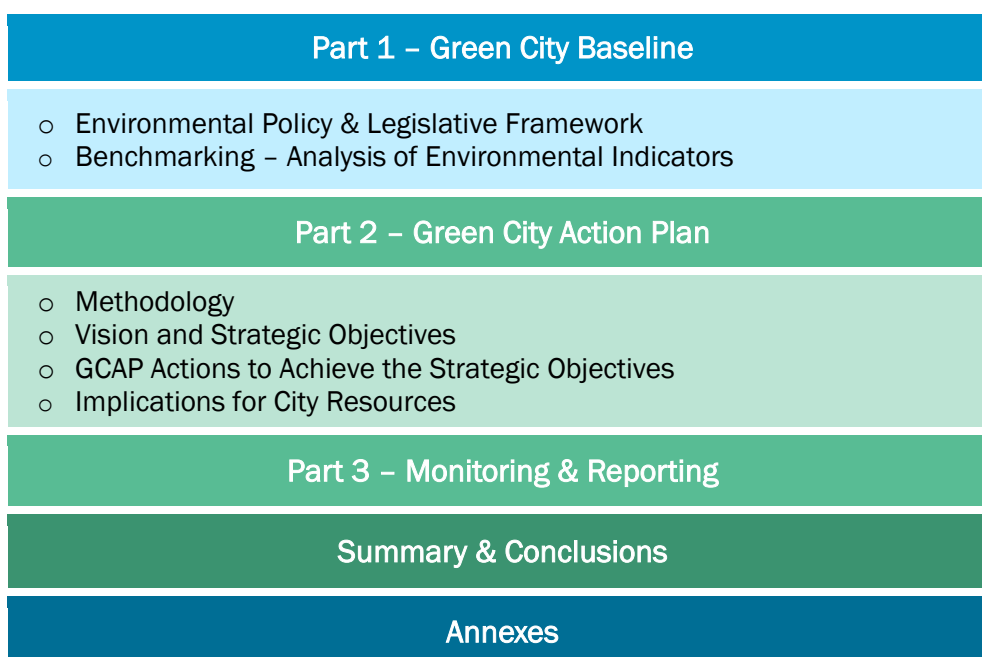
Introduction

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

In order to provide their populations with the myriad of demanded services, cities need inputs of large quantities of resources. As such, cities are a source of significant environmental impacts. Furthermore, major environmental concerns for cities range from the quality of air and traffic congestion to pressure on limited green space, land and water resources. Urban activities, and how they are organised deeply affect the environment, and the overall quality of life of urban populations.

It is in response to this context that EBRD has initiated the development of Green City Action Plans across EBRD's countries of operations. The GCAP for Lviv will be the first in Ukraine. The Methodology was developed by the OECD and ICLEI for the EBRD and is designed to guide our City through the main steps of the development and implementation of a GCAP. These steps include establishing a **Green City Baseline**, developing a **Vision and Strategic Objectives**, developing a set of **Key Programmes and Actions** to improve the environmental situation, implementing these Actions and systematically **Monitoring** the subsequent progress.

The diagram below illustrates the structure of the GCAP document and the interaction between the key sections.



Throughout this process the GCAP has entailed extensive consultation not only within the City but also with our partners, local and international experts and other stakeholders (see Annex 8).

The GCAP takes account of three main aspects to improve the overall environmental situation in Lviv:

- The adoption of national strategies, development of new legislation and standards;
- Improving public awareness and engagement in environmental issues;
- Investment in technical measures.

Within Lviv City Hall there is enthusiasm and determination to improve the environmental performance of the City in all areas. We have a good understanding of what needs to be done, but implementation of the plans to date has been hampered by the limited financial and human resources available. The GCAP will help Lviv to achieve its environmental objectives based on a thorough understanding of current environmental performance, prioritising actions, identifying potential investment opportunities and providing access to additional finance.

Environmental Policy & Legislative Framework

We recognised during the early stages of preparing the GCAP that there were already numerous laws, draft laws, strategies and plans in place or in preparation that are related to the environmental situation in Lviv and Ukraine, and are therefore of relevance to the GCAP.

At the **national level** a range of relatively new (2-3 years) laws, draft laws and strategies provide a strong legislative framework for municipalities to develop their environmental activities. These documents include measures in:

- Environmental Policy;
- Climate Change;
- Sustainable Development;
- Transport Strategy;
- Energy Strategy;
- Electricity Supply and the Electricity Market;
- Energy Efficiency in Buildings; Energy Service Companies; Renewables;
- Drinking Water Quality;
- Wastewater Treatment Standards;
- Waste Management;
- Biodiversity.

Provided that the draft laws are adopted more or less as they stand, there are no evident gaps in legislation in the areas relevant to the GCAP.

At the **local level** there a number of strategies, plans and projects which follow the lead of the national documents but are dealing with local priorities including:

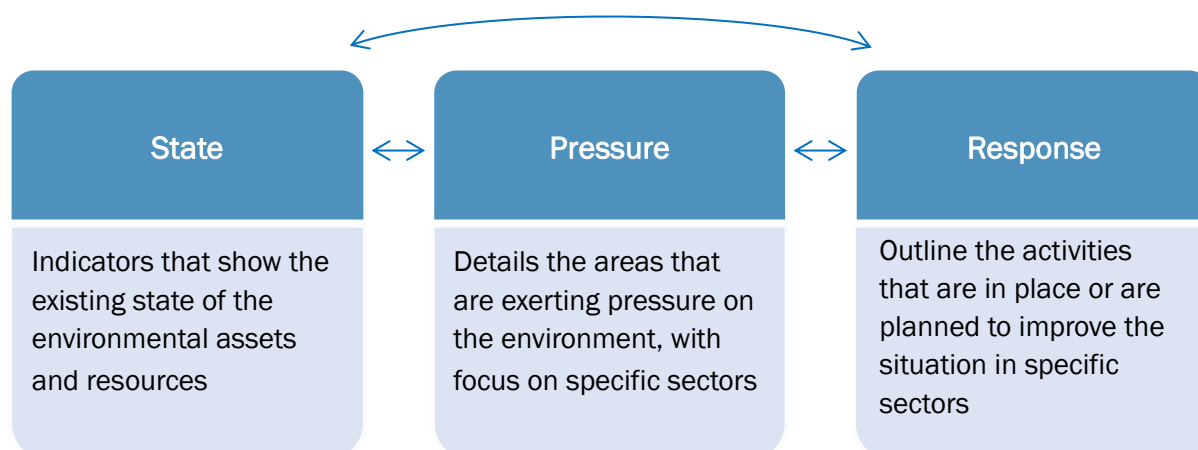
- An *Integrated Urban Development Plan* (IUDP) which is nearing completion;
- Several Transport projects aimed at updating the infrastructure and replacing the vehicle fleet; a *Sustainable Urban Mobility Plan* (SUMP) has also just been completed;
- Waste Management, including improved recycling systems, a new waste treatment facility and remediation of the old landfill;
- Drinking water and wastewater treatment system modernisation;
- Energy Efficiency in Buildings;
- Land Use (including a new Land Use Strategy in preparation) and Biodiversity;
- Industrial Development, including requirements for good environmental standards;
- Adaptation and Resilience to climate change.

All of the above provide a solid platform from which to develop the GCAP.

Environmental Benchmarking

The GCAP Methodology developed by EBRD details a means of assessing the environmental situation through ‘**State**’, ‘**Pressure**’ and ‘**Response**’ (SPR) Indicators. These indicators seek to provide a holistic assessment of urban environmental performance, with the understanding that performance in one area (e.g. ‘State’) is influenced by performance in another (e.g. ‘Response’).

GCAP Pressure State Response Framework



The Methodology uses a ‘traffic light’ system to provide an initial impression of where our environmental performance is poor (red), where some improvement is needed (amber) and where it already meets international standards (green). We have also tracked trends in performance where we have the data.

GCAP ‘Traffic Light’ benchmarking for environmental indicators



The results of the analysis show that the ‘**State**’ indicators where we have the biggest environmental challenges are:

Main areas of concern – ‘State’	
Total Suspended Particles (TSP) including concentrations of PM _{2.5} and PM ₁₀	Air
BOD and Ammonia concentrations in the Poltva River	Water
Share of green space areas within urban limits	Land Use

The main areas responsible for putting '**Pressure**' on the environment are:

Main areas of concern – 'Pressure'	
The age of the vehicle fleet (especially private cars) coupled with the low average travel speed on primary thoroughfares during peak hours	Transport
The high levels of electricity consumption in buildings and industry together with the absence of green building standards and other environmental certifications, and the low level of renewable energy sources	Buildings & Industry
Water consumption per capita (which is closely linked to leakage on the water supply network – non-revenue water)	Water
Low levels of recycling or composting of municipal and industrial waste and the remaining life of the current landfill (in fact the landfill is closed)	Waste

Almost all of the '**Response**' indicators have an 'amber' flag meaning that some actions are already being taken as mentioned above, but that more needs to be done.

Through our analysis of the current situation and the environmental indicators we have identified the following **five** priority environmental challenges for the City:

GCAP Priorities	
Improving our waste management systems including building the new waste treatment plant, improving collection systems and recycling rates, and rehabilitating the old landfill.	Solid Waste
Reconstructing the wastewater treatment plant and reducing leakage on the water supply system	Water
Transport and its impact on air pollution, noise pollution and congestion	Transport
Improving energy efficiency in buildings and the use of urban renewables	Buildings
Improving the area and quality of green spaces in the City	Land Use

Several other areas of concern have also been identified. These are:

Additional areas of concern	
Improving the condition of the district heating supply network	Energy
Taking action to improve biodiversity within the City boundaries	Biodiversity
Improving resilience to flooding and other climate risks	Cross-cutting

This detailed analysis together with extensive consultation has allowed us to develop a GCAP that is realistically achievable over the next five years given the resource constraints of the City, but which will have maximum positive impacts on the City's environment, economic development and social inclusion. The outcomes of this process are presented in the main document with a separate section for each sector.

Vision and Strategic Objectives

The Vision and Strategic Objectives for the GCAP were defined through consultation within City departments but also through the publication of an online questionnaire for stakeholders and the general public that was published on the City website.

The resulting GCAP **Vision** for the City is:

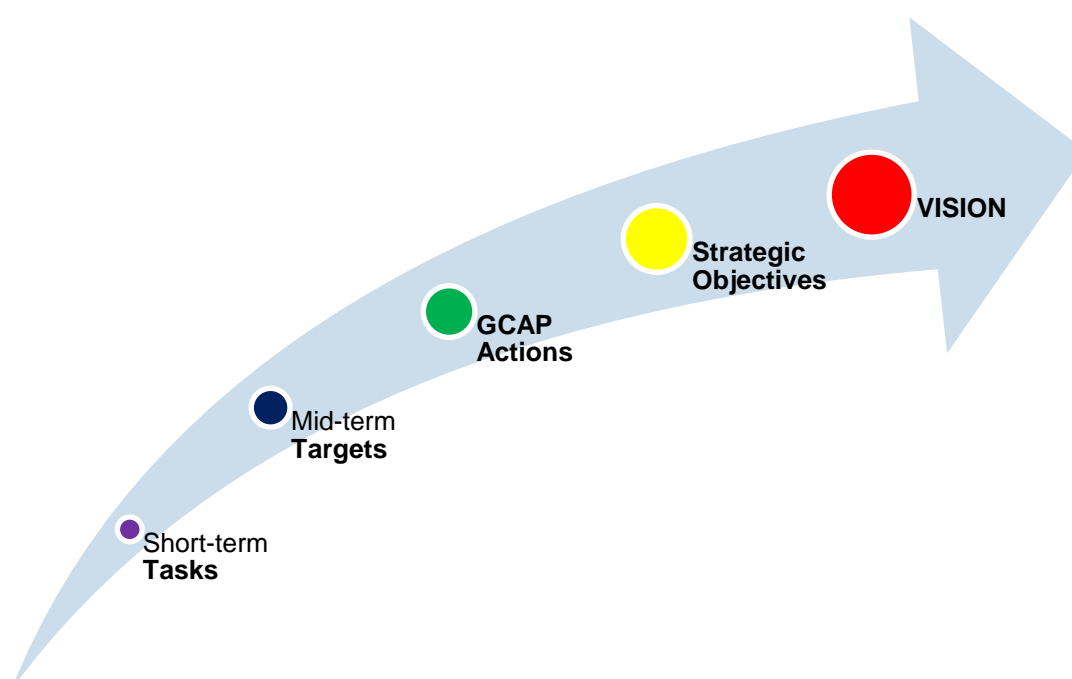
“Clean, Vibrant and Liveable City for All”

The agreed **Strategic Objectives** to achieve this Vision are:

1. Improve air quality in the City.
2. Develop a sustainable mobility system in the City.
3. Bring waste collection, reuse, recycling and treatment up to international standards.
4. Develop a sustainable City water and wastewater management system.
5. Proactive and informed municipal government leadership in energy efficiency and use of renewable energy sources (RES).
6. Develop pleasant, comfortable and functional buildings with maximum energy efficiency and minimum CO₂ emissions.
7. Enhance green spaces and introduce new green elements throughout the City to improve living conditions for citizens and to increase the diversity of flora and fauna within urban limits
8. Lviv businesses meet high levels of sustainability and resource efficiency.

This process enabled us to develop a set of GCAP Actions aimed at achieving the above Strategic Objectives, including **Mid-term Targets** (2028) and **Short-term Tasks** (2020-2023) for each Action.

The relationship between the Vision, Strategic Objectives, GCAP Actions, Mid-term Targets and the Short-term Tasks is illustrated in the diagram below.



Priority Actions

Once we had agreed the Vision and Strategic Objectives, we then considered the potential Actions that are needed to achieve them. Our analysis of the Actions included the following considerations:

- The type of measure (regulation; technical assistance, investment, 'soft' measures);
- The level of priority for the City (high, medium);
- Additional benefits (economic, social, environmental);
- Implementation timescale;
- Difficulty of Implementation (political, financial, social);
- Capital and Operational Costs (high, medium, low);
- Main Actors and Potential Funding Sources.

This process enabled us to select the most appropriate Actions for each Strategic Objective. The results of this analysis are presented in a series of tables at the end of each section which show the selected Green City Actions, Mid-term Targets, timescales, costings (CAPEX and OPEX), and potential funding sources for each sector. More detailed information on costs and impacts of the Measures is provided in **Annex 5**.

The Actions we intend to implement together with their associated Mid-term targets and Short-term Tasks are summarised in the following table.

SUMMARY OF GCAP ACTIONS, MID-TERM TARGETS AND SHORT TERM TASKS			
Strategic Objectives	Proposed Actions	Mid-term Targets (2028)	Short-term Tasks
SO.1 - Improve air quality in the City; SO.2 - Develop a sustainable mobility system in the City	T.1 – Completion of Sustainable Urban Mobility Plan (SUMP), its adoption and implementation	Implementation of the SUMP	Develop and adopt detailed SUMP Action Plan for the period 2021-2023
	T.2 – Completion of e-ticketing project	e-ticketing project complete	Finalise the e-ticketing project
	T.3 – Purchase of new trams, buses and trolley buses	150 new vehicles purchased and operational	Continuing purchase of new vehicles for public transport
	T.4 – Feasibility Study for extension of the tram and trolley bus network, including new depots and transport hubs	Feasibility study completed	Develop feasibility study for the extension of the tram and trolley bus network, including new depots and transport hubs
	T.5 – Feasibility study for the prioritisation of public transport, including dedicated lanes, traffic management and ‘smart’ traffic light systems	Feasibility study completed	Develop feasibility study for the prioritisation of public transport, including dedicated lanes, traffic management and ‘smart’ traffic light systems
SO.1 - Improve air quality in the City; SO.2 - Develop a	T.6 – Development of additional 100km of pedestrian and cycling routes	Additional 100km of pedestrian & cycle paths completed	Prepare for and resume construction of additional 100km of pedestrian and cycling routes

sustainable mobility system in the City	T.7 – Installation of permanent air quality measuring stations and software system linked to City website and public information platform	Air quality monitoring system fully operational	Develop and approve the concept of air quality monitoring and assessment system; Develop feasibility study; Purchase equipment and software; Implement the whole system
SO.3 - Bring waste collection, reuse, recycling and treatment up to international standards	SW.1 (i) – Remediation of the old landfill; SW.1 (ii) – Construction of the MBT plant; SW.1 (iii) – Construction of a new landfill	(i). Old landfill rehabilitated; (ii). MBT plant operational; (iii). Site for new landfill agreed and construction commenced	(i) Continue with rehabilitation of the old landfill. (ii) Build the MBT plant. (iii) Identify and agree location of new landfill site with Lviv Oblast; Commence construction of new landfill
	SW.2 – Improve primary infrastructure for separate waste collection	Recycle 25% of collected municipal solid waste;	Identify localities where containers for separated waste will be placed; Purchase and place containers at selected localities; Analyse demand for secondary materials, and sign contracts with relevant recycling businesses; Increase awareness of citizens on waste separation
	SW.3 – Develop a network of official waste recycling centres	Four waste recycling centres established; 2. Recycle 25% of collected municipal solid waste	Identify localities where the household waste recycling centres will be built: Build and equip the recycling centres; Analyse the demand for secondary materials, and sign contracts with relevant recycling businesses; Increase awareness of citizens about the recycling centres and waste accepted
	SW.4 – Develop a system for composting of organic waste	Two composting plants built; 2. Treat by composting 25% of collected green and organic waste	Set up a system for collection of green waste from parks and other public places; Set up a system of organic household waste management; Set up a system of organic household waste management; Increase awareness of citizens and private sector about possibilities of composting
SO.3 - Bring waste collection, reuse, recycling and treatment	SW.5 – Consider introduction of “pay-as-you-throw” (PAYT) principle	100% of citizens charged for waste collection based on PAYT principle	Analyse possible options of PAYT principle implementation; Set up a system of charges, and approve relevant local regulations; Communicate the regulations to citizens; Establish a team of enforcement officers

up to international standards	SW.6 – Support educational, awareness raising and communication activities	10 projects/actions on waste prevention and/or separation supported each year; 2. Total MSW generation per capita is stabilized at the current level	Establish a system for support of educational, awareness raising and communication activities of external organisations; Provide regular support to external organisations; Organise communication and awareness raising activities
SO.4 - Develop a sustainable City water and wastewater management system	W.1 – Reconstruction of part of the wastewater treatment plant (agreed and ongoing)	WWTP operating at full capacity and treatment to international standards	Complete rehabilitation of WWTP including pumping stations and control systems
	W.2 – Construction of a biogas CHP unit from anaerobic digestion of sludge at the WWTP (agreed and ongoing)	Biogas CHP plant fully operational	Identify and agree additional financing for reconstruction of settling tanks and aeration systems; Complete the construction of the biogas CHP plant
	W.3 – Replacement and/or mechanical cleaning of water supply pipes	Reduce losses of drinking water from distribution pipework by 50%	Undertake a survey of the water distribution network status; Develop a comprehensive plan for modernisation of the water distribution network including associated electrical plant and 'smart' leakage detection systems; Agree financing arrangements; Commence work on repair and replacement of pipework and electrical systems and install leakage detections systems
	W.4 - Renovation/retrofitting of water pipework inside buildings	Reduce water losses from pipework inside buildings by 50%	Undertake a survey of water leakage inside buildings alongside measures for thermal rehabilitation and determine costs and savings; Agree financing arrangements with building owners; Replace/renovate water pipework as part of thermal rehabilitation activities and install smart meters incorporating leakage detection systems.

SO.4 - Develop a sustainable City water and wastewater management system	W.5 - Installation of meters in all residential blocks <i>(on-going)</i>	All communal residential blocks and individual apartments fitted with water meters	Complete installation of water meters in residential blocks and individual apartments; Launch information campaign on how to reduce water usage; Upgrade maintenance facility for water meters and recruit additional staff; Hold discussions with national government on increasing tariff rates
	W.6 - Separate rainwater drainage system from the city sewerage system	Separate rainwater drainage where possible during reconstructions.	Assess all new road reconstruction projects and development sites for suitability of separating rainwater collection systems; Draw up regulations for SUDS in all new buildings and major rehabilitation projects.
SO.5 - Proactive and informed municipal government leadership in energy efficiency and use of renewables	E.1 – Modernisation of street lighting to LED standards	70% of street lighting converted to LEDs	Prioritise locations for street lighting upgrades from the lighting survey; Investigate potential financing routes including IFIs and ESCOs; Commence conversion of street lighting to LEDs
	E.2– Insulation or replacement of DH distribution network plus modernisation of boiler houses, possibly including cogeneration	30% of DH substations and pipework re-insulated or replaced; 30% of heat exchanger stations in the buildings modernised; 60% of boiler houses refurbished	Identify the sections of the DH network most in need of repair and the least efficient boiler houses; Explore potential financing routes, including the IFIs; Investigate the economic case for CHP for upgraded boilers; Continue with DH upgrade programme
	E.3 – Convert district heating boiler plants to biomass firing	10% of non-CHP boilers converted to biomass	Investigate the economic case for biomass firing for DH boilers not converted to CHP; Negotiate a secure supply of wood chip and/or pellets; Convert appropriate boilers to biomass firing

SO.5 - Proactive and informed municipal government leadership in energy efficiency and use of renewables; SO.6 - To develop pleasant, comfortable and functional buildings with maximum energy efficiency and minimum CO2 emissions	B.1 – Thermal rehabilitation of buildings including insulation, windows, boilers, control systems and small-scale renewables	Public building renovation rate to be 3% of the floor area annually.	Develop programme of thermal rehabilitation including Actions B.2 and B.3
	B.2 – Introduction of advanced technical and environmental requirements for new construction and major renovations of public buildings.	Advanced technical and environmental standards to be imposed by the City	Introduction and adoption of advanced technical and environmental requirements for new construction and major renovations plus urban renewables
	B.3 – An improvement programme aimed specifically at public buildings, using the municipal EPC/ESCO mechanism	EPC/ESCO scheme used in 50% of public buildings	Development of EPC/ESCO scheme for public building sector renovation; Creation and establishing financial funds for ESCOs and renewables support; Launch of an EPC/ESCO programme for public building renovation
	B.4 - Wider use of the EPC/ESCO mechanism for financing and implementing energy efficiency improvements	Residential building renovation rate to be 3% of the floor area annually	Development of EPC/ESCO scheme for residential/commercial building sector renovation; Launch of an EPC/ESCO programme for residential/commercial building sector renovation
	B.5 – Use of ‘Smart’ metering and data sharing	Smart metering included in all new buildings and major refurbishments	Technical and financial consultations with building owners and owners’ associations and landlords including ‘smart’ meters
	B.6 – Skills/business development programme for building insulation and small scale renewable energy technologies installers and advisors	All professionals involved in energy efficiency improvements fully trained	Design, promote and deliver training for professionals in installation of energy efficiency improvements

SO.7 - Enhance green spaces and introduce new green and blue elements throughout the City, including development of a green corridor; SO.8 - Improve conditions for increasing flora and fauna within urban limits	L.1 – Completion of the Integrated Urban Development Plan	IUDP adopted and implementation of measures ongoing and monitored	Accept and adopt IUDP ; Explore financing options for priority measures; Commence implementation of recommended measures
	L.2 - Upgrade and modernisation of the GIS system – main focus on environmental parameters and ecology	GIS system upgraded and publicly available.	Update the GIS system software; Undertake an inventory of green spaces urban trees and fauna; Add new elements and parameters into the online database tool
	L.3 - Development of new “Green Corridors” through the City and construction of Green City Line	Develop at least 50 km of new green corridors through the City.	Completion of the pilot project “Green City Line”; Improvement of the central and most disconnected part of the Green City Line; Continue with development of green corridors and smart green hubs
	L.4 - Development of support mechanisms for policy makers and relevant stakeholders, introduction to potential sources of finance and new green support programmes, including development of a Green and Blue Strategy	Surface area of green and blue spaces increased by 20% of the current level; Increase the number of nesting sites for birds and bats by at least 50% compared to the current situation; Develop a Green Strategy including a feasibility study for an orbital forest around Lviv	Develop Green and Blue Strategy; New green programmes for fauna and flora biodiversity and invasive species reduction; Create conditions and programme development for urban community gardening and composting; Development of pets and homeless animal care centres; Ensure a systematic programme of restoration of parks, squares and flower gardens with introduction of waterbodies
	L.5 - Public awareness campaigns and expert training for proper education on the importance of urban land-use and biodiversity	Public information campaigns designed and implemented; Appropriate training for stakeholders delivered	Develop promotional campaigns and education programmes; Run a promotional campaign on land use and biodiversity each year; Deliver training to appropriate stakeholders; Organise public display boards and monitors at all rehabilitated sites
SO.9 - Lviv businesses meet high levels of sustainability and resource efficiency	I.1 – Support programmes for environmental improvements and accreditation in business and industry	200 businesses supported; 50 businesses accredited	Identify the sectors and businesses most likely to benefit from support; Design, promote and deliver an environmental support programme for businesses; Introduce “Green Business” Awards and information programme
	I.2 – Develop a local recycling business ‘cluster’, to reprocess materials collected from the new collections bins and the waste recycling centres	25% of waste is recycled locally; 20 recycling businesses established	Identify existing businesses that could potentially provide recycling services ; Encourage new recycling businesses to invest in Lviv; Assist these businesses to develop business plans and to identify local customers

We have expanded the Ecology Office to oversee all environmental aspects and assigned responsibility for monitoring the GCAP implementation to the City Institute.

Implications for City Resources

We are conscious that the above package of measures represents a big challenge for the City in terms of both financial and other resources.

In Financial terms the overall capital requirements of the GCAP Actions are summarised in the table below, which also indicates potential sources of funding for each sector and Strategic Objective.

Estimated Capital and Operational Costs of GCAP Actions

Strategic Objective	Main Sector	Capital Costs (€ million)	Operational Costs (€ million)	Potential Funding Sources (€ million)		
				City Budget	IFIs & Donors	Private Sector
SO.1	Air Quality	1	1.0	1		
SO.2	Transport	107	1.4	7	100	
SO.3	Solid Waste	78	17.8	4	62	12
SO.4	Water	190	Reduced	10	160	20
SO.5	Energy	115	7.0		115	
SO.6	Buildings	100	1.5	5	30	65
SO.7	Land Use & Biodiversity	43	0.9	10	20	13
SO.8	Industry & Business	20	1.2			20
Resilience	All	0	0.1			
All	Ecology Office	0	0.1			
TOTALS		654	31	37	487	130

The total capital requirements of the actions within the GCAP timescale (5 years) is therefore around **€654 million**. Some €130 million of this will come from private sector partners and €37 million will be directly from the City budget, leaving around **€487 million** to be found from loans from international bodies. Around €130 million of these loans have already been agreed. Servicing a further €357 million of loans may not be possible in the next 5 years so in this case we will need to delay the implementation of some of the lower priority actions unless grants can be obtained from international donors or the national government. This longer timescale could apply for example to renovating or replacing the district heating and water supply networks. Raising the water and wastewater charges to an economic level would also help to pay for Actions in the water sector.

We will explore these alternative financing mechanisms before making a decision on which of the GCAP Actions to delay or implement over a longer timescale.

The main resource required to implement the GCAP apart from finance is people to plan, develop and implement the individual Actions and to work with our partners. For some actions we will need to engage specialist assistance but in most cases our own staff should be able to handle the workload. The total operational cost of the actions from the City budget is estimated to be around **€30 million** over 5 years but this is spread across several City departments and so we are confident that implementing the GCAP is within our current capabilities.

Monitoring & Reporting

The main purpose of our Monitoring Plan (MP) is to establish how the Actions included in the GCAP for each sector impact on the quality of environmental assets as well as the adaptation to natural events such as flooding or heatwaves. Information can also be used for education activities aiming at raising awareness on “green behaviour” and facilitating support for the implementation of “green” measures.

We have developed the MP for the period 2020–2028. It includes a results-based Progress Monitoring Plan and an Impact Monitoring Plan. We will carry out a mid-term review to assess progress against targets and the social and economic benefits arising from actions we have taken in all of the sectors.

Capacity building of key staff involved in the monitoring process will be part of the GCAP implementation. No additional staff are envisaged at this stage, though some investment in IT systems may be required for efficient flow of information.

Monitoring of environmental indicators will rely as much as possible on existing technologies, available data sources and current procedures. Investments in additional equipment that may be required will be justified by the additional benefits of improved information.

Conclusions and Next Steps

The systematic application of the EBRD methodology for developing our Green City Action Plan has resulted in a set of Actions that encompass all areas that have an impact on the City’s environment. By prioritising these Actions, we have been able to develop a plan that will have the maximum impact on our environmental assets as well as producing other social and economic benefits for the City. Whilst the Plan is challenging, we believe that it will be possible to implement the measures over the next five years within the capacity of the City budget and other resources, though recognising that further actions will be necessary after this period if we are to achieve our long-term Vision for 2035.

In developing the GCAP, we have carried out extensive consultation with a wide range of stakeholders so that the views of the City, its citizens, businesses and institutions have been fully taken into account. We recognise that we will need the help and cooperation of all of these groups as well as other partners and, in some cases, the assistance of international financial institutions and donors to provide some of the funding needed.

The Actions will have a positive impact on our main areas of concern such as:

- Emissions to the air;
- Improving waste management and treatment;
- Improving wastewater quality;
- Reducing water leakage in the distribution network;
- Energy use in buildings;
- Increased use of renewable energy;
- Developing more and better quality green spaces in the City;
- Improving the environmental performance of our businesses;
- Improving the resilience of the City to natural events such as flooding and heatwaves.

We estimate that, taken together, the Actions will produce CO₂ emissions savings of around **153,000 tonnes per year** and water savings of around **10.8 million m³ per year**. In addition the Actions will have significant positive impacts on economic growth, job creation, public health and safety, and improved access to public amenities and green spaces.

Realising the GCAP aims and objectives demands action in the short term across all sectors and we intend to commence implementation as soon as possible, and certainly by the beginning of 2020. We look forward to working with Lviv's many stakeholders to achieve the Vision set out in this **Green City Action Plan**.

The proposed GCAP Actions are shown in diagrammatic form in the City map overleaf.

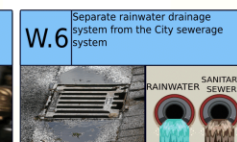
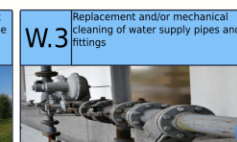
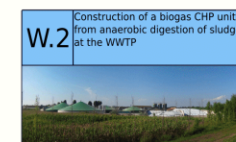
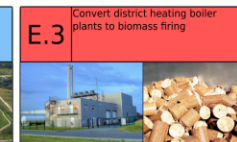
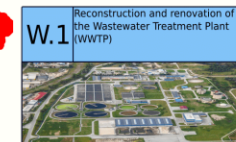
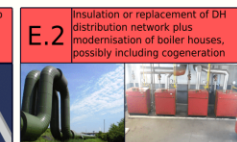
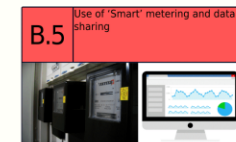
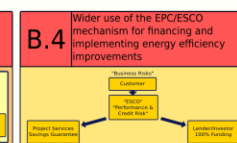
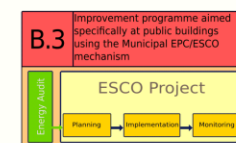
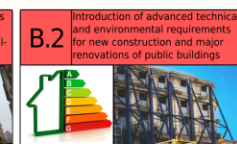
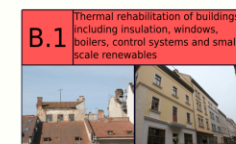
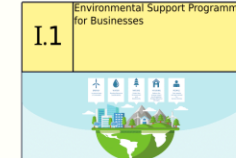
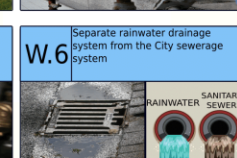
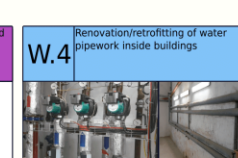
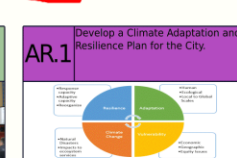
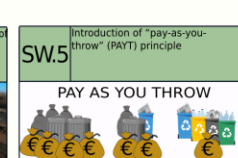
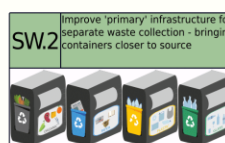
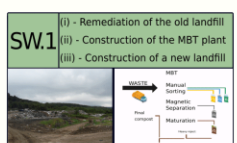
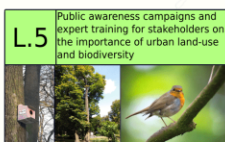
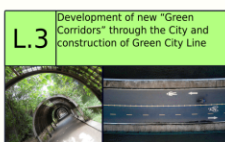
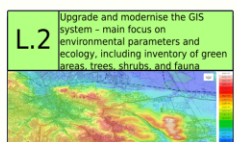
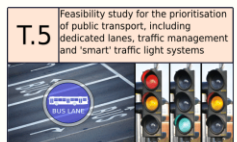
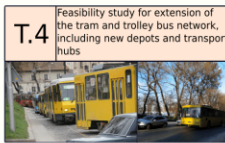
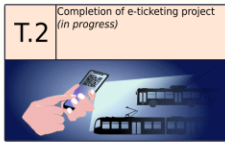
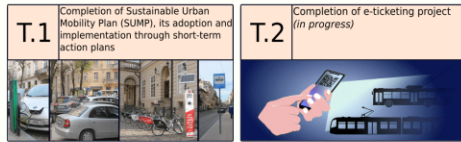
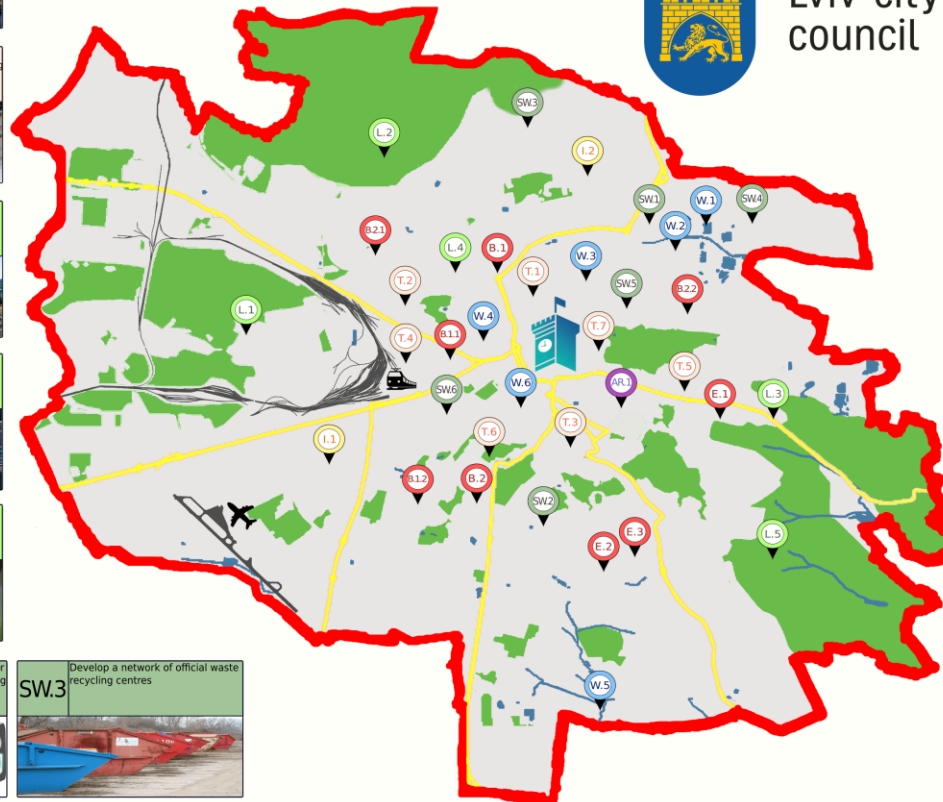


GREEN CITY ACTION PLAN - LVIV

OPEN TO THE WORLD



Lviv city council



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1 Background to the Green City Action Plan

We at Lviv City Hall are proud to present this Green City Action Plan (GCAP) for our City. It has been prepared using the methodology developed by the European Bank for Reconstruction and Development (EBRD) as part of its Green Economy Transition Policy Dialogue Framework. The consultancy assistance required to develop the GCAP has been funded by the Government of the Czech Republic, to whom we wish to express our thanks.

1.1 Project Context

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

In order to provide their populations with the myriad of demanded services, cities need inputs of large quantities of resources. As such, cities are a source of significant environmental impacts. Major environmental concerns for cities range from the quality of air and traffic congestion to pressure on limited green space, land and water resources. Urban activities, and how they are organised deeply affect the environment, and the overall quality of life of urban populations.

For the sustainable development of green cities, it is critical to recognise the relationship between environmental aspects and economic and social issues. This thinking is very much in line with the UN's 2030 Agenda for Sustainable Development and the Sustainable Development Goals (UN 2015) and particularly the Goal 11 calling for governments to make cities and human settlements inclusive, safe, resilient and sustainable.

Governments, civil society, businesses and the donor community have many actions underway to attempt to address the worst of these many urban issues. However, these actions have generally been undertaken in an ad hoc manner. It is critical for the quality of life of urban populations that these multiple urban issues are addressed in a systematic way. Taking a broader strategic view of urban environmental challenges has a number of benefits including:

- Providing input to optimising the allocation of a City's limited financial and personnel capacity to those issues with the greatest environmental benefits
- Enhancing the possibilities to attract finance and support when it is clear how a specific project fits into the broader priorities and road map for environmental improvement in the City.

It is in response to this context that EBRD has initiated the development of Green City Action Plans across EBRD's countries of operations. The GCAP for Lviv will be the first in Ukraine. The Methodology was designed to guide our City through the main steps of the development and implementation of a GCAP – from establishing a **Green City Baseline**, developing a **Vision** and **Strategic Objectives**, developing a set of **Key Programmes and Actions** to improve the environmental situation, implementing these Actions and systematically **Monitoring** progress.

1.2 Green City Action Plan Methodology

The Green City Action Plan (GCAP) methodology has been developed by EBRD based on work by the OECD and the International Council for Local Environmental Initiatives (ICLEI). The GCAP presents the results of benchmarking and prioritisation exercises and defines the long-term Green City vision – within a timeframe of 10-15 years – and Strategic Objectives for each priority area. It focuses on the priority environmental dimensions, using relevant indicators and time-related targets and measures for cities' operations. The GCAP also outlines the scope of actions, the targets set and the major actions developed, and the initial steps of implementing the Plan for a period of 1-5 years. It is an overarching strategic document, which contains the guiding principles providing orientation for our decision-making and our implementation work in the medium-term, i.e. within 3-10 years.

The four main stages of a GCAP are:

Green City Baseline:

This aims to inform policy and strategic decision-making at the start of the process and provide the reference scenario for the business-as-usual against the Green City approach and action. The prioritisation of green city challenges is included in this step.

Green City Action Plan:

This aims to compile and present the agreed development vision and objectives for a period of 10-15 years, the targets to work towards in a period of 3-10 years, and the scope of actions and targets proposed. This step includes the prioritisation of green city *Actions*.

Green City Implementation:

This aims to operationalise and implement the Green City Action Plan, break it down into concrete tasks, allocate budget, time and staff, and monitor the contribution of each measure to the objectives and targets established in the GCAP. This stage also links to provisions made in municipal budgets, and formally establish the reference base for mayors, councillors, and administrative decision makers with regard to further development & investment decisions.

Green City Reporting:

This aims to analyse the successes and failures of the implementation period, provide the basis for taking further political decisions and inform city officials, stakeholders and the public on what the city has done and achieved.

Although detailed implementation is beyond the scope of this document, the implications for the City's financial and other resources is discussed. We have also provided details of the Monitoring Plan we will use to report progress on implementation.

1.3 How to Use This Document

The remainder of this document is set out in the following sections, which describe the key activities and outcomes of the main phases of the GCAP methodology.

Part 1 – Green City Baseline
○ Environmental Policy & Legislative Framework ○ Benchmarking – Analysis of Environmental Indicators
Part 2 – Green City Action Plan
○ Methodology ○ Vision and Strategic Objectives ○ GCAP Actions (by Sector) ○ Implications for City Resources
Part 3 – Monitoring & Reporting
Summary & Conclusions
Annexes

The Vision and Strategic Objectives are defined and the GCAP Actions to achieve the Strategic Objectives are discussed in detail. Further information relating to each Section is provided in the Annexes ([Annex 1 to Annex 7](#)).

1.4 Contributors to the GCAP

Development of the GCAP project has been overseen by a specially created GCAP Unit under the direction of the Deputy Mayor for Financial and Economic Issues. The GCAP Unit includes representatives of the City Investment and Projects Office, the Local Municipal Enterprise (LME) “Green Cities” which is dealing with waste issues in the City, and our arms-length think tank “City Institute” that works in the field of best practice and new project development. This combination of expertise recognises that improving the environment can also lead to economic and social benefits and the creation of many new jobs. The GCAP can eventually capitalise on these opportunities by following the “Green Growth” strategies from other cities and regions.

Several other City Hall Departments have also been involved in developing the GCAP including the Departments of:

- Ecology and Natural Resources
- Urban Development
- Architecture and Urban Studies
- Land Resources
- Transport
- Waste Management
- Housing and Infrastructure
- Energy Management
- Economic Development
- Finance

And also our LMEs:

- “LvivElektrotrans” and “LvivAvtodor” (for Transport)
- “Green Cities” (for Solid Waste)
- “LvivVodokanal” (for Water Supply and Wastewater Treatment)
- “LvivTeploenergo” and “ZaliznychneTeploenergo” (for District Heating).

We have also consulted a wide range of other stakeholders including the private companies responsible for providing transport and waste collection services, universities, business support organisations and NGOs. The full list of contributors is included as [Annex 8](#).

Consultancy support was provided by two Czech consultancy companies, EMPRESS and ENVIROS, assisted by a team of local experts, all of whom were guided by a team from EBRD. The City is grateful for the assistance provided by these organisations.

GREEN CITY BASELINE

2 Environmental Policy & Legislative Framework

This Section provides a profile of the City from an environmental perspective, outlines the Environmental Policy and Legislative Framework that underpins the GCAP and provides details of existing Laws, Strategies and Plans aimed at improving environmental performance in Ukraine and in Lviv.

2.1 City Overview

Historical and Geographical Context

In the mid-13th century Lviv was the capital of a major Eastern European state, called the Kingdom of Galicia–Volhynia. Due to its unique geographical location at the intersection of the main trade routes between the West and the East, in the 15th to 17th centuries Lviv became the leading trade centre of Eastern Europe and the largest city in Ukraine at that time. Lviv has now transformed into a city of particular architectural interest and is the centre of culture, book publishing and printing, arts and crafts.

Lviv is the political, economic, financial, cultural and educational centre of the Lviv Region (Oblast) and of Western Ukraine. The City covers an area of 182 km², is divided into six district municipalities and has a population of around 728,000 people (seventh largest city in the country). Although Ukraine was part of the former Soviet Union, nowadays it has close ties with the EU and the USA. Since Ukraine gained independence from the Soviet Union in 1991, Lviv has acquired the status of the cultural and spiritual capital of the new Ukrainian state. The City celebrated its 750th anniversary in 2006.

The City is the most important business centre of Western Ukraine. It has traditionally been the centre of commerce and small industry. After the World War II, a massive Soviet-style industrialisation was implemented. However after the collapse of the Soviet Union, production in the largest factories was restricted and the Lviv economy was reoriented from heavy to light industry and services. The main economic sectors now include food and beverages manufacturing, information technologies and tourism, although the engineering industry is still important. Also several banks and other financial organisations operate in Lviv.

Lviv is also the most important transport hub in Western Ukraine. Danylo Halytskyi International Airport Lviv, which is located 6 kilometres from the city centre, provides air connections with other cities of Ukraine as well as many European and Middle Eastern destinations. International highways

connect Lviv with Kiev, Budapest, Warsaw and Krakow, while national highways provide connections with other cities of Western Ukraine. Similarly, the railway provides connections with other parts of Western Ukraine; a significant part of the railway connecting Ukraine and Central Europe passes through Lviv.

The City is also an important education centre with a total of 12 universities, eight academies and a number of smaller schools of higher education. In addition, eight institutes of the National Academy of Science of Ukraine and more than forty research institutes can be found in Lviv.

Environmental Context

There is no major body of water within the urban limits of the City. The City is located on the River Poltva, but during the 19th century, the river was modified to form an underground sewerage system for the City. There is only one wastewater treatment plant in the City and this is working at around 50% capacity.

A new waste management company "Green City" was created as a municipal enterprise free of debts from previous activities, to rectify the problem caused by a major fire at the landfill site in 2016. "Green City" will work with a loan from the EBRD to manage the process of building a new waste treatment plant and remediating the old landfill site at Hrybovychi. "Green City" is also working with the Lviv Oblast authorities to agree a site for a new landfill. Once this is determined the company will be involved in its construction.

Besides the waste and water treatment issues, transport is considered to be one of the biggest problems in the City. The public transport system includes trams, trolleybuses, buses and marshrutkas¹. Even though, there have been improvements in the vehicle fleet, the general consensus is that City needs to invest in modernisation and promotion of public transport. Consequently, most journeys in the City are made by private car, many of which are old and in a poor state of repair. This leads to congestion and pollution in the City centre.

The City has a well preserved area in the historical centre, but much of the architecture in the suburban area stems from the Soviet period, and many of the residential and public buildings suffer from poor construction standards and low levels of energy efficiency. There is significant scope for thermal rehabilitation of many buildings including the use of new energy efficient technologies and urban renewables.

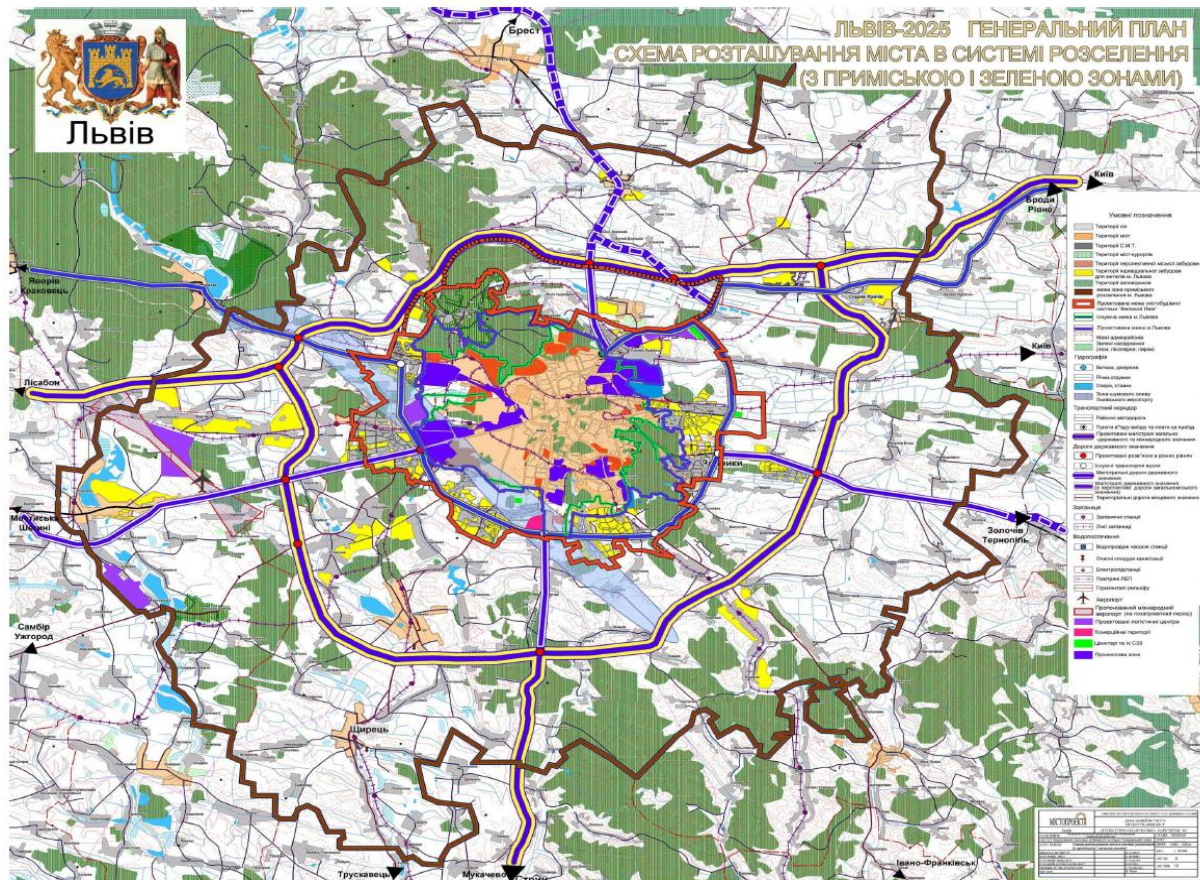
Lviv has over 20 park zones, three botanical gardens and 16 natural monuments. There are two forest areas located on the outskirts of the City, Bryukhovyts'kyi forest on the north and Vynnykivskyi forest-park on the south. The most famous park in the City is Stryisky Park, which dates from 1894. This park is a monument of landscape architecture and is of national significance.

Despite this we are keen to further improve the number and quality of green spaces in the City. This will also help to improve the diversity of flora and fauna within the City limits.

A general urban plan of the City is shown as Fig. 2.1 below.

¹ A form of public transportation based on minibuses, often privately operated.

Figure 2.1 - General Urban Plan for the City of Lviv



Source: Lviv City Hall (City Institute), 2018

City Administration

The City of Lviv has a number of internal departments that are directly relevant to the GCAP including Urban Planning, Ecology & Natural Resources, Waste Management, Housing & Infrastructure, District Heating, Economic Development and Energy Management. Transport and Water Management are handled by arms-length companies that are wholly owned by the City. There is currently no department that covers all environmental issues.

We are committed to improving the environmental situation and are open to new ideas. At the Kick-Off Meeting for the GCAP held on 7th February 2019, the Deputy Mayor stated that the top environmental priority for the City is dealing with the critical waste management situation. Other priorities for the City are transport (emissions, congestion and vehicle fleet size and state), the water supply system and wastewater management, energy efficiency in buildings and improvement of green spaces and land-use.

The City's close links with the EU has led to a determination to implement the relevant environmental regulation and standards and to create even stronger connections with the EU. This was also confirmed by the official visit of Mr. Donald Tusk, President of the European Council, in February 2019. Close links with the EU has led to the development of a number of strategies and plans over the last few years but implementation of many of the recommendations has been hampered by a lack of finance and available human resources within the City government.

2.2 Environmental Governance

The City Council activities are supervised by a Mayor and five Deputy Mayors, each of whom manages several departments, and one Executive Officer. There is no Deputy Mayor that has overall responsibility for environmental issues, and hence there is no separate budget for this.

Lviv Municipal Enterprises (LMEs) are the main entities that deal with transport, heat and water supplies in the City. After the fire at the main City landfill, several private waste management companies for waste collection entered the market and started to take care of collection of municipal waste in the City. The Waste Management department is under direct influence of the Deputy Mayor for Housing and Communal Services.

Electricity transmission and gas transportation are managed by state-owned companies. Electricity distribution in the Lviv Oblast (including the City) is under the control of a public joint-stock company “LvivOblenergo” whilst district heating is supplied by two LMEs, “LvivTeploenergo” and “ZaliznychneTeploenergo”. The water supply and wastewater treatment system is operated by the LME “Vodokanal”. The activities of the three LMEs are subject to state regulation by the National Regulation Commission on Energy and Communal Services of Ukraine. This Commission (Regulator) is responsible for licensing of these companies’ activities, setting tariffs and approving their investment programs.

There is also a separate organisation, “City Institute”, a communal, non-profit organisation run by the City that acts as a “think-tank” in the field of best practice and new project development. It develops policies, strategies and plans in areas such as mobility and land use. Recently the City Institute has led the development of two strategies and plans that are of particular relevance to the GCAP: an “*Integrated Urban Development Plan for Lviv*”² and the “*Sustainable Urban Mobility Plan*” (SUMP).

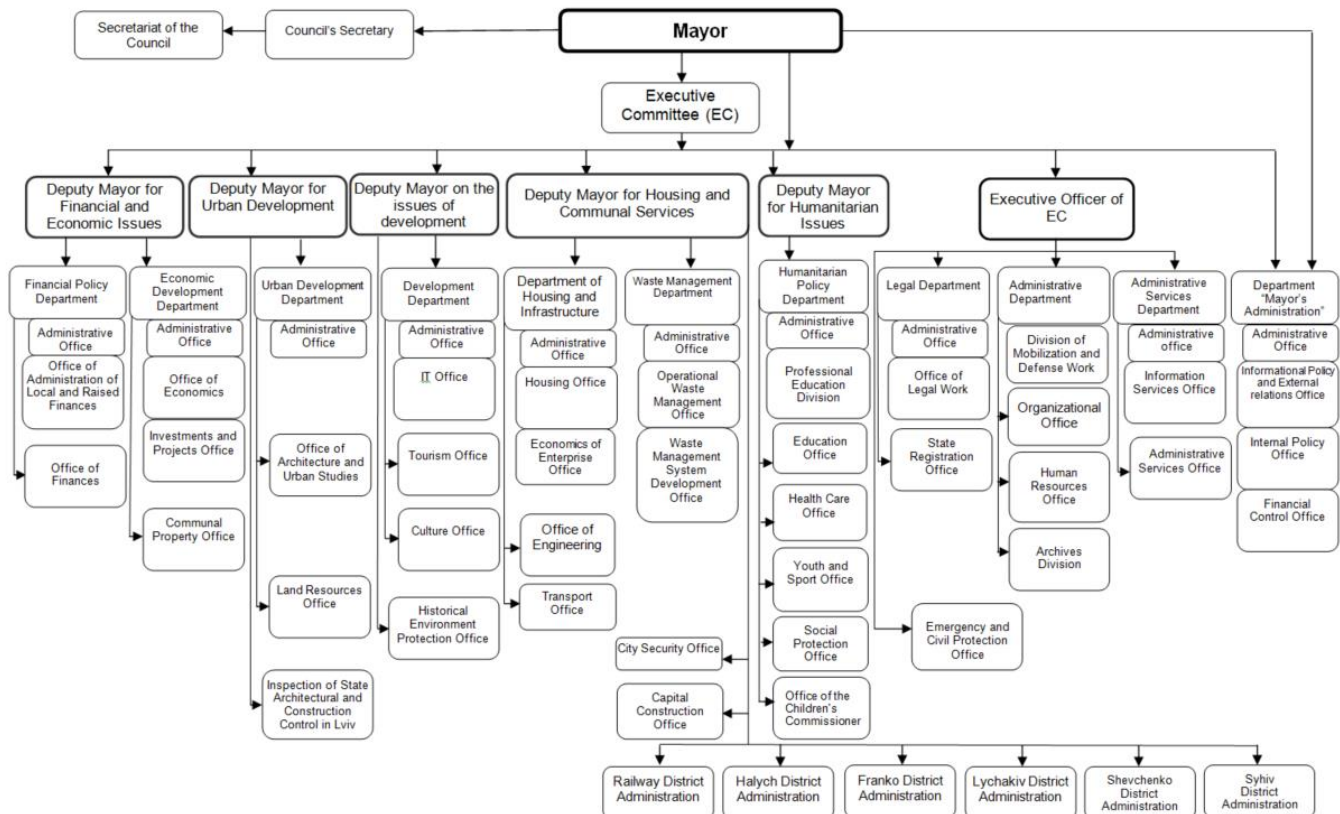
One of the main conditions for successful implementation of the *Integrated Urban Development Plan* is the linking of action plans (such as the GCAP), combining sources of funding and regular monitoring of the implementation with the involvement of representatives of professional bodies and other stakeholders.

The Sustainable Urban Mobility Plan is in its final stages of development and will be adopted by the end of 2019. It is closely linked with the transport sections of the GCAP.

Fig 2.2 below shows the organisation chart of the City Council.

² [https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf/0/23349f49bc91ba52c225793400489747/\\$FILE/%D0%A1%D0%B5%D1%81%D1%96%D1%8F2.pdf](https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf/0/23349f49bc91ba52c225793400489747/$FILE/%D0%A1%D0%B5%D1%81%D1%96%D1%8F2.pdf)

Figure 2.2 - Governmental Organisation Structure of the Lviv City Council, 2019



Source – Lviv City Institute

As can be seen from the above the responsibilities for Architecture, Construction and Land Use fall under the Deputy Mayor for Urban Development whilst Housing, Waste and Transport are the responsibility of the Deputy Mayor for Housing and Communal Services. Furthermore, energy and water supply are handled by arms-length companies as described above. In each case the relevant department or company priorities will not necessarily be focussed on environmental issues.

The City also has an Ecology and Natural Resources Unit (part of the Urban Development Department) which deals with the implementation of the City Council's policy in the field of ecology and landscape planning, improvement and development. This Unit oversees environmental control, compliance with environmental norms and standards in new developments, but does not deal with wider environmental issues such as air and water quality.

This issue is dealt with as one of the first Actions proposed in the GCAP.

2.3 Environmental Policy and Legislative Framework

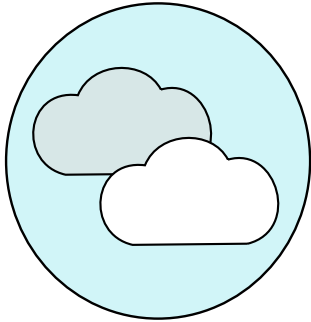
This section outlines the current state of the environment, the key stakeholders and the main policies and legislation relating to each of the main environmental areas. Details of the existing and planned laws, draft laws, strategies, programmes and plans that are relevant to the GCAP at the national, regional (Oblast) and local levels are provided in Annex 1.

At the **national level** a range of relatively new (2-3 years) laws, draft laws and strategies provide a strong legislative framework for municipalities to develop their environmental activities. The main items of relevance for the GCAP are:

- The draft law on the main principles of the *State Environmental Policy of Ukraine to 2030*. This is an overarching document that establishes the framework for environmental management in Ukraine over the next decade and sets a number of environmental goals.
- The law establishing an *Energy Efficiency Fund*. The purpose of the Fund is to achieve an average level of energy savings funded by the Fund or jointly with the Fund of at least at 20%.
- The *Concept of Implementation of the State Policy in the Field of Climate Change to 2030*. The Concept aims to reduce the emissions of greenhouse gases (GHG) per unit of GDP through improved energy efficiency and an increase in the use of renewable energy sources (RES).

At the **local level** the main document covering all environmental areas is the *Integrated Environmental Program for 2017-2022*. This programme sets out the current environmental situation in the City along with the priorities of urban environmental policy for 2017-2022. It covers actions in several areas including waste management, wastewater treatment, air emissions, green spaces and biodiversity, urban development and improving the environmental awareness of our citizens. The actions in land use and urban development will be superseded by our new *Integrated Urban Development Plan (IUDP)* that is in the final stages of preparation.

Other strategies and plans relating to individual sectors are summarised below.



2.3.1 Air & Transport

Current Situation

The major problem of air quality in Lviv lies in the high average annual concentrations of particulates (PM_{2.5} and PM₁₀) and dust, and a slightly elevated average annual concentration of nitrogen dioxide. Concentrations of sulphur dioxide are low. Concentrations of dust, sulphur dioxide and nitrogen oxides in the air show a favourable decreasing trend between 2013 and 2017.

We estimate that around 93% of the air pollution in Lviv comes from transport. We have already replaced some of the older buses and trams which will reduce air pollution as well as improve passenger comfort. A range of actions will take place as a result of developing our Sustainable Urban Mobility Plan (SUMP) which will be adopted by the City council by the end of 2019 (see below).

Relevant Stakeholders

Measurement of Air Quality in Lviv lies under the responsibility of the City Council, *Department of Urban Development*. Under its direction, the Municipal Enterprise “*Administrative and Technical Services*” carries out regular measurements of concentrations of pollutants in the air.

The public transport system in Lviv includes trams, trolleybuses, buses and small buses (“marshrutkas”). Trams and trolleybuses are operated by the Lviv Municipal Enterprise, “*LvivElektrotrans*” while “marshrutkas” are operated by one municipal company (*ATP-1*) and four private companies. Some buses are operated by the City but around 50% are operated by small private companies (though all have to comply with City standards). The number of private cars in the City is estimated at 200,000, of which some 27% are fuelled on diesel.

Relevant Legislation & Policies

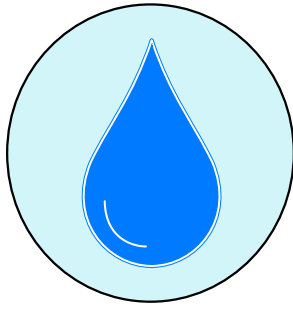
At the national level there are a number of strategies and laws that include elements relevant to the GCAP. These include:

- *National Transport Strategy of Ukraine to 2030*: This is a wide-ranging strategy that covers all transport issues including infrastructure and modes of transport.
- *Law on Traffic*: This law provides the authority to City officials to develop traffic management plans that include the introduction of automated traffic control systems, integrated transport schemes and road traffic management schemes.
- *Strategy on Sustainable Development Goals (SDG) for Ukraine*: This strategy sets out a number of SDGs including those for reducing air pollution by 20% by 2030 compared with 2015.

At the local level the SUMP is fully in line with the national laws and strategies. It covers all areas of transport infrastructure, operations and management including:

- Modernisation of tram, trolleybus and bus fleets;
- Prioritisation of public transport (dedicated lanes);
- Parking policy (including Park-and-Ride);
- Pricing policy (including electronic ticketing);
- Construction of the northern part of the Lviv Ring Road;
- Introduction of the regional rail system into City public transport;
- Optimisation of networks (roads, trolleybus lines, tram lines);
- Development and optimisation of traffic management;
- Construction of 100 km of bicycle lanes.

Implementation of these measures should significantly improve air quality in the City as well as reducing CO₂ emissions.



2.3.2 Water

Current Situation

Water is delivered from six different sources to the City, all of an artesian origin and comprising 180 boreholes. Around 720,000 inhabitants (effectively 100% of the population) are connected to the water supply network. All commercial enterprises and around 93% of private flats and households have water meters installed but there is no water metering at the entrance to communal residential building blocks. There is an on-going programme of installation of meters in these residential blocks, due to be completed by 2020. The distribution pipework is very old and losses are high (around 50%). Actions to improve the situation are ongoing within the limits of the available budget.

Around 95% of households are covered by the sewerage network. The Lviv wastewater treatment plant (WWTP) was built in the 1960s and at the moment it works at only around 50% capacity. Work is already under way to bring the WWTP up to full capacity and international standards. This work is expected to be completed by 2020.

Surface water is discharged along with treated wastewater into the Poltva River which runs in concrete pipes under the City. This creates odour problems in some parts of the City and also further downstream.

Relevant Stakeholders

The municipal enterprise "Lviv Vodokanal" is responsible for water and wastewater management in the City. Vodokanal also supplies water to other cities and villages in the Lviv Oblast.

Relevant Legislation & Policies

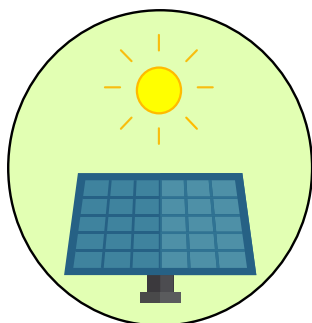
In the Water sector most of the national level laws relate to the provision, quality and safety for drinking water supply and wastewater treatment. These include:

- The law "On Drinking Water, Drinking Water Supply and Sanitation" from 2002 (updated in 2018), which defines the legal, economic and organisational principles for the operation of water supply and sanitation systems;
- The law "On the State Target Programme for Drinking Water in Ukraine for 2011-2020", whose aims are to ensure citizens' rights for adequate living standards by providing drinking water in the required volumes and at the specified quality, as well as providing for the reconstruction of WWTPs in order to reduce the volume of untreated sewage discharged into water bodies.

At the local level the main programme in the sector is the *Comprehensive Sewerage Modernisation Program*, initially approved for 2012 to 2015 but extended for 2016 to 2020. The expected results of this ongoing programme are:

- Improvement of the environmental situation in the City;
- Increasing the wastewater treatment efficiency;
- Improvement of the reliability of existing plant operation;
- Reduction of energy consumption;
- Establishment of own thermal and electrical energy production;
- Reduction of the cost of repair and maintenance work.

As mentioned above, we are already working on rehabilitating the WWTP and also on building a biogas station that will generate electricity from the sewage sludge gas.



2.3.3 Climate Change & Energy

Current Situation

Energy Supply

Electricity and gas supply covers almost 100% of the population in Lviv. Gas coverage is gradually being extended to the few remaining areas of the City.

Around 50-60% of the city inhabitants are supplied from the district heating (DH) system which includes both centralised supply (multi-apartment and public building oriented) and individual heat supply (single family buildings, commerce and industry). Almost all of the heat is produced from gas, though investment projects for conversion of some DH boilers to biomass firing are being prepared. Apart from this there is very little renewable energy supply in the City, with just a handful of solar PV installations on buildings.

Energy Efficiency

Buildings energy efficiency standards in Ukraine are still low in comparison to EU standards, though there is a great deal of current activity at the national level on improving this situation. As well as reducing energy bills, better insulation standards in buildings will also contribute to the City's resilience by combatting stresses from hot and cold weather episodes. There is little or no information about energy efficiency in industry. This sector accounts for some 15-20% of energy use in the City, mainly from small and medium sized enterprises (SMEs).

In 2007, the City Council established an Energy Management Bureau, which includes municipal energy efficiency and energy supervisory departments.

Renewables

As mentioned above, there is very little renewable energy supply in the City. This is a situation which we would like to improve, especially with biomass use in DH and small-scale renewables in buildings (e.g. solar PV, solar thermal, heat pumps etc).

Climate Change

The City actively cooperates on climate change, energy efficiency and renewables projects with international technical assistance projects in a variety of sectors, including projects aimed at improving the municipal infrastructure. Among its partner organizations are EBRD, EIB, USAID, GIZ and NEFCO.

In 2009, Lviv joined the European initiative “Covenant of Mayors for Climate and Energy”³, whose signatories commit to reducing their CO₂ emissions by at least 20% by 2020 compared to the ‘reference year’⁴ followed by the City’s memorandum⁵ (signed in 2018) to make a transition to 100 % renewable energy sources in the City's energy balance by 2050.

³ [The profile of the City of Lviv as a signatory of Covenant of Mayors for Climate and Energy](#)

⁴ For Lviv the ‘reference year’ is defined as the average of the three years 2007 to 2009

⁵ www.cityforlife.org

Relevant Stakeholders

Electricity supplied to the City's consumers is provided by the public joint-stock company LvivOblenergo. In addition to Lviv, this company also supplies electricity to consumers in the Lviv Oblast.

"LvivGaz" is one of the oldest gas utilities in Ukraine and as well as Lviv also covers the Lviv region.

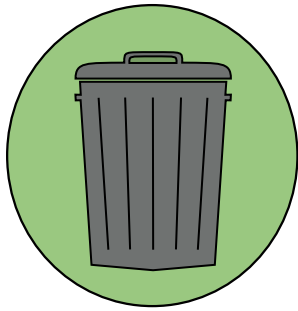
Lviv has two main heat supply companies, the LMEs "LvivTeploenergo" and "ZaliznychneTeploenergo". These enterprises also provide hot water supply services. As a result of cooperation of the City Council with EBRD and Eastern Europe Energy Efficiency and Environment Partnership (E5P), LvivTeploenergo received funds in 2018 for implementing the "Modernisation of District Heating in Lviv" project which is currently on-going.

Relevant Legislation & Policies

The most important laws, strategies and plans governing the energy sector are at the **national level**. These include:

- The *Energy Strategy of Ukraine until 2035*. This was adopted in 2017. The document defines strategic guidelines for the development of the fuel and energy complex of Ukraine for the period until 2035. According to the Strategy the energy intensity of GDP should decrease by more than 50% by 2035 and the share of RES in electricity supply and end-use should be 25%.
- *Concept of State Policy Implementation in the Field of Heat Supply*: this concept proposes a range of measures aimed at ensuring the reliable provision of heat supply services to consumers and improving the energy independence and security of Ukraine. It sets targets for 2035 for average heat consumption per m², the use of alternative fuels and the reduction of losses in heat supply networks.
- *National Action Plan on Renewable Energy until 2020* was adopted in 2014 and covers the period up to 2020. The plan defines target measures on the Government's activity related to the use of renewable energy sources and sets targets for 2020 for the share of RES of 12.4% in heat supply, 11% in the electricity sector and 10% in the transport sector. Those for the heat and electricity supply are close to being achieved but the transport sector is lagging behind the target.
- The *Law on the Electricity Market* from 2017 determines the legal, economic and organisational principles of the operation of the electricity market by ensuring a reliable and safe supply of electricity to consumers and minimising the cost of electricity supply and the negative impact on the natural environment.

At the **local level** the transposition of the above laws has mainly been restricted to improving the efficiency of heat generation and the heat supply networks. EBRD has recently agreed a loan with the City to convert one cogeneration plant for heat and electricity supply to biomass (woodchip) firing.



2.3.4 Solid Waste

Current Situation

As a result of the fire at the City's only landfill site in 2016 which resulted in its closure, improving the Solid Waste situation represents one of the most important environmental and political priorities of our City.

Lviv produces around 250,000 tons of municipal waste per year. Although the vast majority of citizens are provided with a weekly waste collection service, almost all waste is disposed of in landfills in the Lviv Oblast which do not comply with relevant international environmental standards. In the past, little attention has been paid to waste prevention measures, separate waste collection and treatment of organic waste – all of which we would like to change in the next few years.

We are already implementing a number of projects to address the immediate problems with waste management and treatment. The LME “Green City” is working on:

- Remediation of the old landfill site that includes extraction of methane gas for electricity generation and the installation of a leachate treatment system;
- Construction of a waste treatment facility based on mechanical and biological processes (MBT plant), whose outputs can be either composted or sent to local cement plants to be burned as refuse-derived fuel;
- Construction of a new sanitary landfill for disposal of residual waste (in cooperation with the Lviv Oblast authorities).

These and other planned measures will help to solve the current problems and improve our recycling rates.

Relevant Stakeholders

The City has a Waste Management Department that oversees all waste activity in the City. However, the LME “Green City” is responsible for implementing the above projects and for further initiatives to move towards our long-term ‘zero waste’ target. There are six waste collecting companies, of which one is municipal with a market share of 20-25 %, and five private companies.

There are also several NGOs active in the waste sector either promoting the ‘zero waste’ concept, operating small-scale recycling schemes and providing awareness raising activities in schools.

Relevant Legislation & Policies

In 2018 the Ministry of Ecology and Natural Resources of Ukraine prepared the new draft Law “On Waste Management”. This draft Law defines the legal, organisational and economic basis of activities related to the reduction of volumes of waste generation, the introduction of collection, transportation, storage, sorting, treatment, utilisation and disposal systems, as well as the prevention of the negative impact of waste on the natural environment and human health. The actions to achieve a high level of waste management are devolved to the local authorities.

The *National Strategy of Waste Management in Ukraine to 2030* and the subsequent *National Waste Management Plan to 2030* provide for more detailed measures to move towards sustainable waste management. These include:

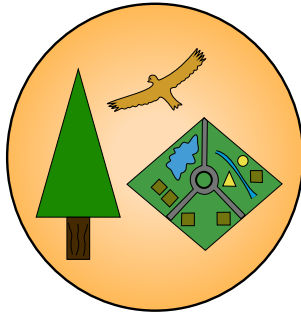
- Involving the population in the separate collection of household waste and encouraging such collection;
- Increasing the population's coverage of household waste collection and disposal;

- Increasing the level of domestic waste recycling;
- Ensuring the commissioning of waste sorting lines and waste recycling plants;
- The introduction of composting of the organic component of household waste in private households in rural areas, as well as suburban areas of cities;
- The creation of pilot projects of facilities for the production of fuels from domestic waste;
- The construction of waste transfer stations to reduce transport costs;
- The closure or reclamation of landfill sites that do not meet the required environmental standards.

At the local level the City has adopted the *Solid Waste Management Strategy in Lviv City for 2017-2019*, which sets the strategic directions for and creates preconditions for further development of solid household waste management in Lviv. It includes the following main objectives and measures:

- Waste prevention, and minimisation of waste that is sent to landfill;
- Introduction of “pay-as-you-throw” (PAYT) principle;
- Development of favourable conditions for repair;
- Material recovery of organic waste;
- Development of separate collection system;
- Creation and support of recycling and processing enterprises;
- Development of hazardous waste management plan;
- Realisation of educational, awareness raising and communication activities.

In addition to the above the City adopted a Waste Management Programme (2018) specifically aimed at household *Waste Electronic and Electrical Equipment (WEEE)*. Also the “*Make Lviv Better*” Project Support Program provides financial support to public and other non-profit organisations for conducting competitions and co-financing of social and cultural projects. These events cover environmental issues, including waste and recycling.



2.3.5 Land Use and Biodiversity

Current Situation

As mentioned earlier Lviv has over 20 park zones, three botanical gardens and 16 natural monuments as well as two forest areas located on the outskirts of the City. According to the *Integrated Environmental Program for 2017-2022 for the City of Lviv* the total area of green plantations in Lviv in different categories in 2012 was 33.3 hectares, including 3.4 hectares within the City centre. However, we recognise that

we need to further improve the number and quality of green spaces in the City. This will also help to improve the diversity of flora and fauna within the City limits. Our new *Integrated Urban Development Plan* (IUDP – see below) will help us to achieve these objectives.

Another priority is the development of an inventory of green spaces and trees since this type of audit has never previously been undertaken. This inventory would determine the variety of plant species and also provide information on the forested areas, most of which need to be managed better.

The City also has a number of brownfield sites which are mainly a legacy of the large industrial enterprises from the Soviet era, some of which are owned by the national railway company and the Ministry of Defence. Since these sites are in private or state ownership we have no direct influence over their remediation, though we are working with several of the owners to improve their appearance and bring them to new uses, such as development of new industrial and commercial zones.

Relevant Stakeholders

All of the activity in this area is under the direct control of City Hall, through the Department of Land Resources, the Institute for Spatial Development, City Institute and the Chief Architect. The role of public enterprise in charge of the biggest parks in the City is important for proper implementation of environmental policies. However we also recognise that the involvement and cooperation of private real-estate developers and the general public will also be essential to make the necessary improvements. We also have a number of NGOs in the City working with schools, producing magazines and undertaking research. However, we recognise that communication and outreach to citizens on land use and biodiversity needs to be improved.

The Ecology and Natural Resources Unit (part of the Urban Development Department) deals with the implementation of the City Council's policy in the field of ecology and landscape planning, improvement and development.

Relevant Legislation & Policies

Land Use is primarily a local issue so there are no national laws governing this area.

For Biodiversity the main **national level** document is the *Concept of the National Program for the Conservation of Biodiversity for 2005 – 2025*. The goals of the Concept are to reduce the degradation of the environment for living species, increase awareness of social activities that can negatively influence biodiversity and the environment, and to improve the state of natural resources and green spaces to encourage biodiversity.

At the **local level** the main current initiative is the new *Integrated Urban Development Plan* (IUDP) which is being developed under the *Integrated Development of Cities in Ukraine* project. This project is being undertaken for the City by the German consultancy GIZ and aims to integrate several other plans into an overall Urban Development Plan. The project is due to be completed by the end of 2019 and will include important links to the GCAP.

We also have two other programmes addressing land use issues – the “*Parks Maintenance Programme*”, which aims to improve the quality of existing parks and gardens, and a special programme to preserve an area of local importance, the “*Peat Bog Belogorsk*”. This is an area of 58.8 hectares which is not intended for property development or other uses. For Biodiversity the main local initiative is the “*Programme of assistance to wild and exotic animals and birds in the city of Lviv for 2019-2023*” which was adopted in 2018.



2.3.6 Resilience

Current Situation

For Lviv our main issues on Resilience are related to adaptation to climate change since the City is not susceptible to natural events such as earthquakes. We do experience localised flooding during periods of heavy rainfall and high temperatures during heatwaves particularly in last decade can cause health problems amongst the more vulnerable members of the population, particularly the elderly and young children. Several of the proposed GCAP actions in the Land Use, Buildings and Water sectors will help to mitigate these effects (see below).

Relevant Stakeholders

As with Land Use & Biodiversity, all of the activities in the Resilience area are under the direct influence of City Hall. However, the involvement of private developers and the general public is also essential in developing our climate adaptation plans.

Relevant Legislation & Policies

The only **national** document referencing Resilience issues is the *National Report on Sustainable Development Goals*. This sets targets for the number of regions that have approved and implemented regional development strategies and plans that will include Resilience measures (100% by 2020 – currently 80%), and the coverage of the national system of centralised alert for the population to national emergencies (60% by 2030 – current level unknown).

At the **local level** the Ecology and Natural Resources Unit recently completed a survey that has identified the main climate risks as:

- Excessive heat and the ‘heat island’ effect during periods of hot weather in the summer. This can lead to respiratory problems in vulnerable population groups as well as discomfort of other citizens;
- Stormy weather involving high winds that cause damage to infrastructure and falling trees;
- Intense rainfall that leads to localised flooding.

It is worth noting that several actions we intend to take within other sectors will have a direct influence on Resilience. For example:

- Improving the thermal insulation of buildings will reduce the vulnerability of occupants to cold weather in the winter and extreme heat episodes in the summer;
- Reducing leakage on the water supply system and improving rainwater collections systems will reduce susceptibility to localised flooding;
- New developments and major reconstructions will include sustainable urban drainage systems (SUDS) to reduce the risk of flooding;
- Improving the quality of our green spaces will reduce the ‘heat island’ effect, thus reducing heat stress for citizens during periods of very hot weather;
- An inventory of trees will identify those most at risk of causing damage during storms.

These cross-cutting themes are recognised later in the GCAP document.

2.4 Existing Laws, Strategies & Plans

We recognised during the early stages of preparing the GCAP that there were already numerous laws, draft laws, strategies and plans in place or in preparation that are related to the environmental situation in Lviv and/or Ukraine, and are therefore of relevance to the GCAP.

In order to avoid ‘reinventing the wheel’ we carried out an analysis of all of these documents. **Annex 1** provides a summary of the documents examined, together with the date they were produced, by whom and an outline of the main findings. The tables in the Annex clearly illustrate the number and variety of laws, strategies and plans relating to environmental performance in Lviv. The most important of these were mentioned in the foregoing sections.

At the **national level** a range of relatively new (2-3 years) laws, draft laws and strategies provide a strong legislative framework for municipalities to develop their environmental activities. These documents include measures in:

- Environmental Policy;
- Climate Change;
- Sustainable Development;
- Transport Strategy;
- Energy Strategy;
- Electricity Supply and the Electricity Market;
- Energy Efficiency in Buildings; Energy Service Companies; Renewables;
- Drinking Water Quality;
- Wastewater Treatment Standards;
- Waste Management;
- Biodiversity.

Provided that the draft laws are adopted more or less as they stand, there are no evident gaps in legislation in the areas relevant to the GCAP.

At the **local level** there a number of strategies, plans and projects which follow the lead of the national documents but are dealing with local priorities including:

- An Integrated Urban Development Plan (IUDP);
- Several Transport projects aimed at updating the infrastructure and replacing the vehicle fleet; a Sustainable Urban Mobility Plan (SUMP) is also being developed;
- Waste Management, including improved recycling systems, a new waste treatment facility and remediation of the old landfill;
- Drinking water and wastewater treatment system modernisation;
- Energy Efficiency in Buildings;
- Land Use (including a new Land Use Strategy in preparation) and Biodiversity;
- Industrial Development, including requirements for good environmental standards;
- Emergency Response.

The current local initiatives are therefore already addressing most of the areas of concern highlighted in discussions with the City Departments and other stakeholders.

2.5 Summary

This overview of the current situation in Lviv and the existing environmental policies and legislation has identified the following five top priority areas:

GCAP Priorities	
Improving our waste management systems including building the new waste treatment plant, improving collection systems and recycling rates, and remediating the old landfill.	Solid Waste
Reconstructing the wastewater treatment plant and reducing leakage on the water supply system	Water
Transport and its impact on air pollution, noise pollution and congestion	Transport
Improving energy efficiency in buildings and the use of urban renewables	Buildings
Improving the area and quality of green spaces and sustainable land use in the City	Land Use

Several other areas of concern have also been identified. These are:

Additional areas of concern	
Improving the condition of the district heating supply network	Energy
Taking action to improve biodiversity within the City boundaries	Biodiversity
Improving resilience to flooding and other climate risks	Cross-cutting

The legislative framework at the national level is strong with no evident gaps provided that the new draft laws are adopted as planned. The local policies and plans that are already in place or under development are addressing our main priority issues. Several projects in the waste, water and transport sectors are already being implemented and will improve the environmental situation in the City.

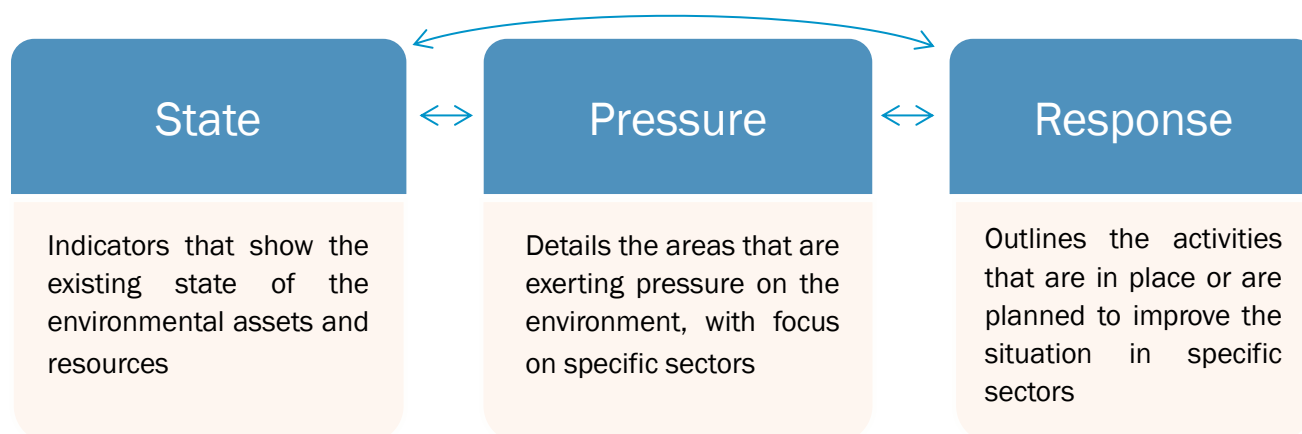
The GCAP will help Lviv to achieve its environmental objectives based on a thorough understanding of current environmental performance, prioritising actions, identifying potential investment opportunities and providing access to additional finance.

3 Benchmarking – Analysis of Environmental Indicators

In the previous sections of this report we have presented a mainly qualitative picture of the environmental situation in Lviv. Examination of Environmental Indicators provides a quantitative analysis of environmental performance measured against international standards.

The GCAP Methodology developed by EBRD details a means of assessing the environmental situation through ‘**State**’, ‘**Pressure**’ and ‘**Response**’ (SPR) Indicators. These indicators seek to provide a holistic assessment of urban environmental performance, with the understanding that performance in one area (e.g. ‘State’) is influenced by performance in another (e.g. ‘Response’).

GCAP Pressure State Response Framework



The Methodology uses a ‘traffic light’ system (red, amber, green) to provide an initial impression of where our environmental performance is poor (red), where some improvement is needed (amber) and where it already meets international standards (green). We have also tracked trends in performance where we have the data.

GCAP ‘Traffic Light’ benchmarking for environmental indicators



The Methodology suggests the use of 35 ‘Core’ indicators to provide an overall picture but, recognising that the data for all of these indicators may not be available, also provides a further 51 ‘Optional’ indicators that can be used as substitutes for the ‘Core’ indicators (i.e. a total of 76 indicators). We have collected data for 34 of the ‘Core’ Indicators and for over 80% of the ‘Optional’ indicators.

Detailed summaries have been prepared for all of the core indicators showing the benchmarks, sources of data, any estimates or calculations used, trend data and links to further information. These detailed summaries are presented in Annex 2.

Summaries of the indicators analysis are shown and discussed in the following sections, including the ‘red’, ‘amber’, ‘green’ status and an indication of the trend (positive, stable, negative) where data is available. ‘Core’ indicators are whole numbers (1, 2, 3...), while ‘Optional’ indicators – being indicator data that provide additional insight in the same indicator area – are denoted as decimals (1.1, 2.1, 3.1...).

3.1.1 Summary – State Indicators

The “State” indicators where the assessments show we have the biggest environmental challenges are:

Main areas of concern – ‘State’	
Total Suspended Particles (TSP) including concentrations of PM _{2.5} and PM ₁₀	Air
BOD and Ammonia concentrations in the Poltva River	Water
Share of green space areas within urban limits	Land Use

Data on air quality are being monitored at up to 35 sites. The air quality in Lviv is poor (red flag) in terms of PM_{2.5} and TSP (and implicitly PM₁₀) and not satisfactory (amber flag) in terms of nitrogen oxides. On the other hand, air quality is good (green flag) in terms of sulphur dioxide. A favourable (decreasing) trend can be observed for all three pollutants. As the energy sector in Lviv is based on natural gas and heavily polluting industries are not present, road transport represents the dominant source of air pollution (estimate 93 %).

Data for Biochemical Oxygen Demand (BOD) has been obtained from 35 sampling points. The average value for 2014 to 2017 is ‘poor’ though with an improving trend. Ammonia concentrations are high with a slightly increasing trend. The explanation lies in the fact that the efficiency of biological treatment at the wastewater treatment plant is only 50 %.

Although the indicator for green space area per 100,000 inhabitants is in the ‘green’ category, the indicator for green spaces within urban limits is in the ‘red’ category.

These findings are in line with the priorities we expressed at the outset of the GCAP preparation.

3.2 'Pressure' Indicators

The 'Pressure' indicators measure the activities that are the main causes of our environmental challenges. They cover Transport, Buildings, Industry, Energy, Water, Solid Waste and Land Use.

Table P - 1: Pressure Indicators

Source of pressure		No	Indicator	Status	Trend
Transport	Energy efficiency and type of energy used	10	Average age of vehicle fleet (total)		No visible trend
	Choice of transport mode	11	Transport modal share in commuting (cars, motorcycles, taxi, bus, metro, tram, bicycle, pedestrian)		Negative – increase of private cars
	Road congestion	12	Average travel speed on primary thoroughfares during peak hours		Stable
	Resilience of transport systems	13	Interruption of public transport systems in case of disaster		Stable
Buildings	Electricity consumption	14	Electricity consumption in residential buildings		Positive - decrease
	Heat / fossil fuel consumption	15.1	Heating/cooling consumption in residential buildings, fossil fuels		Negative - increase
	Building standards	15.3	Share of city enterprises with ISO50001/ EMAS certification or similar		Stable (almost zero)
		15.4	Total value of projects with green building certification as a share of total		Stable (almost zero)



Main area of concern

Source of pressure		No	Indicator	Status	Trend
Industry	Electricity consumption	16	Electricity consumption in industries per unit of industrial GDP		Stable
	Heat consumption	17	Heat consumption in industries per unit of industrial GDP	Data N/A	
	Consumption of fossil fuels in industrial processes	18.1	Fossil fuel combustion in industrial processes per unit of industrial GDP		Negative - increase
		18.2	Share of industrial energy consumption from renewable energy		Positive - increase
	Industrial waste treatment	19	Share of industrial waste recycled as a share of total industrial waste produced		Stable (but almost zero)
	Industrial wastewater	20	Percentage of industrial wastewater that is treated according to applicable national standards		Stable (but mechanical treatment only)
Energy	Electricity provision	21	Share of population with authorized connection to electricity		Stable
	Thermal comfort provision	22	Share of population with access to heating / cooling – gas district heating and electricity		Stable
	Renewable energy provision	23	Proportion of total energy derived from renewables as a share of total city energy consumption		No visible trend
	Resilience of the electricity network to climatic extremes	24	Average share of population undergoing prolonged power outage in case of climatic extremes over the past 5 years		Stable



Main area of concern

Source of pressure		No	Indicator	Status	Trend
Water	Water consumption	25	Water consumption per capita		Stable
	Efficiency of water supply networks	26	Non-revenue water		Stable
	Wastewater treatment	27	Percentage of residential and commercial wastewater that is treated according to applicable national standards		Stable (mechanical treatment only)
	Resilience to floods	28	Percentage of dwellings damaged by the most intense flooding in the last 10 years		Not applicable
Solid Waste	Solid waste generation	29	Total solid waste generation per capita		Stable
	Collection of solid waste	30	Share of the population with weekly municipal solid waste (MSW) collection		Stable
	Treatment of solid waste	31	Proportion of MSW that is sorted and recycled (total and by type of waste)		Stable (but low)
	Landfill efficiency/capacity	32	Remaining life of current landfill(s)		Landfill closed
Land Use	Density / integrated land-use	33	Population density on urban land		Stable
	Urban sprawl	34	Average annual growth rate of built up areas		Not applicable
	Use of existing built-up areas	35	Vacancy rates of offices		Positive - decrease



Main area of concern

3.2.1 Summary – Pressure Indicators

According to the analysis above the main areas responsible for putting pressure on the environment are:

Main areas of concern – ‘Pressure’	
The age of the vehicle fleet (especially private cars) coupled with the low average travel speed on primary thoroughfares during peak hours	Transport
The high levels of electricity consumption in buildings and industry together with the absence of green building standards and other environmental certifications, and the low level of renewable energy sources	Buildings & Industry
Water consumption per capita (which is closely linked to leakage on the water supply network – non-revenue water)	Water
Low levels of recycling or composting of municipal and industrial waste and the remaining life of the current landfill (in fact the landfill is closed)	Waste

Transport

The summary table shows that air pollutants from Transport are mainly due to the age of the car fleet. There are around 200,000 cars registered in Lviv of which at least 50% are older than 13 years. Private cars represent around 24 % of commuting journeys (still in the ‘green’ zone) but the percentage is growing in line with the total number of cars registered. The relative lack of dedicated bus and taxi lanes and of cycle paths also contribute to the problem.

An important problem lies in a very low average travel speed at peak times which causes elevated exhaust emissions. As an increase in the number of private cars is very likely, this problem will certainly become more serious unless action is taken.

Buildings

The available data puts the electricity consumption in residential buildings clearly in the “red” category. Electricity consumption in non-residential buildings based on an estimate of floor area is “amber” though very close to “red”. Total electricity consumption in buildings is categorised as “red”.

Because there is no complete data available for heat consumption in non-residential buildings in Lviv, indicator 15 cannot be calculated. Information puts the heat consumption in residential buildings firmly in the “red” category. All heat in Lviv is produced from natural gas.

There are no official figures available for enterprises with ISO50001 or EMAS, nor for projects with a green building certificate but anecdotal evidence suggests that the numbers are very low (or even zero) so the ratings are certainly in the ‘red’ category (<25%).

Industry

Data on electricity consumption in industry per unit of GDP in the city of Lviv is not available so the data at the Lviv Oblast level were used instead. Moreover, data on industrial GDP is not available – Gross Value Added (GVA) is used instead. The value of kWh/USD is much higher than the limit for the “red” category but this could be because of the use of GVA instead of GDP. No data is available for heat consumption in industry.

Although no data is available on heavy metals emissions from industry, the figure will be low because of the nature of industrial enterprises in the City (i.e. mainly SMEs).

Energy

Data on the proportion of renewable energy at the municipal level is not available. At the national level, this share was 5.7 % (6.61 % in electricity production and 4.93 in heat production) which is below the “red” benchmark value (10 %). We concluded that the situation in Lviv is not different from the situation at national level based on our own knowledge and verbal information received from other stakeholders.

Water

The ‘red’ benchmark for water consumption per capita is mainly due to the high level of losses (around 50%) in the water distribution network. 100% of residential and industrial wastewater is treated, but only mechanical and partial biological treatment is used at present. This contributes to the poor performance of the WWTP and pollution in the River Poltva.

Solid Waste

More than 90 % of Lviv’s population have weekly waste collections (green flag). Although separate waste collection (plastics, paper, glass) has been introduced to some extent, only 2-3% of MSW is currently recycled (against the red flag benchmark of 15 %) while the rest is landfilled. Almost no waste is composted (red flag) and an unknown amount of waste is illegally disposed of in open dumps.

The municipal landfill is closed due to the fire in 2016 and MSW is being sent temporarily for disposal at four landfills located outside the City area, which are not compliant with the EU standards. The remaining life is therefore characterised by a red flag.

These indicators reflect most of our expressed priorities (e.g. transport, waste management, water supply and treatment, and energy in buildings) but do not address areas such as improving green spaces.

Several of the indicators within the individual sectors are also important for **Resilience**. These include: Resilience of transport systems (Indicator 13); Heating/cooling consumption in buildings (Indicator 15); Resilience of the electricity network to climatic extremes (Indicator 24); Resilience to floods (Indicator 28). This reflects the cross-cutting nature of Resilience issues in the GCAP.

3.3 'Response' Indicators

The information below in the "Response" indicators provides a snapshot of our current and planned responses to dealing with the environmental challenges of the City.

Table R - 1: Response Indicators

Topic		No	Indicator	Status	Comments
Transport	Energy efficiency and type of energy used in transport	36	High polluting vehicles are regulated / Energy efficient vehicles are incentivised through fiscal instruments		Will be addressed in the new Sustainable Urban Mobility Plan (SUMP) for Lviv. Following the purchase of trolleybuses financed by EBRD, purchase of new additional trams, buses and trolleybuses is planned to continue.
	Choice of transport modes	37	Extension and improvement of public and non-motorized transport is planned and supported through investment in place		Will be part of the SUMP. Extension of bicycle paths and tramways planned. Increase in the number of parking lots (park and ride) and bus stops also planned.
	Information & awareness	38	Public and non-motorised transport is promoted through Information and awareness campaigns		Campaigns are included in the Integrated Environmental Programme of Lviv
	Congestion	39	Traffic demand is managed (congestion charges, smart technologies)		Project " <i>Reconstruction of the automated control system of traffic</i> " is in progress. Will also be addressed in the SUMP.
	Resilience of transport systems	40	Public transport emergency management (in publicly and/or privately run networks) is planned and tested		Transport emergency management is not in place

Topic		No	Indicator	Status	Comments
Buildings	Electricity and heat consumption	41	Green building is promoted through standards and fiscal incentives		Several laws and draft laws at the national level on construction and energy standards and use of the ESCO mechanism.
		42	Public and private investment in energy efficiency in buildings		City programmes “Warm House” and “Energy Efficient Homes” promote energy efficiency.
		43	Metering and billing for personal energy use is regulated		Metering is in place in the case of electricity and partially in the case of gas.
Industry	Electricity and heat consumption / energy efficient industrial processes	44	Energy efficient industrial machinery is regulated and incentivised through fiscal instruments		Legislation and energy efficiency standards are in place at the national level.
		45	Energy efficient industrial technologies is supported through private investment		Private investments are in place – however their extent is limited.
	Industrial waste / material consumption	46	Material efficiency of new built industrial facilities and waste recycling is regulated and incentivised through fiscal instruments		No such incentives or regulations exist
	Industrial wastewater	47	Industrial wastewater treatment / reuse / recycle is promoted through regulations and fiscal incentives		Wastewater treatment is regulated by national legislation as well as through permitting processes

Topic		No	Indicator	Status	Comments
Energy	Electricity and heat consumption	48	Coverage and quality of electricity and heat supply is improved through investment		Insufficient investments are reported in the CAPEX programmes of the district heating companies.
	Renewable energy development	49	Renewable energy facilities in private buildings are incentivised through fiscal instruments		"Green" tariff for investing in solar energy on private houses (it is possible to install up to 30kW of solar power capacity)
		50	Renewable energy technologies are developed and supported through public and private investment		Support for renewable energy at the national level has been increasing for some time, Recently, quotas and gradual decrease of feed-in tariffs were decided upon.
		51	Renewable energy facilities are incentivised through awareness campaigns		Promotion of renewable energy is carried out through annual exhibitions, conferences and forums.
	Resilience of the electricity network	52	The resilience of electricity networks in case of disaster is tested and enhanced through investment		Resilience is assured through the investment plans of power supply companies.
Water	Water consumption	53	Metering and billing for water use is regulated		Metering and billing covers 50 % of produced water only (50 % of water is lost in the network – non-revenue water).
		54	Water saving / reuse is encouraged through awareness campaigns		No such awareness campaigns exist
	Efficiency of water supply networks	55	Coverage and efficiency of water supply networks is improved through plans and investment		Coverage is sufficient, efficiency is low (high losses). Plans to reduce water losses are in place.

Topic		No	Indicator	Status	Comments
Water	Wastewater treatment	56	Buildings' access to wastewater collection and treatment systems is improved through plans and investment		All buildings in Lviv are connected to the central wastewater network but further investment is needed
	Wastewater treatment	57	Wastewater treatment is promoted through regulations and fiscal incentives		Integrated (municipal) program for modernisation of sewerage 2016 – 2020.
		58	Wastewater billing is regulated		National Commission on state regulation in the sector of communal services sets costs for water supply and wastewater treatment.
	Drinking water pre- treatment	59	Drinking water pre-treatment is enhanced through plans and investment		Pre-treatment at the treatment plants is carried out by LvivVodokanal at an adequate level in accordance with the national standards.
	Resilience to floods	60	Drainage facilities are developed through plans and investment		Priority of the Integrated Environmental Programme of Lviv 2017 – 2022
		61	Business and community resilience is encouraged through awareness campaigns		Conferences and seminars are being organised.
Solid Waste	Solid waste generation	62	Reduction of material consumption / solid waste generation is promoted through awareness campaigns		Some activity in this area by NGOs but much more needed.
	Collection of solid waste	63	Coverage of solid waste collection system is improved through plans and investment		Additional separate collection points are to be established. Four household waste recycling centres planned.

Topic		No	Indicator	Status	Comments
Solid Waste	Collection of solid waste	64	Littering and non-compliance to sorting systems is dis-incentivised through fines and penalties		There are fines and penalties for littering. However, the fines are poorly enforced.
	Treatment of solid waste	65	Composting, recycling and waste-to-energy facilities are developed through plans and investment		New composting facility is planned as part of LME "Green City" programme
		66	Solid waste reuse, sorting and recycling is promoted through information and awareness campaigns		There are a few NGOs and donor funded projects promoting solid waste reuse, sorting and recycling.
	Landfill efficiency and capacity	67	Overcapacity issues in landfills are tackled through plans and investment		Existing landfill was closed. New landfill to European standards will be built in Lviv Oblast.
Land Use	Density / Integrated Land-use / urban sprawl	68	Density is regulated		Density is not regulated in the existing land use plan but will be under the new Integrated Urban Development Plan (IUDP).
		69	Transit-Oriented Development is promoted		Transit orientated development is not regulated in the existing land use plan but will be under the IUDP.
	Use of existing built-up areas	70	Mixed-use development is promoted through zoning regulations / incentives		Mixed use development is not regulated in the existing land use plan but will be under the IUDP

3.3.1 Summary – Response Indicators

The analysis shows that almost all areas need some improvement (amber flag) but that we are already responding (or have established plans to do so) in all of our priority areas. The areas where response to the problems are shown to need significant improvement are not so urgent.

All of the areas requiring improvement are recognised by the City Council and need to be reflected in the GCAP. The need for an approach that encompasses regulation and standards, but also awareness raising and technical investments is evident.

- **Legislation.** New laws and draft laws have been prepared at a national level in most environmental areas – certainly covering Air, Energy Use (especially in buildings), Water and Waste. This legislation will of course include Lviv and some of the legislation will require transposition into local plans (e.g. the National Waste Management Strategy requires the preparation of a local Waste Management Plan).
- **Public Awareness.** Public awareness campaigns as a means of improving environmental performance have not been a major feature of our activities to date. Some NGOs and small companies are working in this area but much more needs to be done.
- **Investment Measures.** The indicators analysis highlights the areas where investment is needed and some of this has already commenced (e.g. in waste management and wastewater treatment). The challenge for the GCAP is to agree which of the remaining projects are the highest priority and to determine sources of finance to implement them.

The following sections include details of the discussions we have held with other stakeholders to prioritise of the areas to be addressed and the actions required, taking into account not only the environmental dimension but also the financial, political and social implications of each measure.

GREEN CITY ACTION PLAN

1 Methodology

In this Section we describe the Methodology we employed to arrive at an overall “Vision” for the GCAP, the “Strategic Objectives” that we need to meet to achieve the Vision and the final set of Actions that will form the Green City Action Plan. For each GCAP Action we have developed Mid-term Targets for 2028 and Short-term (2020-2023) Tasks to facilitate monitoring of progress.

The Methodology builds on the Green City Baseline developed in the preceding Sections and so takes into account:

- The current environmental situation and the laws, strategies and plans relevant to each sector (Section 2);
- The results of the Indicators Analysis (Section 3).

We have also undertaken extensive consultations with City Departments, external stakeholders (private companies, industry bodies, NGOs, independent local and international experts) and the general public to arrive at a GCAP that is realistically possible to achieve within the constraints of the City’s budget and other resources. The consultation process is described in Section 4.2.

1.1 Vision and Strategic Objectives

Initial ideas for the GCAP “Vision” and the “Strategic Objectives” to achieve this Vision were first defined through discussions within City Departments and then with EBRD and the consultant team. We then published an online questionnaire aimed at stakeholders and the general public that was available on the City website from the end of July until 19th August.

Eight possibilities for the **GCAP Vision** were proposed in the survey. The response to the online questionnaire was disappointingly low with only 21 respondents, but this still assisted us to come to a conclusion on the Vision. The most popular choice, supported by 33% of respondents, was “Clean, Vibrant and Liveable City for All” followed by “Lviv - Green and Prosperous City” with 24%. The GCAP “Vision” adopted by the City is therefore:

“Clean, Vibrant and Liveable City for All”

The responses on the proposed Strategic Objectives to achieve the Vision are shown in Table 4.1 below.

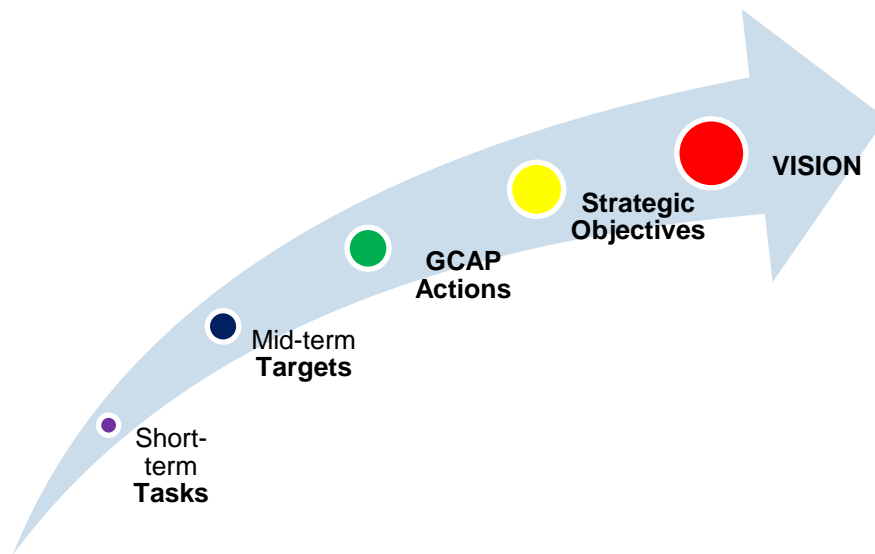
Table 4.1 Proposed Strategic Objectives

	Proposed Strategic Objectives	Result
1.	Improve air quality in the City	Supported by 95.2% of survey respondents
2.	Develop a sustainable mobility system in the City	Supported by 95.2% of survey respondents
3.	Bring waste collection, reuse, recycling and treatment up to international standards	Supported by 95.2% of survey respondents
4.	Develop a sustainable City water and wastewater management system	Supported by 85.7% of survey respondents
5.	Proactive and informed municipal government leadership in energy efficiency and use of renewables	Supported by 85.7% of survey respondents
6.	To develop pleasant, comfortable and functional buildings with maximum energy efficiency and minimum CO ₂ emissions.	Supported by 85.7% of survey respondents
7.	Enhance green spaces and introduce new green elements throughout the City, including development of a green corridor	Supported by 95.2% of survey respondents
8.	Improve conditions for increasing flora and fauna within urban limits	Supported by 85.7% of survey respondents
9.	Lviv businesses meet high levels of sustainability and resource efficiency	Supported by 52.4% of survey respondents Neutral – 28.6% of survey respondents

Although the number of responses was low, it is evident that all of the Strategic Objectives apart from No.9 received very high levels of support (over 85%). The business-oriented objective still received over 50% but is clearly of less importance in the opinion of the respondents. On this basis, coupled with the priority actions emerging from the workshops, we decided to adopt all of the proposed Strategic Objectives as part of the GCAP. However, since Strategic Objectives 7 and 8 are so closely interdependent and any actions will span both areas, we decided to combine them into one Strategic Objective – *“Enhance green spaces and introduce new green elements throughout the City to improve living conditions for citizens and to increase the diversity of flora and fauna within urban limits”*.

The relationship between the Vision, Strategic Objectives, GCAP Actions, the Mid-term Targets and the Short-term Tasks is illustrated in Figure 4.1 below.

Figure 1.1 Relationship between Vision, Strategic Objectives, GCAP Actions, the Mid-term Targets and the Short-term Tasks



Once the Vision and Strategic Objectives had been agreed, the priority GCAP Actions to achieve the Strategic Objectives were defined through the process described below. For each Action we then discussed with relevant stakeholders what would be a reasonable target to aim for in the mid-term (by 2028). In some cases the Action would be completed by then, whilst in other long-term actions an intermediate practical target was agreed. Finally the short-term (2020 to 2023) tasks that needed to be completed to move towards the Mid-term target were identified.

Sections 5 to 13 provide details of the GCAP Actions, their Mid-term targets and Short-term tasks organised under each of the Strategic Objectives.

1.2 Consultation Process

Following initial consultations involving City departments and the Lviv Municipal Enterprises (LMEs) a series of stakeholder workshops were held in May 2019. The aim of these workshops was to develop a ‘Long List’ of potential project ideas for each sector. And Strategic Objective. These workshops were attended by the relevant City Departments, representatives of the LMEs, academia, NGOs and other stakeholders.

A second round of stakeholder workshops was held in July 2019 and was attended by a similar group of stakeholders as in the initial workshops. Once again the workshops were organised on a sectoral basis but related to each of the Strategic Objectives.

The aim of the July workshops was to examine the “Long List” of ideas from the first round of workshops and to refine them into a “Short List” of potential actions for the GCAP. This process involved:

- A presentation of the main challenges previously identified for each sector;
- A round-table discussion amongst the stakeholders during which the initial ideas were considered in turn;
- Scoring of the difficulty of implementation of each idea (technical, political, financial and social) together with its environmental impact by each participant;
- Assigning a final priority score (High, Medium, Low) to each action.

The result was a prioritised 'Short List' of ideas, including suggestions on which ideas should be combined to form a more effective action, and which have direct linkages to other sectors.

The workshops were attended by a total of 57 participants including;

- 17 from City Departments and four from City Institute;
- 10 from the Local Municipal Enterprises (LMEs);
- 10 NGOs;
- 10 from academic institutions;
- 10 from other organisations (such as business support groups).

Several stakeholders attended multiple workshops. A list of workshop attendees (both rounds) is included as Annex 8.

Further meetings were then held in September and were aimed at a deeper analysis of each of the 'Short List' actions and were attended by participants from the relevant City Departments, the appropriate Municipal Enterprises, NGOs and academia. During these discussions we considered:

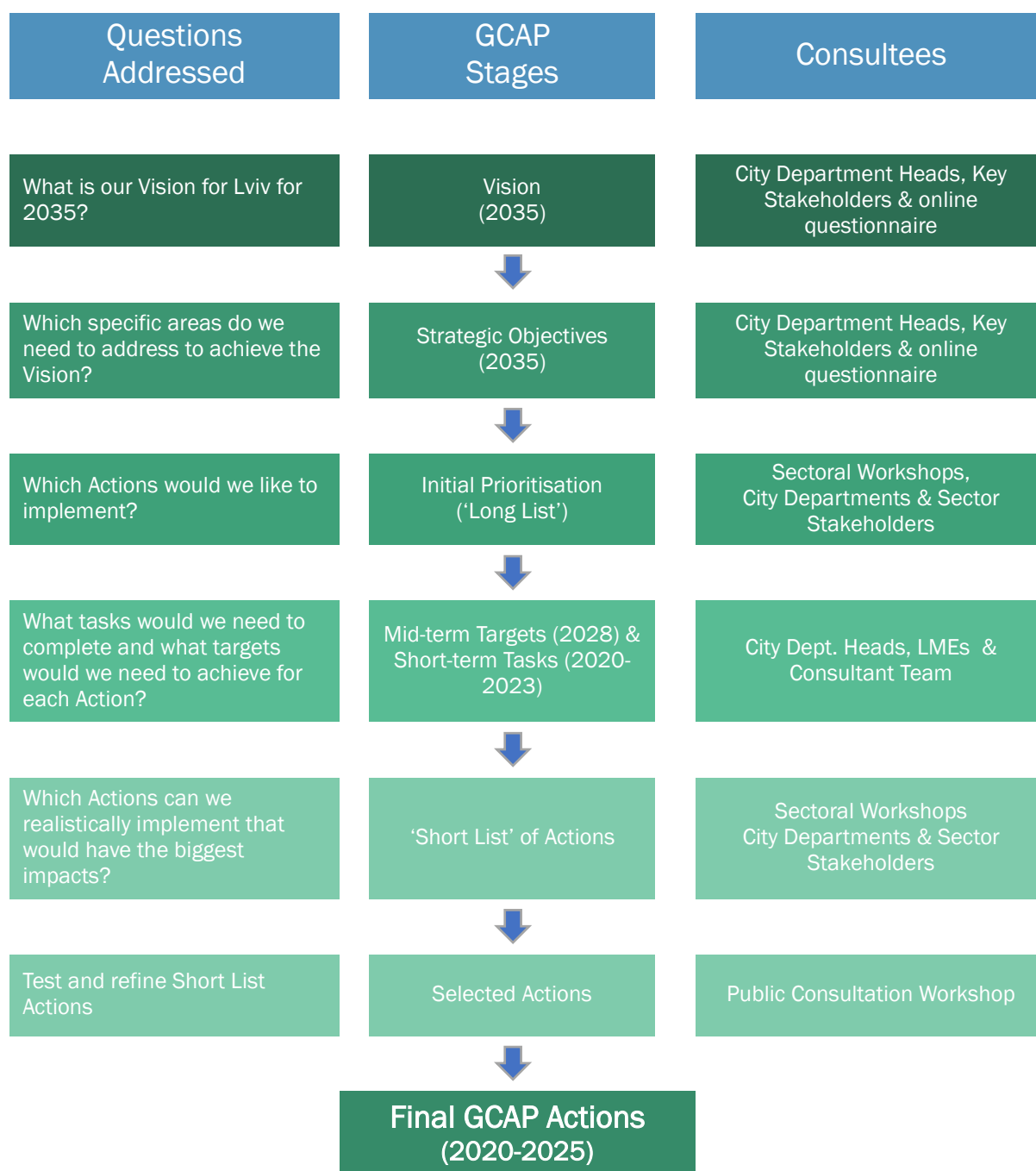
- The economic, social and environmental benefits of each proposed action;
- The capital costs of implementation (CAPEX) and the ongoing operational costs (OPEX);
- Potential sources of funding;
- The implementation timescale;
- Which organisations needed to be involved in implementation and operation of the actions.

Finally we held a **Public Consultation Workshop** on 16th October 2019 at which all of the proposed Actions were discussed in round table sessions with experts from the City, other stakeholders and the consultant team. Around 40 people attended this event and took full part in the discussions. The event was supported by the Czech Consulate.

This resulted in amendments to some of the 'Short List' actions either because they were already partially covered under other programmes or were not feasible in the form originally envisaged. The finally agreed Actions are summarised in a set of Action Description sheets that are included as Annex 3. All of the Actions and their impacts are summarised in Annex 5.

We have also consulted with the City Finance Department to understand the budget categories and the limits on further borrowing to finance the GCAP actions.

The full consultation process to develop the GCAP actions is shown in the flow chart (Fig. 4.2) overleaf.

Figure 1.2 Flow chart of consultation process


This detailed analysis and extensive consultation has allowed us to develop a GCAP that is realistically achievable by 2035. It takes into account the resource constraints of the City but will have maximum positive impacts on the City's environment, economic development and social inclusion. The outcomes of this process are presented in the following Sections of this document.

2 GCAP Actions

2.1 GCAP Actions Summary

The selected GCAP Actions along with their associated Mid-term Targets and Short-term Tasks are summarised under each Strategic Objective in the table below. Further details of all Actions are provided for each Strategic Objective in the following Sections.

SUMMARY OF GCAP ACTIONS, MID-TERM TARGETS AND SHORT TERM TASKS			
Strategic Objectives	Proposed Actions	Mid-term Targets (2028)	Short-term Tasks
SO.1 - Improve air quality in the City; SO.2 - Develop a sustainable mobility system in the City	T.1 – Completion of Sustainable Urban Mobility Plan (SUMP), its adoption and implementation	Implementation of the SUMP	Develop and adopt detailed SUMP Action Plan for the period 2021-2023
	T.2 – Completion of e-ticketing project	e-ticketing project complete	Finalise the e-ticketing project
	T.3 – Purchase of new trams, buses and trolley buses	150 new vehicles purchased and operational	Continuing purchase of new vehicles for public transport
	T.4 – Feasibility Study for extension of the tram and trolley bus network, including new depots and transport hubs	Feasibility study completed	Develop feasibility study for the extension of the tram and trolley bus network, including new depots and transport hubs
	T.5 – Feasibility study for the prioritisation of public transport, including dedicated lanes, traffic management and 'smart' traffic light systems	Feasibility study completed	Develop feasibility study for the prioritisation of public transport, including dedicated lanes, traffic management and 'smart' traffic light systems

SO.1 - Improve air quality in the City; SO.2 - Develop a sustainable mobility system in the City	T.6 – Development of additional 100km of pedestrian and cycling routes	Additional 100km of pedestrian & cycle paths completed	Prepare for and resume construction of additional 100km of pedestrian and cycling routes
	T.7 – Installation of permanent air quality measuring stations and software system linked to City website and public information platform	Air quality monitoring system fully operational	Develop and approve the concept of air quality monitoring and assessment system; Develop feasibility study; Purchase equipment and software; Implement the whole system
SO.3 - Bring waste collection, reuse, recycling and treatment up to international standards	SW.1 (i) – Remediation of the old landfill; SW.1 (ii) – Construction of the MBT plant; SW.1 (iii) – Construction of a new landfill	(i). Old landfill rehabilitated; (ii). MBT plant operational; (iii). Site for new landfill agreed and construction commenced	(i) Continue with rehabilitation of the old landfill. (ii) Build the MBT plant. (iii) Identify and agree location of new landfill site with Lviv Oblast; Commence construction of new landfill
	SW.2 – Improve primary infrastructure for separate waste collection	Recycle 25% of collected municipal solid waste;	Identify localities where containers for separated waste will be placed; Purchase and place containers at selected localities; Analyse demand for secondary materials, and sign contracts with relevant recycling businesses; Increase awareness of citizens on waste separation
	SW.3 – Develop a network of official waste recycling centres	Four waste recycling centres established; 2. Recycle 25% of collected municipal solid waste	Identify localities where the household waste recycling centres will be built: Build and equip the recycling centres; Analyse the demand for secondary materials, and sign contracts with relevant recycling businesses; Increase awareness of citizens about the recycling centres and waste accepted
	SW.4 – Develop a system for composting of organic waste	Two composting plants built; 2. Treat by composting 25% of collected green and organic waste	Set up a system for collection of green waste from parks and other public places; Set up a system of organic household waste management; Set up a system of organic household waste management; Increase awareness of citizens and private sector about possibilities of composting

SO.3 - Bring waste collection, reuse, recycling and treatment up to international standards	SW.5 – Consider introduction of “pay-as-you-throw” (PAYT) principle	100% of citizens charged for waste collection based on PAYT principle	Analyse possible options of PAYT principle implementation; Set up a system of charges, and approve relevant local regulations; Communicate the regulations to citizens; Establish a team of enforcement officers
	SW.6 – Support educational, awareness raising and communication activities	10 projects/actions on waste prevention and/or separation supported each year; 2. Total MSW generation per capita is stabilized at the current level	Establish a system for support of educational, awareness raising and communication activities of external organisations; Provide regular support to external organisations; Organise communication and awareness raising activities
SO.4 - Develop a sustainable City water and wastewater management system	W.1 – Reconstruction of part of the wastewater treatment plant (agreed and ongoing)	WWTP operating at full capacity and treatment to international standards	Complete rehabilitation of WWTP including pumping stations and control systems
	W.2 – Construction of a biogas CHP unit from anaerobic digestion of sludge at the WWTP (agreed and ongoing)	Biogas CHP plant fully operational	Identify and agree additional financing for reconstruction of settling tanks and aeration systems; Complete the construction of the biogas CHP plant
	W.3 – Replacement and/or mechanical cleaning of water supply pipes	Reduce losses of drinking water from distribution pipework by 50%	Undertake a survey of the water distribution network status; Develop a comprehensive plan for modernisation of the water distribution network including associated electrical plant and ‘smart’ leakage detection systems; Agree financing arrangements; Commence work on repair and replacement of pipework and electrical systems and install leakage detections systems
	W.4 - Renovation/retrofitting of water pipework inside buildings	Reduce water losses from pipework inside buildings by 50%	Undertake a survey of water leakage inside buildings alongside measures for thermal rehabilitation and determine costs and savings; Agree financing arrangements with building owners; Replace/renovate water pipework as part of thermal rehabilitation activities and install smart meters incorporating leakage detection systems.

SO.4 - Develop a sustainable City water and wastewater management system	W.5 - Installation of meters in all residential blocks (<i>on-going</i>)	All communal residential blocks and individual apartments fitted with water meters	Complete installation of water meters in residential blocks and individual apartments; Launch information campaign on how to reduce water usage; Upgrade maintenance facility for water meters and recruit additional staff; Hold discussions with national government on increasing tariff rates
	W.6 - Separate rainwater drainage system from the city sewerage system	Separate rainwater drainage where possible during reconstructions.	Assess all new road reconstruction projects and development sites for suitability of separating rainwater collection systems; Draw up regulations for SUDS in all new buildings and major rehabilitation projects.
SO.5 - Proactive and informed municipal government leadership in energy efficiency and use of renewables	E.1 – Modernisation of street lighting to LED standards	70% of street lighting converted to LEDs	Prioritise locations for street lighting upgrades from the lighting survey; Investigate potential financing routes including IFIs and ESCOs; Commence conversion of street lighting to LEDs
	E.2– Insulation or replacement of DH distribution network plus modernisation of boiler houses, possibly including cogeneration	30% of DH substations and pipework re-insulated or replaced; 30% of heat exchanger stations in the buildings modernised; 60% of boiler houses refurbished	Identify the sections of the DH network most in need of repair and the least efficient boiler houses; Explore potential financing routes, including the IFIs; Investigate the economic case for CHP for upgraded boilers; Continue with DH upgrade programme
	E.3 – Convert district heating boiler plants to biomass firing	10% of non-CHP boilers converted to biomass	Investigate the economic case for biomass firing for DH boilers not converted to CHP; Negotiate a secure supply of wood chip and/or pellets; Convert appropriate boilers to biomass firing

SO.5 - Proactive and informed municipal government leadership in energy efficiency and use of renewables; SO.6 - To develop pleasant, comfortable and functional buildings with maximum energy efficiency and minimum CO2 emissions	B.1 – Thermal rehabilitation of buildings including insulation, windows, boilers, control systems and small-scale renewables	Public building renovation rate to be 3% of the floor area annually.	Develop programme of thermal rehabilitation including Actions B.2 and B.3
	B.2 – Introduction of advanced technical and environmental requirements for new construction and major renovations of public buildings.	Advanced technical and environmental standards to be imposed by the City	Introduction and adoption of advanced technical and environmental requirements for new construction and major renovations plus urban renewables
	B.3 – An improvement programme aimed specifically at public buildings, using the municipal EPC/ESCO mechanism	EPC/ESCO scheme used in 50% of public buildings	Development of EPC/ESCO scheme for public building sector renovation; Creation and establishing financial funds for ESCOs and renewables support; Launch of an EPC/ESCO programme for public building renovation
	B.4 - Wider use of the EPC/ESCO mechanism for financing and implementing energy efficiency improvements	Residential building renovation rate to be 3% of the floor area annually	Development of EPC/ESCO scheme for residential/commercial building sector renovation; Launch of an EPC/ESCO programme for residential/commercial building sector renovation
	B.5 – Use of ‘Smart’ metering and data sharing	Smart metering included in all new buildings and major refurbishments	Technical and financial consultations with building owners and owners’ associations and landlords including ‘smart’ meters
	B.6 – Skills/business development programme for building insulation and small scale renewable energy technologies installers and advisors	All professionals involved in energy efficiency improvements fully trained	Design, promote and deliver training for professionals in installation of energy efficiency improvements

SO.7 - Enhance green spaces and introduce new green and blue elements throughout the City, including development of a green corridor; SO.8 - Improve conditions for increasing flora and fauna within urban limits	L.1 – Completion of the Integrated Urban Development Plan	IUDP adopted and implementation of measures ongoing and monitored	Accept and adopt IUDP ; Explore financing options for priority measures; Commence implementation of recommended measures
	L.2 - Upgrade and modernisation of the GIS system – main focus on environmental parameters and ecology	GIS system upgraded and publicly available.	Update the GIS system software; Undertake an inventory of green spaces urban trees and fauna; Add new elements and parameters into the online database tool
	L.3 - Development of new “Green Corridors” through the City and construction of Green City Line	Develop at least 50 km of new green corridors through the City.	Completion of the pilot project “Green City Line”; Improvement of the central and most disconnected part of the Green City Line; Continue with development of green corridors and smart green hubs
	L.4 - Development of support mechanisms for policy makers and relevant stakeholders, introduction to potential sources of finance and new green support programmes, including development of a Green and Blue Strategy	Surface area of green and blue spaces increased by 20% of the current level; Increase the number of nesting sites for birds and bats by at least 50% compared to the current situation; Develop a Green Strategy including a feasibility study for an orbital forest around Lviv	Develop Green and Blue Strategy; New green programmes for fauna and flora biodiversity and invasive species reduction; Create conditions and programme development for urban community gardening and composting; Development of pets and homeless animal care centres; Ensure a systematic programme of restoration of parks, squares and flower gardens with introduction of waterbodies
	L.5 - Public awareness campaigns and expert training for proper education on the importance of urban land-use and biodiversity	Public information campaigns designed and implemented; Appropriate training for stakeholders delivered	Develop promotional campaigns and education programmes; Run a promotional campaign on land use and biodiversity each year; Deliver training to appropriate stakeholders; Organise public display boards and monitors at all rehabilitated sites
SO.9 - Lviv businesses meet high levels of sustainability and resource efficiency	I.1 – Support programmes for environmental improvements and accreditation in business and industry	200 businesses supported; 50 businesses accredited	Identify the sectors and businesses most likely to benefit from support; Design, promote and deliver an environmental support programme for businesses; Introduce “Green Business” Awards and information programme
	I.2 – Develop a local recycling business ‘cluster’, to reprocess materials collected from the new collections bins and the waste recycling centres	25% of waste is recycled locally; 20 recycling businesses established	Identify existing businesses that could potentially provide recycling services ; Encourage new recycling businesses to invest in Lviv; Assist these businesses to develop business plans and to identify local customers

In addition to these Actions we have two over-arching Actions that do not fit under any single Strategic Objective. These are described below.

2.2 GCAP Coordination and Monitoring

Before outlining the Strategic Objectives and their associated Actions, it is necessary to consider how they will be coordinated and monitored.

It is clear from the stakeholder workshops and all previous discussions in developing the GCAP that there are many interactions between the sectors. This implies that several City Departments and expert stakeholders will need to be involved to enable us to achieve our Strategic Objectives and hence the GCAP Vision.

We have a number of internal departments that are directly relevant to the GCAP. Responsibilities for Architecture, Construction and Land Use fall under the Deputy Mayor for Urban Development, whilst Housing, Waste and Transport are the responsibility of the Deputy Mayor for Housing and Communal Services. In addition, energy and water supply are handled by arms-length companies that are wholly owned by the City. In each case the relevant department or company priorities will not necessarily be focussed on environmental issues as their primary objective.

We also have an Ecology and Natural Resources Unit (part of the Urban Development Department) which deals with the implementation of the City Council's policy in the field of ecology and landscape planning, improvement and development. This Unit oversees environmental control and compliance with environmental norms and standards in new developments, but does not deal with wider environmental issues such as air and water quality, nor with enforcement in areas such as illegal effluent discharges and dumping of waste. We have therefore decided to expand the role of the Ecology Office to cover these additional aspects and will recruit the necessary specialist staff to enable this. The Ecology Office will need to work in close cooperation with the Departments mentioned above and also with the Economic Development, Investment & Projects and the Office of Finances.

In parallel with this we have also assigned the role of monitoring the progress of implementation of GCAP Actions to the City Institute. They are already playing a similar role in monitoring the SUMP and the IUDP so adding responsibility for the GCAP plays to their strengths.

The first and over-arching Action for the GCAP is therefore:

Action 0.1 – Expand the roles of the Ecology Office and the City Institute to coordinate implementation of all GCAP Actions and to monitor the progress of implementation

We believe that these new roles can be fully adopted by the middle of 2020 and hence a Mid-term Target is not necessary. The Short-term Tasks will be to:

- Determine the precise roles and responsibilities of the Ecology Office and City Institute;
- Recruit the appropriate specialist staff.

There will be no capital expenditure (CAPEX) associated with this Action but operational costs (OPEX) are likely to rise by around **€100,000** per year because of additional staff and responsibilities.

2.3 Adaptation and Resilience

For Lviv our main issues on Resilience are related to adaptation to climate change since the City is not susceptible to natural events such as earthquakes. The topic was discussed at several of the

sector meetings and is also the subject of a current study by the City Ecology Department. This investigation has concluded that the climate effects that are leading to the most concern are:

- Excessive heat and the 'heat island' effect during periods of hot weather in the summer. This can lead to respiratory problems in vulnerable population groups as well as discomfort of other citizens;
- Stormy weather involving high winds that cause damage to infrastructure and falling trees;
- Intense rainfall that leads to localised flooding.

Several of the proposed actions in the Buildings, Water and Land Use sectors will have a positive impact on these aspects of Resilience (see following Sections) so we believe that the only GCAP Action relating to Adaptation and Resilience to Climate Change is:

Action AR.1 – Develop a Climate Adaptation and Resilience Plan for the City.

The Adaptation and Resilience Plan will bring together all of the above Actions from other sectors and highlight the elements that are relevant to climate change. The study currently being undertaken by the Ecology Department will form a basis for the Plan since it is proposing:

- A satellite map of the hottest areas of the City in the summer months;
- A survey of the condition of urban trees to identify those in danger of falling;
- Potential wind barriers in new construction from 'green' architecture;
- Improved rainwater collection following heavy rain;
- Design of improved drainage systems in street renovations.

Further work in this area will involve other City Departments and external stakeholders.

The Plan will be developed in 2020 so again there is no need for a Mid-term Target and the only Short-term Action is to develop the Plan itself.

Developing the Plan is expected to cost around **€100,000** (external assistance may be needed) but there will be no associated operational costs.

The following Sections take each Strategic Objective in turn and provide details of the Actions that will need to be taken to achieve them.

3 Strategic Objective 1 - Improve Air Quality in the City

Measurements carried out during the last 5 years indicate high concentrations of suspended particulate matter (TSP, PM₁₀ and PM_{2.5}) and also increased concentrations of nitrogen oxides (NO_x). As more than 90 % of air pollution in Lviv is associated with the Transport sector, all transport measures to reduce emissions are presented under Strategic Objective 2 (Develop a Sustainable Mobility System in the City).

The methodology of air quality monitoring currently applied is obsolete (concentrations of PM₁₀ and PM_{2.5} are not measured) and the results of measurements are not comparable with international standards. Moreover, neither the decision-makers nor public have information easily available on actual (near to real time) air quality.

In order to enable efficient air quality management, the introduction of a network of automated monitoring stations complying with international standards and connected to an air quality information system is crucial. The outputs of this information system should be available to the public.

To achieve Strategic Objective 1 only one GCAP Action is proposed to supplement the transport actions described in the following section. This is:

GCAP Action

T.7

Installation of permanent air quality monitoring stations and software system linked to the City website and public information platform

This Action is expected to entail Capital expenditure (CAPEX) of around **€1 million** and have an operating expenditure (OPEX) of €200,000 per year, or a total of **€1 million** over the 5-year timescale of the GCAP.

The table below shows the Action, the Mid-term Targets, the organisations responsible for implementation, the timescale, estimated CAPEX, estimated OPEX and potential funding sources. For the sake of clarity, short term tasks are not included in this table but were shown earlier in Table 5.1 and are also in Annex 5. Further details of the Action are provided in Annex 3.

Note: CAPEX is where funds have to be spent from the City's capital budget or raised from elsewhere. The figure quoted is anticipated expenditure over the life of the GCAP (2020-2025). OPEX is the cumulative operational costs over the life of the GCAP and is used for 'soft' measures such as developing plans or awareness campaigns. It includes both one-off costs for developing individual plans and annual operating costs of systems.

Table 3.1 - Green City Actions, Mid-term Targets, Timescales, Costings and Funding Sources for Strategic Objective 1

No	Green City Action	Mid-term Targets (2025)	Implementing Body	Timescale						CAPEX €	OPEX €	Potential Funding Sources
				2020	2021	2022	2023	2024	2025+			
T.7	Installation of permanent air quality monitoring stations and software system linked to the City website and public information platform	Air quality monitoring system fully operational	City (LME “Administrative-Technical Utility”)							1 million	1 million	City Budget; International Donors

4 Strategic Objective 2 - Develop a Sustainable Mobility System in the City

As the Transport sector is at the top of the list of priorities for improving air quality for the City, several measures have been implemented in the past or are in progress (finalisation of the SUMP – Sustainable Mobility Action Plan, the e-ticketing project, purchase of new vehicles for public transport)

The first Action that needs to be taken is to adopt the Sustainable Urban Mobility Plan (SUMP) and to commence implementation of the necessary actions.

GCAP Action

T.1

Completion of the Sustainable Urban Mobility Plan (SUMP), its adoption and implementation

This Action is almost complete and will therefore not incur any further costs. Future CAPEX and OPEX will be covered in the following individual Actions.

As a comprehensive document, the SUMP is expected to cover all necessary aspects of the Transport sector, including the following priority actions:

GCAP Actions

T.2

Completion of e-ticketing project (in progress – to be completed in 2020)

T.3

Purchase of new buses, trolley buses and trams (in progress – to be continued)

T.4

Feasibility study for extension of the tram and trolley bus network, including new depots and transport hubs

T.5

Feasibility study for the prioritisation of public transport, including dedicated lanes, traffic management and 'smart' traffic light systems

T.6

Development of additional 100km of pedestrian and cycling routes through the City

The table below shows the above Actions together with their Mid-term Targets, the organisations responsible for implementation, the timescale, estimated CAPEX, estimated OPEX and potential funding sources. Further details of each Measure are provided in Section 7.1 following the table.

Table 4.1 - Green City Actions, Mid-term Targets, Timescales, Costings and Funding Sources for Strategic Objective 2

No	Green City Action	Mid-term Targets (2028)	Implementing Body	Timescale						CAPEX €	OPEX €	Potential Funding Sources
				2020	2021	2022	2023	2024	2025+			
T.1	Completion of Sustainable Urban Mobility Plan (SUMP), its adoption and implementation	Implementation of the SUMP	City Transport Office and City Institute							Included below	Included below	City Budget
T.2	Completion of e-ticketing project	e-ticketing project complete	City Institute and LvivAvtodor							2 million	Reduced	City Budget; IFIs & Donors
T.3	Purchase of new buses, trolley buses and trams	150 new vehicles purchased and operational	City Transport Office and LvivAvtodor							100 million	Reduced	City Budget; IFIs & Donors
T.4	Feasibility study for the extension of the tram and trolley bus network, including new depots and transport hubs	Feasibility study completed	City Transport Office and City Institute							Zero	200,000	City Budget; IFIs & Donors
T.5	Feasibility study for the prioritisation of public transport, including dedicated lanes, traffic management and 'smart' traffic light systems	Feasibility study completed	City Transport Office and City Institute							Zero	200,000	City Budget; IFIs & Donors
T.6	Construction of additional 100km of pedestrian and cycling routes	Additional 100km of pedestrian & cycle paths completed	City Transport Office and City Institute							5 million	1 million	City Budget; IFIs & Donors

4.1 Summary of selected actions

The following paragraphs provide more details of each Selected Action under Strategic Objective 2.

Action T.1 – Completion of Sustainable Urban Mobility Plan (SUMP), its adoption and implementation

CAPEX: Included in following Actions

OPEX: Included in following Actions

The **Sustainable Urban Mobility Plan (SUMP)** has been developed almost in parallel with the GCAP and is focused on 'green' methods of transportation (trams, trolleybuses, electric cars, bicycles, scooters, walking etc.) along with improvements to the road and rail network. The SUMP covers all areas of transport infrastructure, operations and management including the following of particular relevance to the GCAP:



- Modernisation of tram, trolleybus and bus fleets;
- Prioritisation of public transport (dedicated lanes);
- Parking policy (including Park-and-Ride);
- Pricing policy (including electronic tickets);
- Optimisation of networks (roads, trolleybus lines, tram lines);
- Development and optimisation of traffic management;
- Construction of 100 km of bicycle lanes.

More details of individual Actions are provided in the descriptions below

Action T.2 – Completion of e-ticketing project

CAPEX: €2 million (remaining)

OPEX: Reduced

The process of introducing an automated payment system for travel in public transport (e-ticket) is in progress and is expected to be finalised by the end of 2021. The operator of the electronic ticketing system will be LME "LvivAvtodor". Timed tickets will be introduced - for a day, three days, a month, a year. Various methods of payment are planned – terminal, debit/credit card, special transport card, and QR code – however the possibility to pay in cash will be retained. This action should have a positive impact on the attractiveness of public transport.

The remaining capital requirement is around **€2 million**. Operating costs will be reduced compared with the current system.



Action T.3 – Purchase of new buses, trolley buses and trams

CAPEX: €100 million

OPEX: Reduced



The Program for the purchase of buses through financial leasing (Document adopted by the City Council of Lviv in 2018) states that the City of Lviv should run 630 buses on working days and 427-434 buses at weekends. Currently there are 480-500 buses on the routes on working days and 350-370 units at weekends. According to recent modelling, the ideal would be 730 buses with modified distribution across the routes. The Lviv Municipal Transport Company proposes to purchase a further 150 buses (minimum Euro 6 standard) and trolley buses with a passenger capacity of at least 100 persons each through financial leasing. We will also continue with the programme to purchase new and second-hand trams. The purchase of new public transport vehicles will increase the attractiveness of public transport for those citizens who currently travel in and around the City by private car.

The capital expenditure for the next phase of this project is expected to be around **€150 million**. Operational costs will be reduced compared with the current vehicles because of lower energy and maintenance costs.

Action T.4 – Feasibility study for the extension of the tram and trolley bus network, including new depots and transport hubs

CAPEX: Zero

OPEX: €200,000

As a first stage in this project a feasibility study is proposed for the extension of the tram and trolley bus network, including new depots and transport hubs, with special attention paid to connection of the suburbs with the City centre. These extended mobility opportunities will increase the attractiveness of public transport. This action will be carried out in parallel with action T.5.



There is no capital expenditure associated with the Action but we will need an estimated **€200,000** (OPEX) to develop the feasibility study.

Action T.5 – Feasibility study for the prioritisation of public transport, including dedicated lanes, traffic management and 'smart' traffic light systems

CAPEX: Zero

OPEX: €200,000



Improvement of traffic management with the prioritisation of public transport is expected to reduce traffic congestion and journey times thus increasing the attractiveness of public transport and reducing the number of private cars in the City. This will also have positive impact on air quality. This Action will be coordinated with Action T.4.

There is no capital requirement at this stage and OPEX to develop the feasibility study will again be around **€200,000**.

Action T.6 – Construction of additional 100km of pedestrian and cycling routes

CAPEX: €5 million

OPEX: €1 million

The Bicycle Network Development Program for 2011-2019 (Document adopted by the City Council of Lviv in 2011) plans that by 2020, the City should have 268 km of cycle paths. The implementation of this Program has been delayed because of a lack of finance so that the current length of cycle paths is around 100 km. This Action is aimed at restarting the project.



Initially we will provide and additional **€5 million** to restart the project and further financing will be sought from the international organisations. We will also require **€1 million** of OPEX over the GCAP timescale for maintenance of the cycle paths.

5 Strategic Objective 3 – Bring waste collection, reuse, recycling and treatment up to international standards

We recognise that at the moment, solid waste management is not only an environmental problem but also one of the major political issues in Lviv after the accident at the Hrybovychi landfill site in 2016 which resulted in the closure of the whole site.

The main challenges identified in the Solid Waste sector are:

- Decrease/stabilise the amount of waste generated;
- Gradual introduction of waste separation system, including organic waste;
- Collection and treatment of ‘bulky’ and hazardous waste;
- Construction of a new sanitary landfill for residual waste;
- Development of local/regional recycling industry;
- Increasing citizens’ environmental awareness, particularly in relation to recycling.

In order to address these challenges, we have already prepared several specific investment projects, which will be implemented in the next two years with financial support provided by EBRD and other donors. These projects are the subject of the first GCAP Action under this Strategic Objective.

GCAP Action

SW.1

- SW.1 (i) – Remediation of the old landfill
- SW.1 (ii) – Construction of the MBT plant
- SW.1 (iii) – Construction of a new landfill

The CAPEX required for the three projects are €17 million, €31 million and €14 million respectively (a total of **€62 million**). The OPEX over the GCAP timescale is estimated to be **zero** for SW.1 (i), **€9 million** for SW.1 (ii) (3 years operation) and **zero** for SW.1 (iii) (not operational in GCAP timescale).

Other priority Actions under this Strategic Objective are:

GCAP Actions

SW.2	Improve primary infrastructure for separate waste collection
SW.3	Develop a network of official waste recycling centres
SW.4	Develop a system for composting of organic waste
SW.5	Introduce the “pay-as-you-throw” (PAYT) principle for charging for residual waste
SW.6	Support educational, awareness raising and communication activities

Table 8.1 below shows for each Action the Mid-term Targets, the organisations responsible for implementation, the timescale, estimated CAPEX, estimated OPEX and potential funding sources. Short descriptions of each Action follow the table and further details are provided in Annex 3.

Table 5.1 - Green City Actions, Mid-term Targets, Timescales, Costings and Funding Sources for Strategic Objective 3

No	Green City Action	Mid-term Targets (2028)	Implementing Body	Timescale						CAPEX €	OPEX €	Potential Funding Sources
				2020	2021	2022	2023	2024	2025			
SW.1	i) Remediation of the old landfill	Old landfill remediated	LME "Green City"							17 million	Zero	City Budget; IFIs & Donors
	(ii) Construction of the MBT plant	MBT plant operational	LME "Green City"							31 million	9 million (3 years operation)	City Budget; IFIs & Donors
	(iii) Construction of a new landfill	Site for new landfill agreed and construction commenced	LME "Green City" and Lviv Oblast							14 million	Zero (not operational in GCAP timescale)	City Budget; IFIs & Donors
SW.2	Improve primary infrastructure for separate waste collection	Recycle 25% of collected municipal solid waste	City Hall Waste Dept; LME "Green City"; Waste collection operators							1-2 million	2 million (4 years operation)	City Budget; Private Sector
SW.3	Develop a network of official waste recycling centres	Four waste recycling centres established; Recycle 25% of collected municipal & business solid waste	City Hall Waste Dept; LME "Green City"; NGOs							2 million	3 million (3 years operation)	City Budget; Private Sector
SW.4	Develop a system for composting of organic waste	Two composting plants built; Treat by composting 25% of collected green and organic waste	City Hall Waste Dept; LME "Green City"; NGOs							2-3 million	3 million (4 years operation)	City Budget; IFIs & Donors
SW.5	Introduce the "pay-as-you-throw" (PAYT) principle for charging for residual MSW	100% of citizens charged for waste collection based on PAYT principle	City Hall Waste Dept; LME "Green City"							1-4 million	400,000 (2 years operation)	City Budget; Private Sector
SW.6	Support educational, awareness raising and communication activities	10 projects/actions on waste prevention and/or separation supported each year; Total MSW generation per capita is stabilised at the current level	City Hall Waste Dept; NGOs; Business Support Organisations							Zero	400,000 (4 years operation)	City Budget; Private Sector

5.1 Summary of Selected Actions

The following paragraphs provide more details of each Selected Action under Strategic Objective 3.

Action SW.1 – (i) Remediation of the old landfill & (ii) Construction of the MBT plant & (iii) Construction of a new landfill

CAPEX: (i)	€17 million	OPEX: (i)	Zero
(ii)	€34 million	(ii)	€9 million
(iii)	€14 million	(iii)	Zero



As mentioned above this is one of the highest priorities for Strategic Objective 3 (and probably for the whole GCAP). In order to implement these projects the LME “Green City” has received a loan from EBRD⁶, a loan from the Clean Technology Fund (CTF) and a grant from the Eastern Europe Energy Efficiency and Environmental Partnership (E5P), administered by EBRD, and has applied for a loan from the European Investment

Bank (EIB) to finance the three linked projects.

Work on remediation of the old landfill site and building the MBT plant has already commenced. The City is liaising with the Lviv Oblast authorities to identify a suitable location for the new landfill site. The LME “Green City” is leading on these projects.

Action SW.2 – Improve ‘primary’ infrastructure for separate waste collection

CAPEX: €1-2 million	OPEX: €2 million
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Although separate waste collection has already been introduced to some extent and separate collection bins (plastics, paper, and glass) are located at many points in the City centre, the recycling rate of municipal solid waste is still only 2-3%. The situation can be improved by intensification of separate collection points, i.e. bringing them closer to the citizens. Experience from cities where recycling is well developed shows that with improved accessibility, the involvement of citizens increases considerably. Improvement of the infrastructure needs to be accompanied by citizens’ awareness raising about the possibilities and importance of waste separation. Consequently, the availability of separated materials can boost the development of local recycling businesses.



⁶ Funding source: SIDA-EBRD Ukraine Energy Efficiency and Environment Consultant Cooperation Fund; Project: Ukraine – Lviv Solid Waste Management Project.

The estimated cost of the new bins and developing the new sites is estimated to be **€1-2 million**. Operating costs are estimated at €500,000 per year, or **€2million** over the GCAP timescale. Some of this will come from the City budget but most will be from the private waste collection companies.

Action SW.3 – Build official waste recycling centres

CAPEX: €3 million

OPEX: €3 million

Many types of household and business waste that can be recycled are not suitable for collection through separate collection points (bins) situated on streets. They may be too large or are not produced in such quantities that it is worthwhile collecting them through the network of separate collection points. These may include items such as bulky waste (furniture, mattresses), construction and demolition waste (C&D), tyres, textiles, wood, home electrical appliances, electronic equipment, etc. In future, this type of waste can be accepted at specified 'waste recycling centres' (WRC) located at several places in the City. Not only can they boost development of local recycling businesses (as with Action SW.2) but they also create a space for the involvement of the social enterprise sector that can handle some types of waste. This can partially address the issue of 'informal recycling' by poor people – some may be able to find employment in such centres or enterprises, though for the majority it may still be necessary to make some small payment for bringing recyclable materials to the WRCs. The WRCs can also accept hazardous waste, which should not end up in a mixed waste, to transfer it to dedicated facilities. All the possibilities should also be supported by awareness raising activities.



The initial capital expenditure during the GCAP timescale is estimated at **€3million** for establishing the first of four centres with an ongoing operating cost of **€3million** in subsequent years. Again most of the funding will come from the private sector with some support from the City budget.

Action SW.4 – Develop a system for composting of organic waste

CAPEX: €3 million

OPEX: €3 million



Almost no organic waste is composted, although it represents an important part of total waste generated in the City. Instead of being landfilled, it can be used for production of compost in a municipal composting plant as well as at citizens' homes (home or communal composting). The LME "Green City" is planning to build

the City's first composting plant, treating 35,000 tonnes per year of waste, alongside the MBT plant. The system will handle both municipal green waste from parks and other public places (grass, leaves, branches, etc.) and organic waste from households. Also private sector businesses (in particular from the hospitality sector) will have the possibility to use the municipal composting plant with appropriate charging mechanisms.

The compost product will be used in the City's parks and gardens and will also be available for sale to the public and businesses. Lower grade compost will be used in the landfill remediation projects.

In the longer term we plan to build a second composting plant once potential markets for the product have been established.

The first composting plant is expected to cost **€3 million** and will be operational by 2021. Operational costs over four years are expected to be **€3 million**, though some of this will be offset through sales of compost products. The LME “Green City” will be responsible for building and operating the plant but NGOs and small businesses will be involved in collecting the organic waste.

Action SW.5 – Introduce the “pay-as-you-throw” (PAYT) principle

CAPEX: €1-4 million

OPEX: €400,000

At the moment, citizens in Lviv are charged a modest fee for waste collection services on a basis of a flat rate (per m²), which may discourage them from behaving in a way to prevent and separate waste. Introduction of charges that take into account the amount of residual waste generated has proven to be a successful motivating factor to encourage more environmental friendly behaviour. The citizens will be given a possibility to separate waste for free (measures SW.2 – SW.4) and will be charged only for the amount of residual mixed waste produced. In order to prevent illegal dumping of residual waste (with the aim to decrease the charge), it may be necessary to introduce penalties and involve the City’s enforcement capacities. Introduction of PAYT charges is subject to availability of a sufficient separate waste infrastructure. Any new local regulations will need to be in line with national legislation.

The initial cost to set up the system is estimated to be **€1-4 million** depending on the complexity of the chosen methodology and is expected to be in operating by 2022. Operational costs over the subsequent years of the GCAP timescale are estimated at **€400,000**. These costs will be offset by the revenues obtained from the PAYT system. Responsibility for establishing and running the systems will be with the City Waste Department.

Action SW.6 – Support educational, awareness raising and communication activities

CAPEX: Zero

OPEX: €400,000



Ongoing projects as well as newly proposed measures have the potential to lead the City to introduction of modern, environmental friendly waste management practices, which are in line with international standards. Nevertheless, involvement and behaviour of citizens is a crucial aspect on this journey; therefore, a continuous process of education and awareness raising plays an important role in the overall system. The awareness raising programme could include social media, posters, public events and inserts in other City mailings to citizens.

The City could organise its own communication and awareness raising activities; however, it can also make use of knowledge and capacities of external organisations such as NGOs, schools, educational centres, etc. to strengthen information efforts. Taking into account the limited resources these organisations have, regular support from the City will be necessary.

There is no capital expenditure associated with this Action. Operational costs including designing the programme and providing ongoing support are estimated to be **€400,000** over four year. This will come from the City budget and the private sector.

6 Strategic Objective 4 - Develop a sustainable City water and wastewater management system

The Lviv Municipal Enterprise "LvivVodokanal" is responsible for drinking water supply and wastewater management in the City. We regard improving the quality and reducing the losses of drinking water, together with improvements in wastewater treatment as our second highest short term priority after waste management. In the near future we anticipate that the tariff charges for water and sewage treatment will be increased because of new national legislation. This will provide a higher revenue stream which will help to fund some of the necessary improvements and also allow us to undertake improved maintenance of the water supply and wastewater treatment systems.

We have already commenced work on remediation of the WWTP, building a biogas plant and on metering of drinking water. Completion of these projects (Actions W1, W.2 and W.5) is therefore the first priority to achieve Strategic Objective 4.

GCAP Actions

W.1	Reconstruction and renovation of the WWTP
W.2	Construction of a biogas CHP unit from anaerobic digestion of sludge at the WWTP
W.5	Installation of water meters in residential blocks

However, during discussion at the workshops a number of other actions have emerged as priorities to complete the picture. These are:

GCAP Actions

W.3	Replacement and /or mechanical cleaning of water supply pipes and fittings
W.4	Renovation/retrofitting of water pipework inside buildings
W.6	Separate rainwater drainage system from the City sewerage system

Table 9.1 below shows for each Action the Mid-term Targets, the organisations responsible for implementation, the timescale, estimated CAPEX, estimated OPEX and potential funding sources. Short descriptions of each Action follow the table and further details are provided in Annex 3.

Table 6.1 - Green City Actions, Mid-term Targets, Timescales, Costings and Funding Sources for Strategic Objective 4

No	Green City Action	Mid-term Targets (2028)	Implementing Body	Timescale						CAPEX €	OPEX €	Potential Funding Sources
				2020	2021	2022	2023	2024	2025+			
W.1	Reconstruction and renovation of the WWTP	WWTP operating at full capacity and treatment to international standards	LvivVodokanal							30 million	Reduced	City Budget; IFIs & Donors
W.2	Construction of a biogas CHP unit from anaerobic digestion of sludge at the WWTP	Biogas CHP plant fully operational	LvivVodokanal and City Hall							30 million	Reduced	City Budget; IFIs & Donors
W.3	Replacement and/or mechanical cleaning of water supply pipes and fittings	Reduce losses of drinking water from distribution pipework by 50%	LvivVodokanal and City Hall							100 million	Reduced	City Budget (water charging revenues); IFIs & Donors
W.4	Renovation/retrofitting of water pipework inside buildings	Reduce water losses from pipework inside buildings by 50%	LvivVodokanal and Building Owners							10-20 million	Reduced	City Budget; IFIs & Donors; Private Sector
W.5	Installation of water meters in residential blocks	All communal residential blocks and individual apartments fitted with water meters	LvivVodokanal and City Hall "Green City"; NGOs							1 million	1 million	City Budget; Private Sector
W.6	Separate rainwater drainage system from the City sewerage system	Separate rainwater drainage where possible during reconstructions; SUDS installed as part of all new building developments and major rehabilitation.	City Hall, National Government & LvivVodokanal							10-20 million	Reduced	City Budget; National Government; IFIs & Donors

6.1 Summary of Selected Actions

The following paragraphs provide more details of each Action

Action W.1 – Reconstruction and renovation of the WWTP

CAPEX: €30 million

OPEX: Reduced



The Lviv wastewater treatment plant (WWTP) was built in the 1960s and at the moment it works at 40-50% of its capacity. The WWTP has fully functional mechanical and partially functional biological treatment stages. There are also problems with the input pumping station and blowers with their associated control systems that are causing overflows into the Poltva River with consequent pollution. Work is already under way to resolve these problems and to bring the WWTP up to full capacity and international standards with the assistance of a loan from EBRD. This work is expected to be completed by 2020.

The cost of the reconstruction is **€30 million** and funding has already been agreed with EBRD. The operating costs will be significantly reduced due to improved energy efficiency (and hence reduced costs) from replacing or upgrading major electrical equipment such as pumps, fans and blowers. LvivVodokanal is responsible for implementing this project.

Action W.2 – Construction of a biogas CHP unit from anaerobic digestion of sludge at the WWTP

CAPEX: €30 million

OPEX: Reduced

Currently sewage sludge is dewatered and disposed of in fields for natural drying. A feasibility study has been carried out and work has commenced on building a biogas combined heat and power (CHP) plant based on anaerobic digestion of the sludge. However, since commencement of the work it has been discovered that it will be necessary to reconstruct the primary and secondary settling tanks and aeration systems in addition to the grit chambers. This will make it possible to achieve a project load of 120t of dry solids per day and efficiently implement the project. We are therefore currently seeking additional finance to complete this project to a satisfactory standard.



The total cost of the work has been assessed at **€30 million** including the cost of the additional elements. Operating costs will be reduced because the electricity generated will supply the WWTP with any surplus exported to the grid. Again Vodokanal is responsible for implementing the project.

Action W.3 – Replacement and/or mechanical cleaning of water supply pipes and fittings

CAPEX: € 100 million over 5 years

OPEX: Reduced



Currently there are around 50% of losses in the water distribution network. This means that 50% of all clean water produced is non-revenue, which we consider to be a major problem. The biggest single source of loss is from the distribution pipework, which includes pipework within buildings. LvivVodokanal management estimate that up to 80% of the leaks are 'invisible', i.e. they are mostly underground, making it more difficult to identify and fix the problem.

The water supply system was built in 1960s and there has been little or no regular maintenance for the last 30 years. The pipework is made from cast iron and plastic. Due to the age and previously inadequate maintenance of the pipework, some sections of the water supply piping are clogged with mineral sediments which causes pressure problems and further leakages in the system.

Dealing with this problem will be long-term and expensive because much of the pipework will need to be replaced, meaning major excavation works across the City. We are also investigating technologies that can remove sediments without the need to excavate the roads and pavements that could be useful on some sections of the distribution system. This technology is only applicable to pipework that is not in a state of disrepair so it will be necessary to undertake an evaluation of the pipework system by camera prior to starting work. Another alternative is to line the existing pipework with a flexible plastic sheath, though again this will only be possible on some sections of the distribution system where there are few junctions. Once solutions have been implemented it will also be necessary to install leakage detection systems to minimise losses in the future.

As part of this project it will also be necessary to replace or upgrade the electrical equipment (transformers, switchgear, pumps, controls) at the pumping stations as much of the existing plant is very old (mid-20th century).

LvivVodokanal estimate that this action will require expenditure of at least €20 million per year, i.e. **€100 million** over the GCAP timescale. Expenditure at this level will only be possible with the assistance of finance from IFIs and donors, plus tariffs for water supply being raised to an economic level. This will require discussions with National Government. However, operating costs would be significantly reduced because of the reduced leakage and the upgrades of the electrical equipment, both of which will lead to lower electricity costs. These savings should lead to a good payback on the investment. The Action would also lead to improved conditions for citizens in terms of better quality drinking water, fewer interruptions in supply and more consistent water pressure. Savings in the first few years could be used to finance improvements in subsequent years. Vodokanal will be in charge of implementation but we at City Hall will lead the discussions with IFIs and National Government.

Action W.4 – Renovation/retrofitting of water pipework inside buildings

CAPEX: €10-20 million

OPEX: Reduced

A second major source of leakage of drinking water is from pipework inside of buildings. In order to minimise costs and disruption to building occupants, renovation work or replacement of pipework should take place at the same time as thermal remediation of buildings (see Action B.1). Smart meters incorporating leak detection systems should be installed at the same time.

The capital expenditure required is estimated at **€10-20 million** but this is heavily dependent on how much work can be done in tandem with other building remediation activities. Operational costs will be reduced because of the lower costs for water supply and the reduction in damage to buildings. Funding for buildings remediation is expected from IFIs and donors and some of this can be used for renovation of internal water pipe work. Implementation will mainly be the responsibility of building owners and their contractors.



Action W.5 – Installation of water meters in residential blocks

CAPEX: €1 million

OPEX: € 1 million

Around 93% of private flats and households, as well as all commercial and industrial enterprises, have water meters installed but there is no water metering at the entrance to communal residential building blocks. Water consumption per capita is around 25% higher where there is no meter. LvivVodokanal has already started on installing the additional meters in communal residential blocks and individual apartments.



Tariffs for water supply are set by a National Commission but need to be around three times higher to cover the real cost of operating and maintaining the network. The shortfall is made up from the City budget. Complete metering of all consumers would allow accurate charging for water, though the tariff rates would need to be increased if the full costs are to be covered. Lower water consumption would also reduce the load on the WWTP.

Once this project is complete we will launch a publicity/information campaign on actions to reduce water consumption. We will also need to upgrade the maintenance facility for meters as they need to be tested and calibrated every five years.

The capital expenditure for the remaining meters is around **€1 million**. Operating costs for maintenance of the meters is estimated at €200,000 per year, or **€1 million** over the GCAP timescale. This will come via Vodokanal from the City budget.

Action W.6 – Separate rainwater drainage system from the City sewerage system

CAPEX: €10-20 million

OPEX: Reduced

Implementing this Action would be very difficult in the built-up areas of the City as it would require extensive excavation of roads and pavements. Separate systems already exist in three districts of the City and are planned for the new industrial zone at Syhnyvka. It should be possible to separate the rainwater and sewerage water systems during reconstruction and certainly in new buildings and land development. As part of construction permits for new buildings and major refurbishments it will be mandatory to include Sustainable Urban Drainage Systems (SUDS) which would slow the release of rainwater into the drainage systems. Some of the collected rainwater could be used in City parks and gardens. This would ease the pressure on the WWTP and reduce localised flooding, thus contributing to our activities on Resilience.

Capital expenditure if restricted to new developments and major refurbishments is likely to be **€10-20 million**. Operating costs would be reduced because of the lower loads on the WWTP and the reduced costs of dealing with the aftermath of localised flooding.

Vodokanal would be responsible for overseeing the work required, working in close cooperation with contractors for the improvement schemes. City Hall and the National Government will need to be involved in drawing up regulations for SUDS.



7 Strategic Objective 5 - Proactive and informed municipal government leadership in energy efficiency and use of renewable energy sources

We recognise that the City can demonstrate leadership in energy efficiency and the use of renewables in a number of sectors. The actions relating directly to Buildings and Industry are described separately under Strategic Objectives 6 and 8 below. The actions under Strategic Objective 5 therefore concentrate on the public services of street lighting and district heating.

These are:

GCAP Actions	
E.1	Modernisation of Street Lighting to LED Standards
E.2	Insulation or replacement of DH distribution network plus modernisation of boiler houses, possibly including cogeneration
E.3	Convert district heating boiler plants to biomass firing

Table 10.1 below shows for each Action the Mid-term Targets, the organisations responsible for implementation, the timescale, estimated CAPEX, estimated OPEX and potential funding sources. Short descriptions of each Action follow the table and further details are provided in Annex 3.

Table 7.1 - Green City Actions, Mid-term Targets, Timescales, Costings and Funding Sources for Strategic Objective 5

No	Green City Action	Mid-term Targets (2028)	Implementing Body	Timescale						CAPEX €	OPEX €	Potential Funding Sources
				2020	2021	2022	2023	2024	2025+			
E.1	Modernisation of Street Lighting to LED Standards	70% of street lighting converted to LEDs	City Hall (Housing & Infrastructure Dept)							20 million	Reduced	City Budget; IFIs & Donors; Private Sector
E.2	Insulation or replacement of DH distribution network	1. 30% of DH substations and pipework re-insulated or replaced 2. 30% of heat exchanger stations in the buildings modernised 2. 60% of boiler houses refurbished (including some with CHP)	District Heating Companies; City Hall (Finance Dept)							35 million	5 million	City Budget; IFIs & Donors
E.3	Convert district heating boiler plants to biomass firing	10% of non-CHP boilers converted to biomass	District Heating Companies; City Hall (Finance Dept)							60 million	2 million	City Budget; IFIs & Donors

7.1 Summary of Selected Actions

The following paragraphs provide more details of each Action

Action E.1 – Modernisation of Street Lighting to LED Standards

CAPEX: €20 million

OPEX: Significantly reduced

Converting street lighting to LEDs is now well established as an effective energy saving measure across most European countries. Not only can it save around 40-60% of electricity consumption, it significantly reduces maintenance costs and also reduces light pollution (because it is more directional) and provides a strong visual message to citizens on energy efficiency in action. There are around 30,000 street lights to be modernised in Lviv. The pilot project currently under implementation by the City assumes modernisation of 3-5% (900 – 1,500 pcs) lighting installations.

Modernisation of street lighting is ideally suited to the ESCO concept because of the highly predictable level of savings or it could also be a PPP project (public-private partnership). These financing routes will be explored by the City once the appropriate regulations and contractual terms are in place.

The capital costs for replacing all of the street lighting in the City (including some lighting columns) is estimated at **€20 million**. Operating costs would be significantly reduced for the reasons mentioned above and the simple payback should be in the region of 2-3 years. Financing could come from the City budget, the IFIs and potentially from the private sector through an ESCO mechanism. Responsibility for implementing the project lies with the Housing and Infrastructure Dept. at City Hall.

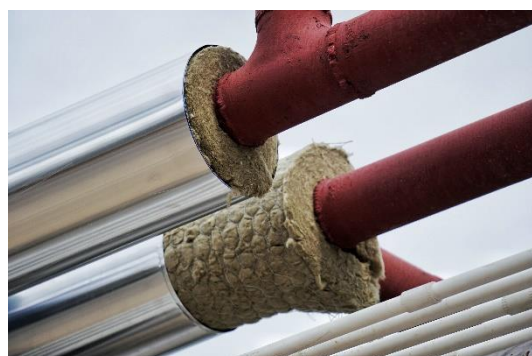


Action E.2 – Insulation or replacement of DH distribution network

CAPEX: €35 million

OPEX: €5 million

Modernisation of the DH network and boiler houses will be a long and expensive task, probably extending well beyond the GCAP timescale of 2025 as there are 1,800 heating points and more than 450 km of pipelines within the two City district heating networks. The main responsibility for improvements lies with the DH companies LvivTeploenergo and ZalyznychneTeploenergo but they will need to work in close cooperation with the City. Some work has already started on the installation of individual sub-stations, network replacement with pre-insulated pipes, modernisation of boilers and control systems, and new gas engine units for CHP. This type of



investment project needs first to have a general strategy document to identify the goals, the actions needed to achieve these goals and all of the other critical elements such as financing. In addition, studies on the economic effectiveness of CHP need to be undertaken. As demand is falling it may be more economic to close down some sections of the network and to heat the building with individual boilers. Discussions will continue with the IFIs on the potential for further financing for DH improvements.

The capital expenditure within the GCAP 5-year timeframe is expected to be **€35 million**. Operational costs for ongoing maintenance of the upgraded systems is expected to be €1 million per year, or **€5 million** over the GCAP timescale. Finance is expected to come from the City budget and from IFIs and donors. The DH companies will be responsible for ongoing implementation of the project while City Hall will be in charge of negotiations with the IFIs.

Alongside these improvements we will also consider the introduction of low carbon sources such as large-scale heat pumps and centralised solar thermal into the DH systems. Thermal rehabilitation of buildings (Actions B.1 to B.4) will also allow the operating temperature to gradually be reduced, leading to lower heat losses in the system. The use of 'smart' metering, heat cost allocators and individual apartment metering (Action B.5) will also lead to reduced consumption and operating costs of DH in the City.

Action E.3 – Convert district heating boiler plants to biomass firing

CAPEX: €60 million

OPEX: €2 million



This action should be carried out in parallel with Action E.2. Biomass firing (wood chip or pellets) should be considered for the DH boilers that are not converted to CHP. CHP could technically be used with biomass but it would involve steam cycle generation and would not be economic at this scale. For those boilers that are not being converted to CHP, the economic case for replacement biomass boilers should be considered. There is a current proposal to replace one gas boiler (25MW) with biomass firing. It will also be necessary to maintain (and even expand) the DH distribution network and negotiate a secure supply of wood chip or pellets from reasonably local sources (ideally within the Lviv Oblast).

BIOMASS

This Action would demonstrate the City's commitment to make a transition to 100 % renewable energy sources in the city's energy balance by 2050.

The capital cost within the GCAP timescale is estimated to be **€60 million** based on the cost of the current proposal. Operating costs for maintenance are estimated to be **€2 million**. Once again finance could come from the City budget and from IFIs and donors. The two DH companies would be responsible for implementing the project with City Hall handling negotiations with the IFIs.

8 Strategic Objective 6 -

Develop pleasant, comfortable and functional buildings with maximum energy efficiency and minimum CO₂ emissions

The City's commitment to energy efficiency in public buildings is clear and similar effort is seen from the residential building owners. The Strategic Objective for the Buildings sector is that they provide pleasant, comfortable and functional spaces without wasting energy and focusing on CO₂ emissions minimisation.

Energy efficiency in buildings (public and residential) covers innovations applied to each area of building energy services in an integrated fashion, including urban renewable systems, building fabric, lighting, heating, ventilation and air conditioning technologies. Success will require a defined policy and measures that are implemented efficiently and consistently.

There is a consolidated register of municipal/public buildings which includes data about energy performance (including energy consumption) and energy bills in buildings, the condition of building structures, heating/cooling systems, building areas, building project design, etc. However, similar information and awareness about energy performance of residential buildings is lacking. Residents need simple access to understandable, reliable information, as well as consistent engagement with qualified service providers.

The actions under Strategic Objective 6 therefore concentrate on improvement of energy efficiency in buildings, technical and financial tools and schemes to fund improvements. These are:

GCAP Actions

B.1	Thermal rehabilitation of public buildings including insulation, windows, boilers, control systems and small-scale renewables;
B.2	Introduction of advanced technical and environmental requirements for new construction and major renovations of public buildings
B.3	Improvement programme aimed specifically at public buildings, using the Municipal EPC/ESCO mechanism
B.4	Wider use of the EPC/ESCO mechanism for financing and implementing energy efficiency improvements
B.5	Use of 'Smart' metering and data sharing
B.6	Skills/business development programme for building insulation and small scale renewable energy technologies installers and advisors

Actions B.1, B.2 and B.3 are closely linked and together formulate a comprehensive Action in public buildings. Actions B.4, B.5 and B.6 spread the activities wider to all types of buildings in the City.

Table 11.1 below shows for each Action the Mid-term Targets, the organisations responsible for implementation, the timescale, estimated CAPEX, estimated OPEX and potential funding sources. Short descriptions of each Action follow the table and further details are provided in Annex 3.

Table 8.1 - Green City Actions, Mid-term Targets, Timescales, Costings and Funding Sources for Strategic Objective 6

No	Green City Action	Mid-term Targets (2028)	Implementing Body	Timescale						CAPEX €	OPEX €	Potential Funding Sources
				2020	2021	2022	2023	2024	2025+			
B.1	Thermal rehabilitation of public buildings including insulation, windows, boilers, control systems and small-scale renewables.	Public building renovation rate to be 3% of the floor area annually.	City Hall (Dept. of Housing & Infrastructure)							20 million	Reduced	City Budget; IFIs & Donors
B.2	Introduction of minimal advanced technical and environmental requirements for new construction and major renovations of public buildings.	New regulations in place	City Hall (Dept. of Housing & Infrastructure)							Zero	€500,000	City Budget; National Government
B.3	Improvement programme aimed specifically at public buildings, using the Municipal EPC/ESCO mechanism.	EPC/ESCO scheme used in 50% of public buildings	City Hall (Dept. of Housing & Infrastructure)							Included in B.1	Reduced	City Budget; IFIs & Donors
B.4	Wider use of the EPC/ESCO mechanism for financing and implementing energy efficiency improvements.	Residential building renovation rate to be 3% of the floor area annually.	City Hall; ESCOs and Building Owners							50 million	Zero	Private Sector
B.5	Use of 'Smart' metering and data sharing.	Smart metering included in all new buildings and major refurbishments	Utility Companies; Building Owners							30 million	Reduced	City Budget and Private Sector (Utility Companies)
B.6	Skills/business development programme for building insulation and small scale renewable energy technologies installers and advisors.	All professionals involved in energy efficiency improvements fully trained.	City Hall & Business Support Organisations							Zero	1 million	City Budget; IFIs & Donors; Private Sector

8.1 Summary of Selected Actions

The following paragraphs provide more details of each Selected Action.

Action B.1 – Thermal rehabilitation of buildings

CAPEX: €20 million

OPEX: Reduced

The various elements of an energy efficiency retrofit will be performed as part of a whole building energy improvement plan. Improving energy efficiency of the existing buildings (public - schools, kindergartens, offices and residential) is essential not only for the achievement of energy savings, but also to meet our objectives on climate change. Rehabilitation projects within the public building sector consist mainly of:



- Significant improvements in wall, roof and floor insulation levels;
- Higher efficiency gas fired boilers (also applies when replacing boilers) in buildings not connected to DH;
- Independent time control of space heating zones and balancing of heating systems;
- Individual heat consumption measurement systems;
- New double-glazed windows;
- New radiators;
- Modernisation of internal lighting systems.

The refurbishments will also include small-scale renewables such as solar thermal, solar PV and heat pumps.

Energy audits will provide building owners with a basis for identifying appropriate options for energy efficient retrofit plans prior to making any improvements. Where a number of phased upgrades are planned, expert advice will be sought to coordinate these works.

All products, materials and systems used for renovation should be in conformity with relevant national building regulations, standards, Codes of Practice and product certification.

The estimated capital costs are **€20 million** over the GCAP timeline. We recognise that more needs to be spent but progress will be limited by the number of qualified companies able to implement the necessary works. Operational costs of the buildings will be reduced because of the energy savings and reduced maintenance. Some of the capital expenditure will come from the City budget but we will also be seeking further grants and loans from the IFIs and donors. The Department of Housing and Infrastructure will lead on this project.

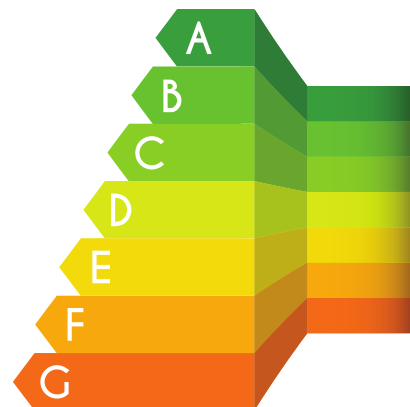
Action B.2 - Introduction of advanced technical and environmental requirements for new construction and major renovations of public buildings

CAPEX: Zero

OPEX: €500,000

The introduction of advanced technical and environmental requirements and standards will start with development of the requirements for specific characteristics of buildings and systems with the aim of including them into the Oblast Building Regulations and passing them through the approval procedure. The Action will include:

- Providing capacity building to the engineers, industry and control authorities about the new requirements for energy performance of buildings - calculation of energy use for space heating, cooling, ventilation, energy requirements for lighting, building automation and



building management systems, requirements of different EN and ISO standards, standardized reporting systems etc.

- Specification of advanced Energy Performance requirements for buildings or building units/elements with a view to achieving cost-optimal level requirements;
- Incorporating robust energy monitoring tools;
- Introducing an energy efficiency certification scheme.

We will liaise with National Government and the Lviv Oblast Authorities to implement this Action.

There is no capital expenditure associated with this Action. Operational costs for setting up the scheme, training of participants and monitoring progress are estimated to be €500,000 over the GCAP timescale. The Department of Housing and Infrastructure will coordinate the project with the assistance of the Energy Management Bureau.

Action B.3 - Improvement programme aimed specifically at public buildings, using the Municipal EPC/ESCO mechanism.

CAPEX: Included in B.1 above

OPEX: €1million

The action proposes the establishment of a public “Municipal ESCO” which will be created under the roof of the City administration (e.g. Energy Management Bureau). A “Municipal ESCO” approach for public buildings is an option for an energy services market concentrated under the roof of a publicly-owned entity (e.g. “LvivESCO”) which would maintain control over the whole project lifecycle.

The main project steps would be:

- 1) The City allocates funds to the LvivESCO public buildings energy saving program;
- 2) Local public authorities will apply for financing (IFIs, donors’ funds, State budget);
- 3) LvivESCO defines the project (initiation, evaluation, budgeting, energy performance contracting, etc.);
- 4) LvivESCO tenders for services provided by subcontractors;
- 5) The subcontractor provides the services under close monitoring of LvivESCO;
- 6) LvivESCO performs commissioning test and runs Measurement and Verification Plan (M&V Plan) of achieved savings.

The City would receive the revenue from the achieved energy savings of the beneficiary institution and repays the debt to the LvivESCO.

The Action could be initiated within three years, requiring effort in designing the system and changing the existing operational arrangements. It would provide opportunities for investments and allow for EPC contracts in the public sector, and would apply in particular to energy and thermal rehabilitation of schools, medical centers, etc.

There would be no additional capital expenditure over and above that in Action B.1 but Action B.3 would provide an alternative financing option for the building renovations. Operational costs for the ESCO are estimated at €1million over 5 years. This would come from the City budget but would be repaid through the energy savings. Assistance in setting up the scheme may be available from the international institutions.

Action B.4 - Wider use of the EPC/ESCO mechanism for financing and implementing energy efficiency improvements.

CAPEX: €50 million

OPEX: Zero



In this Action we will extend the ESCO principle to the private sector and all buildings in the City. Using advanced schemes for implementation of energy saving measures for residential buildings and incentives for urban renewables involving private funds (EPC/ESCO scheme) is a modern energy efficiency and building renovation approach that increase investments from private investors.

ESCOs can be expected to make a significant contribution provided that the regulatory framework in Ukraine is fully developed for the private building sector, including the first pilot projects. In an energy performance contracting (EPC) arrangement, the Energy Service Company (ESCO) is responsible for optimising building services systems and system operations in existing buildings across all branches of construction and maintenance. The (private sector) ESCO provides the capital for the projects and receives revenue from the energy savings over a defined period of time.

The capital costs will be dependent on how quickly the scheme can be established and the number of ESCOs entering the market. During the GCAP timescale the expenditure could be as high as **€50 million**, all of which would come from the private sector. Operating costs would be covered by the savings and no costs would fall on the City budget. The City will initiate the scheme but operation will depend on the ESCOs involved.

Action B.5 - Use of 'Smart' metering and data sharing

CAPEX: €30 million

OPEX: Reduced

Smart meters are tools used to manage and record heat and electricity consumption and the performance of buildings. The SMART meters are able to provide detailed and accurate analytics on heat and electrical usage in real-time or at predetermined intervals, all without human intervention. They will include heat cost allocators and individual apartment metering of district heating.

The energy saving potential of collecting and sharing a broad spectrum of information about buildings consumption includes the value of quick, accurate measurements and the elimination of estimates based on floor area. Having accurate and timely data encourages consumers to pay more attention to their energy usage and to take action to reduce it.



There are also advantages to the energy supplier. A smart meter can automatically send daily/monthly meter readings to utility supplier and the bill is paid accurately for the energy used. They can also highlight leakage in DH and water systems and enable fast remedial action to be taken, thus reducing operating costs.

The required CAPEX for the Smart metering programme is estimated at **€30 million** and would come from the utility companies (municipal and private). Their operating costs would be reduced because of the elimination of manual meter reading and quick highlighting of faults.

Action B.6 - Skills/business development programme

CAPEX: Zero

OPEX: €1 million

With this action it is intended to overcome barriers and skills gaps in various professions to provide a highly skilled workforce with relevant competencies in effective implementation of the measures in the building sector and installation of small scale/urban renewable energy technologies and the latest approaches to combat the heat island effects such as green facades and roofs.

The training programme will focus on three main areas - building envelope, building heating and cooling, renewable energy integration and efficient use of electricity. Curricula will be developed, along with training materials to support installers of systems and advisors. Training courses will be organised into short modules for each of the main target areas and will be targeted to different levels of the workforce.

The Action will promote cooperation between the training centres in the construction industry, national and local business associations, commercial and professional associations and other certification bodies of the construction sector. The Action will be initiated by the City but will rely on business support organisations for development and delivery of the training.

There is no capital expenditure associated with this Action but operational costs of **€1 million** are anticipated to design the courses and deliver them over the GCAP timescale. This will come mainly from the private sector but assistance may also be available from the international institutions.

9 Strategic Objective 7 -

Enhance green spaces and introduce new green elements throughout the City to improve living conditions for citizens and to increase the diversity of flora and fauna within urban limits.

Improving the quantity and quality of green spaces in the City has been a consistent theme in all of the stakeholder consultations. This includes the development of 'green corridors' that will not only enhance green spaces for recreation but will also encourage greater biodiversity. Other green elements would include urban gardens, green roofs, vertical greenery, domestic lawn and flower gardens, and brownfield restorations to open public spaces. To this we will add so-called 'blue spaces' such as ponds, small lakes and fountains all of which help to combat the 'heat island' effect in the City.

The proposed Actions to achieve this Strategic Objective are:

GCAP Actions	
L.1	Complete the Integrated Urban Development Plan (IUDP) and commence implementation
L.2	Upgrade and modernise the GIS system
L.3	Development of new 'Green Corridors' through the City and construction of 'Green City Line'
L.4	Development of support mechanisms for policy makers and relevant stakeholders including development of a Green Strategy.
L.5	Public awareness campaigns and expert training for stakeholders on the importance of urban land-use and biodiversity

Table 12.1 below shows for each Action the Mid-term Targets, the organisations responsible for implementation, the timescale, estimated CAPEX, estimated OPEX and potential funding sources. Short descriptions of each Action follow the table and further details are provided in Annex 3.

Table 9.1 - Green City Actions, Mid-term Targets, Timescales, Costings and Funding Sources for Strategic Objective 7

No	Green City Action	Mid-term Targets (2028)	Implementing Body	Timescale						CAPEX €	OPEX €	Potential Funding Sources
				2020	2021	2022	2023	2024	2025			
L.1	Complete the Integrated Urban Development Plan (IUDP) and commence implementation	IUDP adopted and implementation of measures ongoing and monitored	City Hall (Dept. of Urban Development) and City Institute							30 million	Zero	City Budget; IFIs & Donors
L.2	Upgrade and modernise the GIS system	GIS system upgraded and publicly available.	City Hall (Land Resources Office)							800,000	Unchanged	City Budget
L.3	Development of new 'Green Corridors' through the City and construction of 'Green City Line'	Develop at least 50 km of new green corridors through the City.	City Hall (Land Resources Office; Ecology Office); City Institute							12 million	200,000	City Budget; IFIs & Donors; Private Sector
L.4	Development of support mechanisms for policy makers and relevant stakeholders, including Development of a Green and Blue Strategy.	1. Surface area of green spaces increased by 20% of the current level 2. Increase the number of nesting sites for birds and bats by at least 50% compared to the current situation	City Hall (Land Resources Office; Ecology Office)							Zero	200,000	City Budget; IFIs & Donors; Private Sector
L.5	Public awareness campaigns and expert training for stakeholders on the importance of urban land-use and biodiversity	1. Public information campaigns designed and implemented 2. Appropriate training for stakeholders delivered	City Hall (Land Resources Office; Ecology Office)							Zero	500,000	City Budget; IFIs & Donors

9.1 Summary of Selected Actions

The following paragraphs provide more details of each Action.

Action L.1 – Complete the Integrated Urban Development Plan (IUDP) and commence implementation

CAPEX: €30 million

OPEX: Zero

The IUDP has been under development by the City Institute and the consultants GIZ since 2018 and is due to be completed in by the end of 2019. It will in effect be the new Master Plan for land use and development in Lviv. The IUDP will cover all necessary steps for sustainable and modern expansion of the City. Development of the Sustainable Urban Mobility Plan (SUMP) is also being led by the City Institute and is described under Strategic Objective 2. Although it applies mainly to the Transport sector it will also have significant impacts on Land Use.

Both of these concepts are key documents for future development of the City in terms of land-use and transport.

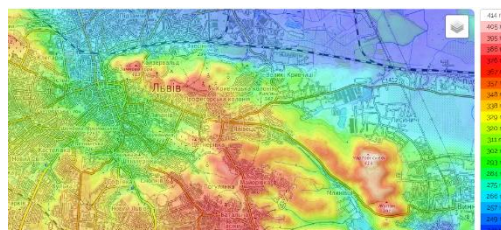
In the first two years of the GCAP timescale the IUDP will be completed and adopted and sources of finance will be explored. Thereafter an expenditure of €10 million per year for implementation is anticipated, i.e. **€30 million** over the remaining three years of the GCAP. Since the IUDP development is almost complete there will be no ongoing operating costs.

Action L.2 Upgrade and modernise the GIS system

CAPEX: €800,000

OPEX: Unchanged

Updating the GIS database should be a priority as it represents the appropriate tool for further development of the IUDP and its future amendments. An updated GIS database would provide the opportunity to see the system as a whole and to highlight environmental issues. We already have a GIS-based environmental map but it is obsolete and does not include the majority of environmental parameters, such as noise, fauna, flora, air pollution. The new GIS online database (Lviv Geoportal) would be publicly available free of charge and will contain the most important sectors which have an impact on the environment. It will include information on current and future land-use, air pollution, noise pollution, water, landscape, heat island effect and climate resilience, parking, waste collection points, smart waste bins, cycling routes, public transportation routes, building land price, engineering and geological information.



A good database covering the condition of urban trees would identify those most susceptible to damage during storms and so help with our Resilience actions.

The cost for upgrading the GIS software is **€800,000**. Operational costs will be unchanged but the system will be much improved.

Action L.3 - Development of new 'Green Corridors' through the City and construction of 'Green City Line'

CAPEX: €12 million

OPEX: €200,000

The City Institute together with a consultant team appointed by GIZ has started the development of project called 'Green City Line', which will connect the north and south parts of the City by green spaces and bicycle lanes. Green City Line will be a dynamic public space that addresses different targets that could share the same space - city commuters, urban recreation and suburban journeys. Green City Line will also be a route that could host entertainment programs and create a

pleasant environment for a weekend trip or walk. The green corridors would also help to reduce the 'heat island' effect in the City.



Development of 'smart-park' areas through the City will help citizens to understand the importance of urban greenery and could become a place for social gatherings. Also this would mitigate the problem of urban-sprawl, which is becoming more and prevalent in recent years.

Once the 'Green City Line' concept is completed in 2020, expenditure of €3 million per year is anticipated, i.e. **€12 million** over the remaining GCAP timescale. The cost of completing the concept (OPEX) will be around **€200,000**.

Action L.4 - Development of support mechanisms for policy makers and relevant stakeholders including development of a Green and Blue Strategy

CAPEX: Zero

OPEX: €200,000

We have already started to implement specific measures with regards to green and blue spaces and biodiversity in the City. These measures, which are also supported under this action include:

- Increasing the number and surface area of green spaces;
- Feasibility study into remediation of existing rivers and lakes and the creation of new ponds and lakes
- Ensuring compliance with cleanliness norms and requirements for the maintenance of green and blue facilities in the parks of the City;
- Preserving existing forests;
- Providing timely and qualified care of trees and shrubs;
- Ensuring a complete and systematic restoration of lawns and flower gardens;
- Reducing the threat of falling trees due to strong winds and age of trees;
- Reducing the damage to the trees from pests and diseases;
- Improving the biodiversity of birds, bats and insects,
- Invasive species reduction,
- Improving pets and homeless animal care.

However, it is necessary to create transparent conditions for NGOs and other organisations to take part in developing new ideas with regards to improvement of green and blue spaces biodiversity in the City. This requires the introduction and development of support mechanisms for policy makers and relevant stakeholders, including an introduction to potential sources of finance and development of new green programmes for environmental improvements.

We plan to develop guidelines for improvement of biodiversity in the city followed by a specific action plan and implementation process. This Green and Blue Strategy will better and more precisely define the steps necessary to increase the quality of green and blue spaces and species diversity in the City, especially within the urban limits. Part of the Green and Blue Strategy will be a feasibility study to analyse the possibility of creating an orbital forest around City.

The Green and Blue Strategy will also enhance cooperation mechanisms between the City and Oblast authorities in the creation of green spaces and new ponds and lakes.

There is no capital cost associated with this Action since all implementation costs for the improvements are included in other Actions. The operational cost for developing the guidelines is estimated as **€200,000**.

Action L.5 - Public awareness campaigns and expert training for stakeholders on the importance of urban land-use and biodiversity

CAPEX: Zero

OPEX: €500,000

In order to support and enhance the above actions in the Land Use and Biodiversity sectors it will be necessary to prepare public awareness campaigns (posters, seminars, events) and to organise training for appropriate stakeholders to achieve the optimum results.

There is no capital expenditure associated with this Action. Operational costs for developing the training materials and delivering awareness events over five years are estimated at **€500,000**.

10 Strategic Objective 8 -

Lviv businesses meet high levels of sustainability and resource efficiency

The assessment of the Business and Industry sector has shown that businesses have low levels of knowledge about environmental performance, standards or improvement measures, and there is little support available. It is also recognised that an inability to meet international environmental standards will affect the ability of businesses to compete in the international market. At the same time there is an opportunity to develop a 'cluster' of high-value businesses that could help to address some of these challenges, particularly in the recycling sector.

Actions proposed as part of this GCAP initiate industry support programmes. The primary target for the support will be SMEs in the potentially most polluting sectors such as chemicals, metals processing and food production. Improvements in industrial environmental performance will be also supported by measures in other sectors, particularly in Land Use and Waste. These measures are described under the appropriate Strategic Objectives.

To achieve Strategic Objective 8, we propose to introduce two main measures:

GCAP Actions	
I.1	Introduce a support programme for environmental improvements in industry and commerce
I.2	Develop a local recycling business 'cluster', to reprocess materials collected from the new separate collections bins, waste recycling centres and construction sites

Table 12.1 below shows for each Action the Mid-term Targets, the organisations responsible for implementation, the timescale, estimated CAPEX, estimated OPEX and potential funding sources. Short descriptions of each Action follow the table and further details are provided in Annex 3.

The City has limited direct influence over the Industry and Business sectors so we will work closely with business support organisations to deliver this Strategic Objective.

Table 10.1 - Green City Actions, Mid-term Targets, Timescales, Costings and Funding Sources for Strategic Objective 8

No	Green City Action	Mid-term Targets (2028)	Implementing Body	Timescale						CAPEX €	OPEX €	Potential Funding Sources
				2020	2021	2022	2023	2024	2025+			
I.1	Introduce a support programme for environmental improvements in industry and commerce	1. 200 businesses have been supported to reduce their environmental impacts and report on performance. 2. 50 businesses have gained ISO 14001 or 50001 certification or EMAS registration	Business Support Organisations							Zero	€1 million	City Budget; IFIs & Donors; Private Sector
I.2	Develop a local recycling business 'cluster', to reprocess materials collected from the new separate collections bins, waste recycling centres and construction sites.	1. 25% of waste is recycled locally 2. 20 recycling businesses established	City Hall (Investment Office); Business Support Organisations							€20 million	€200,000	Private Sector (CAPEX); City Budget (OPEX)

10.1 Summary of Selected Actions

The following paragraphs provide more details of each Action.

Action I.1 – Introduce a support programme for environmental improvements in industry and commerce

CAPEX: Zero

OPEX: €1 million

Action I.1 will include providing assistance to reduce the environmental impact of businesses through improvements in resource efficiency (raw materials, energy, waste, effluent) and the achievement of recognised international standards such as ISO 14001, ISO 50001 or EMAS. It will also introduce “Green Business” awards for the best performing businesses and develop an information programme of case studies and ‘success stories’ to encourage replication of the use of new technologies, ‘green’ procurement and good concepts for environmental improvements. The programme will be undertaken in partnership with existing business support organisations such as the Centre for Cleaner Production, Business Club Ukraine and the British-Ukrainian Chamber of Commerce (BUCC) and may need to extend wider than the City boundaries to include the Lviv Oblast. The information programme will include events (workshops, seminars, training courses) and regular bulletins on case studies, success stories and “How To” guides. This programme will supplement the one-to one support (e.g. audits, implementation assistance) provided by the Business Support Organisations.



There is no capital expenditure associated with the Action. Operational costs for developing the programme and delivering it over four years is expected to be **€1 million**. The City Investment office will liaise with the business support organisations on both development and delivery. Financial support is anticipated from the international institutions.

Action I.2 – Develop a local recycling business ‘cluster’, to reprocess materials collected from the new separate collections bins, waste recycling centres and construction sites.

CAPEX: €20 million

OPEX: €200,000

This Action will aim to encourage local recycling businesses as a starting point to developing a wider environmental business ‘cluster’ in Lviv. This is in line with our strategy to develop high value businesses to the City that incorporate the latest technologies and contribute to improving our environmental performance.

As described under Strategic Objective 3, the City is introducing new waste management practices including separate materials collection, two waste collection points and building an MBT plant. These will result in significant quantities of materials such as glass, paper & card, plastics, green waste, electrical and electronic equipment (WEEE), and items such as furniture and mattresses being collected. There will also be large amounts of construction and demolition (C&D) waste generated as a result of the reconstruction work happening in the City. All of these materials will

need to be recycled or reprocessed into a state where they can find a ready market. Some small recycling operations already exist in the City and their activities could be expanded into greater volumes and/or other materials.



For some materials (e.g. packaging) it may be necessary to wait for the introduction of Extended Producer Responsibility (EPR) legislation, which is currently under discussion at a national level. EPR will produce a revenue stream that could be used to provide subsidies to the recycling sector in order to make the businesses economically viable. However, for materials such as C&D waste and WEEE there is a ready market for the products so these businesses should be self-sustaining. Recycling these materials is also relatively non-controversial since they produce no odours so businesses can be sited on existing business parks or brownfield sites. For C&D waste there is a close synergy with ongoing new construction in the City so this sector would be a good place to start with development of the recycling sector.

It is a requirement of the National Waste Management Strategy to 2030 that all waste materials such be recycled as close as possible to the source, i.e. within the Lviv Oblast or at least in Western Ukraine. This also makes economic sense as such wastes are expensive to transport over long distances and recycling locally creates new job opportunities.

There are clear links with the Solid Waste and Land Use sectors in this Industry measure.

The capital cost for establishing the new recycling businesses is estimated to be **€20 million**, all of which will come from the private sector. Operational costs to set up and support the programme are expected to be **€200,000** from the City budget via the Investment Office

11 Implications for City Resources

We are conscious that the above package of measures represents a big challenge for the City in terms of both financial and other resources.

11.1 Financial Resources

In **Financial** terms the overall capital requirements and operational costs of the GCAP measures are summarised in the table below, which also indicates potential sources of funding and approximate amounts for each Strategic Objective and sector.

Table 11.1 - Estimated Capital and Operational Requirements of GCAP Actions

Strategic Objective	Main Sector	Capital Costs (€ million)	Operational Costs (€ million)	Potential Funding Sources (€ million)		
				City Budget	IFIs & Donors	Private Sector
S0.1	Air Quality	1	1.0	1		
S0.2	Transport	107	1.4	7	100	
S0.3	Solid Waste	78	17.8	4	62	12
S0.4	Water	190	Reduced	10	160	20
S0.5	Energy	115	7.0		115	
S0.6	Buildings	100	1.5	5	30	65
S0.7	Land Use & Biodiversity	43	0.9	10	20	13
S0.8	Industry & Business	20	1.2			20
Resilience	All	0	0.1			
All	Ecology Office	0	0.1			
	TOTALS	654	31	37	487	130

Further details of costings for each Sector are provided below.

Air Quality

We will require €1 million for the purchase and implementation of the new air monitoring system. Operating costs are estimated to be €200,000 per year, or €1 million over the GCAP timescale. This funding will come from the City budget.

Transport

In the Transport sector, one major cost (around €100 million) is for the purchase of new trams, buses and trolley buses to improve efficiency and reduce emissions. We have already agreed a loan of €48 million from EBRD to replace the tranche of trams and buses and we will seek further loans from EBRD and other international bodies for the remainder as our borrowing capacity allows. Additional expenditure of around €5 million is required for developing new cycleways and walking routes. Again we will seek support from the IFIs for this. We will also require around €2 million for completion of the e-ticketing project.

OPEX costs include €200,000 each for feasibility studies on extending the tram and trolley bus network and for the new traffic management system, plus a further €1 million over five years for maintenance of the cycleways and walking routes. Hence the OPEX should be covered from the City budget.

Solid Waste

Actions in the Solid Waste sector will require CAPEX of €78 million. However €48 million for the projects to remediate the old landfill and build the MBT plant has already been secured from EBRD and other international institutions and further funding for the new landfill site of €14 million has been provisionally agreed. Of the remaining €16 million around €12 million will come from the private sector leaving some €4 million to be funded directly from the City Budget.

Operational costs of around €18 million for the MBT and composting plants, the new waste collection systems and recycling centres, and the awareness campaigns will be split between the private sector and the City budget. Some of these costs will be offset through revenues from the 'pay as you throw' charging mechanism.

Water

The Water and Wastewater sector is where we need the most investment (around €190 million) over the next five years following almost zero investment for the last 30-40 years. Loans for €60 million have already been agreed for reconstructing the WWTP and building a biogas CHP plant. Revenues from electricity generation will help to pay for these loans.

Replacement and cleaning of the water supply network will cost a minimum of €100 million over 5 years. We will seek further financing from the international institutions to support this project but full implementation will only be possible if water charging tariffs are increased to an economic level and this will require the agreement of the national government. Reduced

leakage in the pipework will also help to offset the costs. A further €30 million will be required for remediating pipework inside buildings, completing the installation of water meters in residential blocks and separating rainwater drainage systems from the sewerage system in new developments. Around 60-70% of this €30 million will come from the private sector with the remainder from the City budget. Support from the IFIs may also be available.

OPEX in this sector will be significantly reduced from the current levels because of savings from improved efficiency of the WWTP, electricity generation from the CHP plant, reduced water leakage from distribution and buildings pipework, and lower expenditure on dealing with localised flooding.

Energy

Actions in the Energy sector require a total investment of €115 million. €20 million of this is for replacing street lighting with LEDs which should provide an excellent payback (2-3 years) and could be funded via an IFI loan (or possibly through an ESCO arrangement). Some work has already commenced on improvements to the district heating networks but we estimate that a further €35 million will be required over the next 5 years. Funding for this will be sought from EBRD and other international institutions. The largest investment in this sector (€60 million) is for converting DH boilers to biomass firing. This is not as high a priority in the short term but would contribute significantly to achieving our renewables targets.

Ongoing operational costs for the DH network and the biomass boilers are estimated at €7 million over the GCAP timescale. These costs would be offset by the significant reduction in energy and maintenance costs of the LED street lighting.

Buildings

In public buildings the largest expenditure (€20 million) is for thermal rehabilitation and the introduction of small-scale renewables for which we will seek further loans from EBRD and other IFIs. We recognise that more than this needs to be spent but the pace of implementation will be affected by the shortage of skilled companies and people to implement the necessary improvements. Part of the loan repayment will come from lower energy and maintenance costs in the buildings. In the residential sector we envisage that improvements in the buildings will require around €50 million but that this will come from the private sector via an ESCO mechanism. Installing 'smart' meters is likely to cost around €30 million, some of which will come from the private sector and the remainder from the City budget via the utility companies.

We will need some €1 million to develop and run the skills development programme but overall the OPEX in this sector will be reduced because of the significant energy savings.

Land Use & Biodiversity

In this sector we estimate that we will need to spend around €42 million on improving green spaces and establishing 'green corridors' through the City as envisaged in the IUDP. Some of this will come from the City budget but we will also seek loans from the international funders.

These will also be a contribution from the private sector where the improvements affect privately owned land. We will also require €800,000 for the upgraded GIS system.

For OPEX we will need around €900,000 over the GCAP timescale for development of a Green and Blue Strategy, the public awareness campaign and maintenance of the green corridors. This will come mainly from the City budget, though some assistance for the awareness campaigns may be available from international bodies.

Industry & Business

In the Industry sector capital expenditure of around €20 million will be required for setting up recycling businesses but all of this will come from the private sector.

For OPEX we will need to spend €1 million to develop and run the environmental support programmes, with the cost split between the City budget, IFIs and the private sector. We will also need €200,000 from the City budget to promote the sector via the Investment Office.

Resilience

The Actions required to improve our climate resilience are included in several of the other sectors, especially Water, Energy, Buildings and Land Use. No further separate CAPEX is therefore required in the GCAP.

We will need around €100,000 to develop the Climate Resilience Plan.

The total capital requirements of the actions within the GCAP timescale (5 years) is therefore around **€654 million**. Some €130 million of this will come from private sector partners and €37 million will be directly from the City budget, leaving around **€487 million** to be found from loans from international bodies. Around €130 million of these loans have already been agreed. Servicing a further €357 million of loans may not be possible in the next 5 years so in this case we will need to delay the implementation of some of the lower priority actions unless grants can be obtained from international donors or the national government. This longer timescale could apply for example to renovating or replacing the district heating and water supply networks. Raising the water and wastewater charges to an economic level would also help to pay for Actions in the water sector.

We will explore these alternative financing mechanisms before making a decision on which of the GCAP Actions to delay or implement over a longer timescale.

11.2 Other Resources

The main resource required to implement the GCAP apart from finance is people to plan, develop and implement the individual actions and to work with our partners. For some actions we will need to engage specialist assistance but in most cases our own staff should be able to handle the workload. The total operational cost of the actions from the City budget is estimated to be around **€30 million** over 5 years but this is spread across several City departments and so we are confident that implementing the GCAP is within our current capabilities.

MONITORING PROGRESS

12 Monitoring and Reporting

Monitoring has essentially two key goals: to inform the decision makers about the consequences of their actions and to inform the public about the progress of the City towards environmental performance. The main purpose of the Monitoring Plan (MP) is to establish how the actions included in the GCAP for each sector (transport, buildings, industry, energy, water, solid waste, land use/biodiversity, resilience) impact the quality of environmental assets: air quality, water bodies, drinking water, land/soil quality, water resources, green spaces, greenhouse gases (GHG) emissions, as well as the resilience to natural events such as flooding and heatwaves.

The MP therefore covers monitoring of the implementation of agreed actions and their progress towards targets and objectives, as well as of their likely impacts on the quality of the environment.

The main purpose of systematic monitoring is to inform the planning of actions as well as to provide information to the key stakeholders including EBRD and to the public. Information can also be used for information and education activities aiming at raising awareness on “green behaviour” and facilitating support for the implementation of “green” measures.

We have developed the MP for the period 2020 – 2028. It includes a results-based Progress Monitoring Plan and an Impact Monitoring Plan (both included as [Annex 6](#)). We will carry out a mid-term review (MTR) to assess progress against targets and the social and economic benefits arising from changes in the sectors.

12.1 Progress Monitoring Plan

The Progress Monitoring Plan (PMP) is based on the planned actions for the respective sectors. Our underlying assumption is that the short-term tasks will lead to the achievement of mid-term targets, which will contribute to achieving the strategic objectives of the associated sectors. Meeting the strategic objectives will contribute to the improvement of the quality of environmental assets.

We have prepared the PMP to distinguish between:

- Actions already under implementation;
- Planned Actions.

These Actions are discussed further in [Annex 3](#).

The timeline includes milestones for each activity. Mid-term targets, indicators and activities from relevant plans included in the GCAP actions (e.g. SUMP, IUDP) are reflected in the PMP. Awareness, stakeholder consultations and participation have been included as “cross cutting” measures.

The PMP will be used as the basis for preparing periodic progress reports. Activities under implementation and achieved milestones will be marked in a different colour to provide visual evidence of actual progress. Reports will cover the progress achieved in the implementation of the GCAP (during the reporting period and cumulative), explanation of variances between planned and actual progress, and plans for the next reporting period. Objectively verifiable indicators have been formulated for each milestone.

Responsibilities for gathering information on indicators, updating the PMP and reporting are summarised below. Overall responsibility for monitoring GCAP implementation progress will be with the City Institute, which is already playing a similar role in monitoring the SUMP and the IUDP.

Sector	Participating Offices
Coordination of Monitoring and Reporting	City Institute
Transport	Housing & Infrastructure (Transport Office)
Solid Waste	Waste Management
Water	Housing & Infrastructure
Energy	Housing & Infrastructure
Buildings	Housing & Infrastructure
Land Use & Biodiversity	Urban Development (Land Resources and Ecology Offices)
Industry	Investment & Projects Office
Resilience	Ecology Office
Financial Issues	Financial Office

12.2 Impact Monitoring Plan

We have prepared an Impact Monitoring Plan (IMP) comprising two parts:

- The first part links the Actions with environmental indicators. **Annex 6** differentiates for each action between significant, medium, minor and no measurable impacts. This will help to better assess the influences that specific actions are likely to have on changes in the environmental indicators.
- The second part of **Annex 6** includes the baseline for ‘State’ and ‘Pressure’ indicators likely to be influenced by the actions. Only indicators that are measured and baseline values are available have been included.

Some measurable changes in indicator values could occur and will be established after three years of GCAP implementation, i.e. at the end of 2023. Target savings and improvements related to measures should be evident by 2028, provided the implementation progresses as planned.

We acknowledge that external factors beyond our control will also influence the indicators' values. A measurement mechanism allowing sampling at "pressure locations" to measure changes likely due to the actions will be set up where feasible to improve attributability. Comparison with overall changes in the City will help to identify other possible pressure sectors/locations and design appropriate actions.

The main responsibility for compiling, analysing and interpreting information on indicators and preparing the mid-term and final reports lies with the City Institute supported by the relevant City Departments.

12.3 Mid-term Review

The Mid-term review (MTR) will establish progress made towards the targets for both the Progress Monitoring Plan and the Impact Monitoring Plan. Decision makers and external experts are recommended to participate in the MTR to further facilitate ownership of the GCAP and to discuss/agree upon/introduce possible modifications.

The MTR will rely mainly on secondary data for information of Monitoring Plan progress and changes in the quality of environmental assets, with verification of selected indicators. For the assessment of social and economic benefits and sector-specific improvements, mixed methods may be used and triangulated as appropriate. Data from quantitative surveys based on a representative sample of households stratified along key characteristics (such as gender, schoolchildren) would for example provide data on green behaviour or the support of, or opposition to individual measures. Qualitative methods could include a transect walk⁷, observations, key participant interviews, as well as group interviews and focus group discussions, case studies or process tracing.

12.4 Utilisation of Monitoring Information

The City will use the information among others to adjust planning and prioritisation of actions, for informing the EBRD and existing/potential partners in the environmental sector, for adjusting the environmental monitoring technologies, and for informing and motivating the public. New policy options may be identified to accelerate Green City development.

EBRD will incorporate the information and lessons learned into the process of choosing, preparing and appraising projects. The Bank will also use the information to evaluate its effectiveness in supporting the City's green development, and guide future discussions and cooperation with City officials.

⁷ A transect walk is a type of walk an evaluator might take around a community in order to obtain a representative observation of its people, surroundings, and resources. Transect walks are a kind of spatial data gathering tool. The transect walk is planned by drawing a "transect line" through a map of a community. The line should go through, or transect, all zones of the community in order to provide a representative view. The evaluator, accompanied by several community members, walks along the area represented by the transect line on the map. He or she talks to the community members while observing conditions, people, problems, and opportunities.

We have formulated the MP with emphasis on simplicity, clarity and efficient utilisation. Capacity building of key staff involved in the monitoring process will be part of the GCAP implementation. No additional staff are needed to carry out the MP at this stage, though some investment in IT may be required for efficient flow of information.

Monitoring of environmental indicators will rely as much as possible on existing technologies and procedures. Investments in new technologies and additional equipment that may be required will be compared with the additional benefit of improved information.

The budget for the MTR is estimated at about **€100,000**.

SUMMARY and CONCLUSIONS

13 Summary and Conclusions

The systematic application of the EBRD methodology for developing our Green City Action Plan has resulted in a set of actions that encompass all areas that have an impact on the City's environment. By prioritising these actions we have been able to develop a plan that will have the maximum impact on our environmental assets as well as producing other social and economic benefits for the City. Whilst the Plan is challenging, we believe that it will be possible to implement most of the actions over the next five years within the capacity of the City budget and other resources, though we may need to delay some actions or implement them over a longer timescale unless some grants can be obtained from the national government or international institutions. We also recognise that further actions will be necessary after this period if we are to achieve our long-term Vision for 2035.

In developing the GCAP we have carried out extensive consultation with a wide range of stakeholders so that the views of the City, its citizens, businesses and institutions have been fully taken into account. We recognise that we will need the help and cooperation of all of these groups as well as other partners and, in many cases, the assistance of international financial institutions and donors to provide some of the funding needed.

The Actions that we have developed through this process and that we intend to implement in each sector are summarised in the table below.

Table 13.1 - Summary of GCAP Actions

Air Quality
<ul style="list-style-type: none"> ○ Purchase and install a new air monitoring system
Transport
<ul style="list-style-type: none"> ○ Adoption of Sustainable Urban Mobility Plan ○ Completion of e-ticketing project ○ Purchase of new trams and trolley buses ○ Feasibility study for extension of the tram and trolley bus network ○ Feasibility study for traffic management system ○ Construction of pedestrian and cycling routes

Solid Waste

- Remediation of the old landfill
- Construction of the MBT plant
- Construction of a new landfill
- Improve primary infrastructure for separate waste collection
- Develop a network of official waste recycling centres
- Develop a system for composting of organic waste
- Introduce the “pay-as-you-throw” charging principle for residual waste
- Support educational and awareness raising activities

Water

- Reconstruction and renovation of the WWTP
- Construction of a biogas CHP plant at the WWTP
- Replacement or cleaning of water supply pipework and fittings
- Renovation of water pipework inside buildings
- Installation of water meters in residential blocks
- Separate rainwater drainage systems from sewerage systems in new developments

Energy

- Modernisation of street lighting to LEDs
- Insulation or replacement of DH distribution pipework
- Convert DH boilers to biomass firing

Buildings

- Thermal rehabilitation of public buildings
- Introduction of advanced technical and environmental standards in public buildings
- Improvement programme using a municipal ESCO mechanism
- Wider use of the ESCO mechanism for non-public buildings
- Use of ‘smart’ meters and data sharing
- Skills development programme for technology installers and advisors

Land Use & Biodiversity

- Commence implementation of the Integrated Urban Development Plan
- Upgrade and modernise the GIS system
- Development of ‘Green Corridors’ through the City
- Support mechanisms for policy makers and development of a ‘Green and Blue Strategy’
- Public awareness campaigns on land use and biodiversity

Industry & Business

- Environmental support programme for industry and businesses
- Develop a recycling sector to process collected waste materials

Resilience

- Development of a Climate Resilience Plan

The expanded Ecology Office will oversee all environmental issues whilst GCAP implementation will be monitored by the City Institute.

The Actions include a range of measures including:

- New strategies and plans;
- ‘Soft’ measures such as awareness raising and business support programmes;
- Investments in all sectors in new systems, plant & equipment and improved land use.

The total capital requirement of these Actions is estimated to be around **€574 million** over five years broken down by sector as follows:

Table 13.2 - Capital Expenditure Requirements

Sector	Estimated Capital Costs (€ million)
Air Quality	1
Transport	107
Solid Waste	78
Water	190
Energy	115
Buildings	100
Land Use & Biodiversity	43
Industry & Business	20
Resilience	Zero (additional)
TOTAL	654

The total capital requirements of the actions within the GCAP timescale (5 years) is therefore around **€654 million**. Some €130 million of this will come from private sector partners and €37 million will be directly from the City budget, leaving around **€487 million** to be found from loans from international bodies. Around €130 million of these loans have already been agreed. Servicing a further €357 million of loans may not be possible in the next 5 years so in this case we will need to delay the implementation of some of the lower priority actions unless grants can be obtained from international donors or the national government. This longer timescale could apply for example to renovating or replacing the district heating and water supply networks. Raising the water and wastewater charges to an economic level would also help to pay for Actions in the water sector.

We will explore these alternative financing mechanisms before making a decision on which of the GCAP Actions to delay or implement over a longer timescale.

The Actions will have a positive impact on our main areas of concern such as:

- Emissions to air (particularly PM_{2.5}, PM₁₀ and Total Suspended Particulates);
- Improving waste management and treatment;
- Improving wastewater quality;
- Reducing water leakage in the distribution network;
- Energy use in buildings;
- Increased use of renewable energy;
- Developing more and better quality green spaces in the City;
- Improving the environmental performance of our businesses;
- Improving the resilience of the City to natural events such as flooding and heatwaves.

We estimate that, taken together, the Actions will produce in CO₂ emissions savings of around **153,000 tonnes per year** and water savings of around **10.8 million m³ per year**.⁸ In addition the Actions will have significant positive impacts on economic growth, job creation, public health and safety, and improved access to public amenities and green spaces.

Realising the GCAP aims and objectives demands action in the short term across all sectors and we intend to commence implementation as soon as possible, and certainly by the beginning of 2020. We look forward to working with Lviv's many stakeholders to achieve the Vision set out in this **Green City Action Plan**.

⁸ Savings derived from Indicator Action Sheets Nos. 8 and 25 plus population statistics

Annexes

A1 – Previous Strategies & Plans

A2 – Indicator Summary Sheets

A3 – Action Summaries

A4 – Actions Map

A5 – Actions Costs and Impacts

A6 – Monitoring Plan / Impact Monitoring Plan

A7 – Estimated CO₂ & Water Savings

A8 – Contributors to the GCAP

Annex 1.1 – Summary of National Level Laws, Strategies and Plans

Table. A1.1.1 – Cross Sectoral Measures

Cross Sectoral Measures				
Name	Type	Author	Year	Summary Findings
On main principles (strategy) of state environmental policy of Ukraine until 2030	Draft Law	VRU, Register No. 8328 dated 26.04.2018	2018	<p>The purpose of the draft law is to review the main strategic objectives of the state environmental policy based on the reasons for the environmental problems of Ukraine and the financial capacity of the country to address them.</p> <p>The draft law shapes the vision of the environment that Ukraine should achieve in 2030 and identifies the following strategic goals by 2030:</p> <ul style="list-style-type: none"> - Formation in the society of environmental values and principles of sustainable consumption and production - Ensuring the sustainable development of natural resources potential of Ukraine - Ensuring the integration of environmental policy in the decision-making process on the socio-economic development of Ukraine - Reduction of ecological risks for ecosystems and population health to socially acceptable - Improvement and development of the state system of environmental management
On Energy Efficiency Fund	Law	VRU	2017	<p>The law defines the legal, economic and organisational principles for the establishment and operation of the Energy Efficiency Fund.</p> <p>The Law establishes that the Energy Efficiency Fund is formed to support energy efficiency initiatives, the introduction of instruments of stimulation and support to improve energy efficiency and energy saving.</p> <p>The purpose of the Fund's activity is to achieve an average level of energy consumption savings in the aggregate of all projects funded by the Fund or jointly with the Fund, at least at 20 percent level.</p> <p>The Fund is a legal entity, the founder of which is the Cabinet of Ministers of Ukraine.</p> <p>One of the sources of funding of the Fund could be financial contributions and assistance in the form of target grants from governments, agencies and institutions of foreign countries, as well as from international financial organizations.</p> <p>In particular, the Fund's financial functions include: provision of partial reimbursement of energy efficiency measures, grants to legal entities and individuals directly or through partner banks (to cover part of the loan, interest rate or part thereof, etc.); development and implementation of programs for the partial reimbursement of the cost of economically feasible energy efficiency measures; development of financial eligibility criteria for partner banks involved in the implementation of programs and implementation of the Fund's projects.</p> <p>The technical functions of the Fund include, in particular: the introduction of best practices and experience in the field of energy efficiency, technical training in the field of energy efficiency; providing applicants with advice on the possible</p>

				<p>improvement of the technical component of their applications for partial reimbursement; technical evaluation of energy efficiency projects; development of technical eligibility criteria for partner banks and other intermediaries involved in the implementation of projects funded by the Fund; development of recommendations for the selection of construction companies and other contractors for beneficiaries of the Fund's financing; developing a list of energy efficiency measures for which the Fund may provide partial reimbursement; creation and maintenance of databases on projects implemented within the framework of the Fund's programs, their effectiveness, as well as any other databases required by the Fund.</p> <p>The Law defines measures on energy efficiency, the cost of which may be partially reimbursed by the Fund, which include, in particular: the implementation of thermo-modernization; introduction of effective monitoring and control systems; installing high-performance heating and cooling systems and equipment, and replacing existing systems and equipment by more efficient. The list of these measures could be extended by the Fund's Supervisory Board and made public on its official website.</p>
Concept of implementation of state policy in field of climate change until 2030	Concept	Resolution of CMU dated 7 December 2016 p. No. 932-p	2018	<p>The objective of the Concept is to improve the state policy in the field of climate change in order to achieve sustainable development of the state, create legal and institutional prerequisites for the gradual transition to low carbon development under the conditions of economic, energy and environmental safety and increase of the welfare of citizens.</p> <p>The main directions of the Concept's implementation are: strengthening institutional capacity regarding formulating and ensuring implementation of state policy in the field of climate change; preventing climate change through reduction of anthropogenic emissions and increasing the absorption of greenhouse gases and ensuring a gradual transition to low carbon development of the state; adaptation to climate change, increased resilience and reduced risk associated with climate change.</p> <p>Among the measures envisaged by the Concept, the following should be noted: reduction of energy intensity of the gross domestic product in accordance with the Strategy for Sustainable Development "Ukraine 2020" approved by the Decree of the President of Ukraine dated January 12, 2015 No. 5; increase of the share of energy produced from renewable energy sources in the overall structure of the state's energy consumption in accordance with the National Renewable Energy Action Plan for the period up to 2020; the introduction of market and non-market mechanisms aimed at reducing anthropogenic emissions or increasing the absorption of greenhouse gases; implementation, together with neighbouring partner countries, of cross-border projects for adaptation to climate change; to ensure that the energy intensity of the gross domestic product is reduced by 20 percent by the end of 2020; ensure achievement in 2020 of the target - the national indicative energy saving target of 9 percent of the average end-of-year energy consumption indicator; ensure achievement by 2020 of the share of energy produced from renewable energy sources in the general structure of energy consumption of the state at the level of 11 percent; to strengthen the capacity of local executive bodies and local government bodies to develop and implement measures to prevent and adapt to climate change.</p> <p>The Concept states that the amount of financing, material and technical resources and labor resources necessary for its implementation will be determined annually, taking into account the capacity of state and local budgets, the amount of international technical assistance</p>

Table A1.1.2 – Air & Transport

Air				
Name	Type	Author	Year	Summary Findings
National report. Sustainable Development Goals: Ukraine	Strategy	CMU, UNDP	2017	<p>The National Report identifies indicators of the Sustainable Development Goals (SDGs) by 2030 adapted to the Ukrainian conditions.</p> <p>In order to implement SDG 11 "Sustainable development of cities and communities", this document provides for the following indicators: the total amount of pollutant emissions from stationary sources in the atmosphere in 2020 should be 95%, in 2025 - 90%, in 2030 - 80% comparatively with 2015; the number of cities in which the average daily concentrations of the main pollutants in the air exceed the average daily maximum allowable concentrations, in 2020 should be 22, 2025 - 20, in 2030 - 15 units (at the time of the report's preparation - 23 cities)</p>
Transport				
Name	Type	Author	Year	Summary Findings
Air Code of Ukraine	Law	VRU	2011, Redaction of 2018	<p>The Air Code of Ukraine sets the legal framework for aviation activities and airspace use.</p> <p>In particular, the Law stipulates that airports that are in communal ownership are not subject to alienation, sale, privatization, exchange, pledging. At the same time, they can be transferred to concession, lease, management, and also be the subject of other agreements concluded in accordance with the legislation of Ukraine. An essential condition for such agreements is the prohibition of changing the intended purpose of the aerodrome facilities that ensure its main production activity. Construction and reconstruction of airports, civil airfields may be carried out in accordance with the established procedure at the expense of the State Budget of Ukraine, local budgets, own funds of air companies, as well as at the expense of other sources not prohibited by law.</p> <p>In accordance with the Law the powers of local executive authorities in this area include, in particular, the following: compliance with the requirements for the use of the aerodrome territory; ensuring in the framework of their powers of construction, reconstruction, improvement and exploitation of access roads to airports; organization of improvement of airport land plots; organization of regular public transport traffic between airports and settlements; ensuring of electric communications between airports and settlements.</p> <p>The law also sets requirements to protection of the population from harmful influence of emissions of pollutants, noise, electromagnetic radiation, the risk of aviation events during the exploitation of airports.</p>
On urban electric transport	Law	VRU	2004 (2017)	<p>The law defines the legal, organizational and socio-economic principles of the operation of urban el. transport of general use.</p> <p>In particular, this Law stipulates that local governments develop local programs for the development of urban electric transport of general use and provide for their implementation, set tariffs for trips, organize passenger transportation and control it; establish the procedure for collecting fares; implement measures on the development, improvement and</p>

				<p>equipment of the route network; introduce an automated system of registration of payment of fares, establish the order of its functioning.</p> <p>The renewal of rolling stock, as well as other objects of urban electric transport, is carried out at the expense of state and local budgets and other sources. Financing of rolling stock renewal from the state budget is provided subject to the allocation of appropriate funds from local budgets.</p>
On motorways	Law	VRU	2005 (2019)	<p>The law regulates the functioning and development of motorways.</p> <p>This Law defines the streets and roads of cities and other settlements as a separate category of road network. Streets and roads of cities and other settlements are managed by the local governments and are in communal property. Management of the operation and development of streets and roads of cities and other settlements is carried out by the relevant local governments to which competence they belong.</p> <p>The responsibilities of local governments in the field of motorways are regulated by the Law, they are, in particular: ensuring the continuous, safe, economic and convenient conditions for traffic of vehicles and pedestrians; organization of construction, reconstruction, repair and maintenance of streets and roads of cities; ensuring compliance with norms of environmental legislation in the process of construction, reconstruction, repair and maintenance of streets and roads of cities; performance of capital and current repair of streets and roads at the expense of funds of corresponding local budgets (as co-financing on a contractual basis).</p> <p>Local governments are responsible for reimbursing of loses of users of streets and roads of cities and other settlements that have arisen due to their unsatisfactory condition.</p> <p>Financing of construction, reconstruction, repair and maintenance of streets and roads of cities is carried out at the expense of budgets of cities, as well as other sources of financing, determined by the legislation. The allocation of funds for the construction, reconstruction, repair and maintenance of streets and roads of cities is carried out by the relevant CBOs in accordance with the priorities defined by the state programs and perspective plans for the development of the transport system of cities and other settlements, taking into account the actual state of the street-road network.</p> <p>The law also establishes requirements for environmental protection. In particular, it provides for the obligatory reclamation of land plots temporarily employed in the process of construction, reconstruction and repair of highways; the need to provide in the design decisions on the construction, reconstruction, repair of motor roads measures to minimize harmful emissions into the atmosphere by means of transport; a ban on the operation of road vehicles, in which harmful emissions to the atmosphere exceed the permissible standards, as well as road construction materials that pollute the air and water resources beyond the permissible limits; a ban on felling trees that is not related to road safety.</p> <p>Financing of construction, reconstruction, repair and maintenance of streets and roads of cities is carried out at the expense of budgets of cities, as well as other sources of financing, determined by the legislation. The allocation of funds for the construction, reconstruction, repair and maintenance of streets and roads of cities is carried out by the relevant local governments in accordance with the priorities defined by the state programs and perspective plans for the development of the transport system of cities and other settlements, taking into account the actual state of the street-road network.</p>

				<p>The law also sets requirements for environmental protection. In particular, it provides for the obligatory reclamation of land plots temporarily employed in the process of construction, reconstruction and repair of motorways; the necessity to ensure in the design decisions on the construction, reconstruction, repair of motorways of measures to minimize harmful emissions into the atmosphere by means of transport; a ban on the operation of road vehicles, in which harmful emissions to the atmosphere that exceed the permissible standards, as well as road construction materials that pollute the air and water resources beyond the permissible limits; a ban on felling trees that is not related to road safety.</p>
On railway transport	Law	VRU	1996 (2018)	<p>The law stipulates the competence of local governments in the field of railway transport, which, in particular, includes: control over the work of rail suburban passenger transport and railway stations; agreement of tariffs in suburban traffic; approval of the issue of railway stop points; closure of railway stations for servicing passengers, carriage crossings through railways.</p> <p>The local governments also have the responsibility to organize the implementation of works on the improvement of railway stations land plots, the construction and arrangement of entrances to railway stations, provision of their telephone communication and transport links with settlements by the location of stations, prevention of offenses in railway transport.</p>
On traffic	Law	VRU	1993 (2019)	<p>The law regulates public relations in the field of traffic and its safety.</p> <p>The competence of city councils and their executive bodies, in the field of traffic, this Law, in particular, includes: development, approval and implementation of urban road traffic development programs and traffic safety; the formation of city funds, including extrabudgetary, for financing programs and individual measures aimed at the development of traffic and its safety; organization of traffic on the territory of a city in accordance with relevant general plans, projects of detailed planning and building of settlements; the introduction of automated traffic control systems, integrated transport schemes and road traffic management schemes with environmentally safe conditions; organization of construction, reconstruction, repair and maintenance of motorways, streets, railway crossings; making decisions on the placement, equipment and functioning of parking areas for vehicles and taxis on the streets and roads of cities; organization of the system of measures on medical ensuring of traffic safety and control over its implementation; imposing within the competence of administrative penalties for violation of legislation in the field of traffic and its safety; management of work on the collection of taxes, duties and other mandatory payments in the field of traffic; introduction of an automated control system for payment of the cost of parking services within the city, approval of technical requirements for this system; definition of ways to stimulate the use of electric vehicles and other environmental modes of transport.</p> <p>The law provides for that local governments are responsible for creating safe traffic conditions on the roads, streets and railroads under their jurisdiction. For this purpose, they within their competence carry out the preparation, approval and implementation of traffic safety programs. The development of these programs is based on a rational combination of territorial and sectoral planning, the formation of interconnected balanced indicators taking into account the socio-economic and environmental conditions of a particular region, the level of development of the road network, the situation with of accidents and other indicators of a unified system of state traffic accounting. Financing of the measures provided for by the programs, as well as other measures for ensuring road safety, is carried out at the expense of the state budget, deductions from ministries, other central executive bodies and associations, local budgets, extra budgetary funds and funds.</p>

National report. Sustainable Development Goals: Ukraine	Strategy	CMU, UNDP	2017	<p>The National Report identifies the Sustainable Development Goals adapted to the Ukrainian conditions by 2030.</p> <p>In order to implement SDG 9 "Industry, Innovation and Infrastructure" this document provides for the following indicators: the rate of deterioration of the main means of transport in 2020 should be 49%, in 2025 - 45%, in 2030 - 45% (at the time of the report preparation - 51.7%); the share of electric transport in interconnection in 2020 should be 65%, in 2025 - 70%, in 2030 - 75% (at the time of preparation of the report - 60.2%); the share of public transport vehicles that takes into account the needs of people with disabilities in 2020 should be 25%, in 2025 - 35%, in 2030 - 50% (at the time of writing the report - 15%).</p>
National Transport Strategy of Ukraine for the period up to 2030	Strategy	Resolution of CMU dated 30 May 2018 No.430-p	2018	<p>The strategy defines the main directions of development of the transport industry for the period up to 2030.</p> <p>Among the stipulated objectives of the Strategy, in particular, are the following: the development of terminal passenger and cargo complexes with multimodal technologies at the expense of their owners and public-private partnership with ensuring international standards of passenger service quality, including persons with reduced mobility and persons with disabilities; stimulating the introduction of innovative technologies (smart infrastructure and smart mobility) and smart transport systems; spreading the use of "cloud" data storage technologies, virtualization, data centres, etc.; increasing the capacity of the road network through the introduction of smart transport systems; transition of financing of the road economy from the "residual principle" to medium and long-term planning; construction of ring roads around Kyiv and other large cities; widespread use of innovative technologies for ensuring road safety; reduction of the amount of greenhouse gas emissions into the air from mobile sources (up to 60 percent of the 1990 level), including due to an increase in the share of public transport and electric vehicles, electric buses, bicycles; reduction of the total volume of emissions into the air of pollutants from mobile sources (up to 70 percent from 2015 level); an increase in the share of use of electric vehicles, in particular the bringing of the share of electric transport in internal traffic to 75 percent, in 2030; increasing the use of alternative fuels and electricity by 50 per cent by 2030; adopting a plan of measures to reduce the impact of transport on the environment through the introduction of energy saving technologies, the use of alternative motor fuels, the restoration and expansion of the possibilities of using electric transport; an increase in the share of vehicles of general use, taking into account the needs of people with disabilities and other less-mobile groups, up to 50 percent by 2020.</p>
Strategy of traffic safety increasing in Ukraine for the period up to 2020	Strategy	Resolution of CMU dated 14 June 2017 No. 481-p	2017	<p>The purpose of the Strategy is to reduce the mortality rate due to traffic accidents by at least 30 percent by 2020, the severity of the consequences of traffic accidents for road users and reduce the socio-economic losses from road traffic injuries.</p> <p>The strategy includes, in particular, the following tasks for local governments: equipping sidewalks, introducing traffic constraints, setting pedestrian enclosures, improving pedestrian infrastructure and parking areas, street lighting, organizing security islands and regulated pedestrian crossings, building separate cycling paths in cities and suburban roads, limiting vehicle speed and developing cycling infrastructure.</p> <p>Implementation of the Strategy should be carried out at the expense of the Road Fund in the framework of the State Budget of Ukraine, funds of local budgets, economic entities, regardless the form of ownership, target loans of banks, international technical assistance, investment funds, and other sources.</p>

Table A 1.1.3 – Buildings

Buildings				
Name	Type	Author	Year	Summary Findings
National Action Plan on Energy Efficiency until 2020	Action plan	Resolution of CMU dated 25.11.2015 No. 1228-p	2015	<p>The plan specifies target measures on the government's activity in the field of energy efficiency and identifies the targets to be achieved in this area.</p> <p>The Plan, in particular, specifies that in 2005 the total energy consumption by the service sector (both commercial and budgetary) reached 4.71 million tons of oil equivalent, representing 5.69 percent of the total final energy consumption in Ukraine. A significant share of energy consumption in this area relates to public buildings which today amount about 100 thousand in Ukraine (22 thousand general education schools, 24 thousand preschool institutions, 24 thousand club-type cultural institutions, 225 museums, about 4 thousand hospitals and other institutions). It is planned to reduce energy consumption in these buildings by 30%. The expected level of investment in this area is estimated at EUR 35070 million by 2020. The main funding sources for the activities planned by the Action Plan are the Energy Efficiency Fund, local budgets, funds from international financial organizations and private investments, in particular energy service companies.</p>
On Energy Efficiency in Buildings	Law	VRU	2017	<p>The law defines the legal, socio-economic and organizational principles for activities in the field of energy efficiency in buildings and aims at reducing energy consumption in buildings.</p> <p>The law provides for the setting minimum requirements for the energy efficiency of buildings by a central executive body, which ensures the formation of state policy in the field of construction. It is determined that the class of energy efficiency of buildings accepted for exploitation shall be not less than the minimum requirements to energy efficiency effective on the date of commencement of construction works.</p> <p>The Law has introduced the certification of energy efficiency of buildings, which is mandatory in particular for: buildings with a heated area of more than 250 square meters, all premises where local authorities are located (in case of their thermo-modernization of such buildings); buildings in which it is carried out the thermo-modernization using state support and which results in the achievement of the class of energy efficiency of building not lower than the minimum requirements to energy efficiency of the building.</p> <p>The law provides for the creation of a database of energy certificates, which is formed and maintained by the central executive authority, which implements state policy in the areas of efficient use of fuel and energy resources, energy saving, renewable energy sources and alternative fuels, and is made public on the official web site of this body.</p> <p>It is introduced professional certification of persons intending to carry out certification of energy efficiency and inspection of engineering systems, the procedure of which is set by the Cabinet of Ministers of Ukraine.</p> <p>The law provides for the priority of the use of the following energy supply sources for construction projects: decentralized district heating systems with the use of renewable energy sources; cogeneration units; district heating and cooling systems with the use of renewable energy sources; heat pumps</p> <p>The law provides for the approval by the Cabinet of Ministers of the National Plan for increasing the number of buildings with close to zero energy consumption, which should be reviewed every 5 years (not yet approved).</p>

				<p>According to the Law, financing of measures to ensure (increase) the level of energy efficiency of buildings should be carried out at the expense of the owner (co-owners) of buildings, funds of state and local budgets, other sources not prohibited by law, and also on the basis of public-private partnership or energy service.</p> <p>The law provides for the possibility of providing state support for measures to ensure (increase) the energy efficiency of buildings, which may be carried out through: budget investment allocations; cheapening of loans for implementation of measures to ensure (increase) the level of energy efficiency of buildings (reimbursement of interest on loans and / or part of the loan amount); reimbursement of part of the cost of measures to ensure (increase) the level of energy efficiency of buildings; preferential lending; provision of state and local guarantees for loans; implementation of stimulating tariffs and pricing for utilities and energy; implementation of public-private partnership, etc.</p> <p>The priority directions of providing state support in accordance with the Law are: carrying out of thermo-modernization of buildings; introduction of automated systems for monitoring and management of building engineering systems; reconstruction and modernization of heating systems (with the installation of equipment for automatic temperature control of the heat carrier depending on weather conditions and equipment for automatic control of the temperature of air in the premises); installation of autonomous systems in buildings using fully or partially renewable energy sources, heat pumps, cogeneration units or accumulative heating systems.</p>
On introduction of new investment opportunities, guaranteeing the rights and legitimate interests of business entities for conduction of large-scale energy modernization "	Law	VRU	2015 (2018)	<p>The law establishes the legal and economic principles for the implementation of energy service to increase the energy efficiency of state and communal property objects.</p> <p>The law establishes the procedure for approval by the executive body of the relevant local council or local executive authority (regarding communal property objects) of a decision on the purchase of the energy service for certain buildings (structures) and the peculiarities of conducting the procurement procedure for the energy service.</p> <p>The law also sets the essential terms of the energy service agreement, the procedure for calculating the price of the energy service agreement, taking into account a fixed percentage of the cost reduction of the customer for the energy service to pay the corresponding fuel and energy resources and / or housing and communal services, as well as the frequency of payments to the executor of the energy service.</p>
On Amendments to the Budget Code of Ukraine regarding the introduction of new investment opportunities, guaranteeing the rights and legitimate interests of business entities for conduction of large-scale energy modernization	Law	VRU	2015	<p>The law has amended the Budget Code of Ukraine by providing for the possibility of taking long-term commitments by the executive power bodies and local governments for the energy service within the amount of the reduction of expenditures for housing and communal services and energy carriers (compared to expenditures that would be made in the absence of the energy service). In addition, a procedure for the correction of such obligations is established in the event that in the reporting period actual reduction of these expenses is less than planned in accordance with the terms of the agreement.</p>

Table A1.1.4 – Industry

Industry				
Name	Type	Author	Year	Summary Findings
National report. Sustainable Development Goals: Ukraine	Strategy	CMU, UNDP	2017	<p>The National Report identifies the Sustainable Development Goals adapted to the Ukrainian conditions by 2030.</p> <p>In order to implement SDG 8 "Decent work and economic growth", the report intends to achieve the following indicators: the return on main assets in 2020 should be 0.26, in 2025 – 0.35, in 2030 – 0.45 (at the time of preparation reports – 0.23); the growth rate of labour productivity in 2020 should be 104%, in 2025 - 103.6%, in 2030 - 105.8% (at the time of writing the report - 99.1%); the employment rate of the population aged 20-64 in 2020 should be 66%, in 2025 - 68%, in 2030 - 70% (at the time of the report preparation - 64.4%); the share of workers employed in work with harmful working conditions in the total number of registered employees in the year 2020 should be 22%, in 2025 - 17%, in 2030 - 12% (at the time of preparation of the report - 26%); the number of employed workers in SMEs should reach 8.3% in 2020, 9.5% in 2025, and 10.5 % in 2030 (6.5% at the time of the report's preparation).</p> <p>In order to implement the SDG 9, "Industry, Innovation and Infrastructure", the report intends to achieve the following indicators: the share of workers employed in the enterprises belonging to the high and medium high-tech sectors of the processing industry in 2020 should be 26%, in 2025 - 28 %, in 2030 - 29% (at the time of the report's preparation - 21 %); the share of realized innovative production in the volume of industrial in 2020 should be 5%, in 2025 - 10%, in 2030 - 15% (at the time of writing the report – 1.4%); the level of coverage of the population by Internet services in 2020 should be 55, in 2025 - 75, in 2030 - 100 subscribers per 100 inhabitants (at the time of writing the report - 33).</p>

Table A1.1.5 – Energy

Energy				
Name	Type	Author	Year	Summary Findings
Energy Strategy of Ukraine until 2035 "Security, energy efficiency, compatibility "	Strategy	Resolution of CMU dated 18 August 2017 No. 605-p	2017	<p>The document defines strategic guidelines for the development of the fuel and energy complex of Ukraine for the period until 2035.</p> <p>According to the Strategy, in the period up to 2035, the energy intensity of GDP should decrease by more than 50%; the share of RES in the structure of electricity consumption should be 25%.</p> <p>At the first stage of the Strategy implementation (by 2020) it is envisaged to achieve high ecological norms of production, transportation, transformation and consumption of energy; to provide financing for investment projects within the framework of the National plan for reducing emissions from large combustion plants; increase RES in the final consumption up to 11%. At the second stage (by 2025) it is envisaged to ensure the formation of local heat supply systems taking into account the potential of local fuels, supply logistics, regional and national energy infrastructure; improve the efficiency of existing district heating systems; ensure the attraction of private investments. In particular, it is envisaged the intensive investment in the RES sector, the introduction of "smart"</p>

				<p>energy networks and the creation of a wide infrastructure for the development of electric transport. At the third stage (until 2035), in particular, it is envisaged the investing in new generation technologies based on smart technologies. Within the framework of the Strategy implementation, the following tasks have been assigned to the local governments: development and approval of plans (schemes) for the development of local energy supply systems, regional programs for the modernization of municipal heat and power; coordination of investment plans of municipal energy companies; implementation of energy saving and energy efficiency potential, renewable energy at the local level.</p> <p>Among the priority tasks to be addressed in this area, the following are specified: support of the implementation of cogeneration projects at the CHP plant and cogeneration for biofuels; application of energy service contracts (ESCOs) in the budget sphere and housing and communal sector; increase of thermal resistance of enclosing structures in buildings (insulation of walls, roofs and cellars, replacement of windows and doors), replacement and / or installation of energy efficient equipment (boilers, heat recuperators, automatic control systems, etc.); carrying out measures to ensure the regulation of the consumption of heat energy by the consumer (replacement of central thermal units by individual, reconstruction of in-house heating networks, installation of common house and individual heat-regulators); a possible transition from the most inefficient sources of TPP to modular home boiler houses; Replacement of pipelines by pre-insulated and cost reductions in transportation of energy; modernization of heating units; use of heat of technological processes of industrial enterprises; the transition to autonomous and / or individual heating in cities where the state of the CO system leads to excessive losses and inefficient use of resources.</p> <p>At the same time, the Strategy stipulates that the share of direct investments from the State budget of Ukraine in the development of energy infrastructure should not exceed 5-10%.</p>
Concept of State Policy Implementation in field of Heat Supply	Concept	Resolution of CMU dated 18 August 2017 No. 569-p	2017	<p>The purpose of the Concept is to determine ways of implementing an effective state policy aimed at ensuring the reliable provision of heat supply services to consumers, ensuring energy independence and security of Ukraine; reducing the negative impact on the natural environment, improving the financial and economic condition of enterprises, introducing a transparent efficient system of settlements between the consumer and the provider of services, creating conditions and stimulating the attraction of investments in the field of heat supply.</p> <p>Implementation of the Concept is expected during 2017-2035 in three stages.</p> <p>At the first stage (2017-2018), it was envisaged in particular: updating heat supply schemes of settlements by developing schemes for the development of heat supply systems that will provide the optimal combination within the settlement of different types of heat supply (centralized, autonomous or individual (apartment), simplification of procedures for implementation of investment projects aimed at reconstruction, modernization and development of enterprises; stimulation of reduction of the level of losses of heat during its generation up to 8% and its transportation up to 12%, ensuring 100 percent commercial accounting of the consumed heat.</p> <p>At the second stage (2019-2025), the following is envisaged: technological renewal of heat supply systems at all stages of the technological process, achievement of the average annual energy consumption of heat (80-60 kWh per square meter); increasing of the share of alternative energy sources use in the generation of heat (up to 30 percent); stimulation of bringing the technological state of enterprises in compliance with the needs of consumers in the case of thermo-modernization of buildings (40-50 percent of buildings).</p>

				<p>At the third stage (2026-2035), it is envisaged in particular that: reconstruction and modernization of heat supply systems at all stages of the technological process, achievement of the average annual energy consumption of heat (60-20 kWh per square meter); increasing of the share of alternative energy sources use in the generation of heat (up to 40 percent); reduction of heat energy losses in heat networks during its transportation to the consumer up to 10 percent; stimulation of bringing the technological state of enterprises in compliance with the needs of consumers in the case of thermo-modernization of buildings (100 percent of buildings).</p> <p>In order to implement competition and investment policy in the field of heat supply, the Concept envisages the improvement of the mechanism of attracting private capital under lease and concession agreements and improving the forms of management adapted to market conditions.</p> <p>Financing of measures on the implementation of the Concept is planned to be carried out by attracting financial resources from international financial and donor organizations, in particular the World Bank, the International Bank for Reconstruction and Development, the European Investment Bank, the European Bank for Reconstruction and Development, the Northern Ecological Finance Corporation and other organizations in the form of loans and grants, as well as from other sources not prohibited by law. It is planned to attract investments from international financial organizations and other investors for the implementation of the Concept in the estimated amount of UAH 4 billion.</p>
National Action plan on renewable energy until 2020	Action Plan	Resolution of CMU dated 1 October 2014 p. No. 902-p	2014	<p>The plan defines target measures on the Government's activity related to the use of renewable energy sources and sets targets to be achieved in this area.</p> <p>The plan provides for the achievement in 2020, in particular, the following indicators: the share of renewable energy in heating and cooling systems - 12.4%, the share of renewable energy in the electricity sector - 11%; the share of renewable energy in the transport sector - 10%.</p>
National report. Sustainable Development Goals: Ukraine	Strategy	CMU, UNDP	2017	<p>The National Report identifies the Sustainable Development Goals adapted to the Ukrainian conditions by 2030.</p> <p>In order to implement SDG 7 "Affordable and clean energy", the report intends to achieve the following indicators: by 2030 to increase electricity generation in 1.15 times (from 157.7 to 182 billion kWh); to bring up to 9% the technological costs of electricity in the distribution electric networks (today - 11.5%); to bring up to 12% heat losses in electricity grids (today - 12%); to increase the share of electricity generated from renewable sources in the total final energy consumption to 17.1% (today 4.9%).</p>
On electricity sector	Law	VRU	1998	<p>The law defines the legal, economic and organizational principles of activities in the electricity sector and regulates relations related to the production, transmission, supply and use of energy, ensuring Ukraine's energy security, competition and consumer rights and workers protection. After the introduction of the electricity market in Ukraine (01.07.2019), in accordance with the Law of Ukraine "On the Electricity Market", almost all of the provisions of this Law will expire.</p>
On electricity market	Law	VRU	2017	<p>The law determines the legal, economic and organizational principles of functioning of the electricity market, regulates relations related to the production, transmission, distribution, sale and purchase of electricity, ensuring reliable and safe supply of electricity to consumers, taking into account consumer interests, development of market relations, minimizing the cost of electricity supply and minimizing the negative impact on the natural environment. In addition, the Law establishes the procedure for the connection of electric units to electric networks, the procedure for access to electric networks, the procedure for the construction of generating capacities, and the possibility of</p>

				<p>assigning special obligations to members of the electricity market to ensure public-interest in the process of functioning of the electricity market.</p> <p>As of today, only certain provisions of this Law, in particular concerning the retail electricity market, have come into force. In full, the Law will come into force on 01.07.2019</p>
On alternative energy sources	Law	VRU	2003	<p>The law defines the legal, economic, environmental and organizational principles for the use of alternative energy sources and facilitates their expansion in the fuel and energy complex.</p> <p>According to the Law, financing of measures in the field of alternative energy sources should be carried out both at the expense of funds provided in wholesale tariffs for electricity and tariffs for heat energy, by introducing a special target premium to the tariff established by law, and at the expense of enterprises, institutions, organizations, funds from the state and local budgets, voluntary contributions and other funds not prohibited by law. The specified norm will not work after 01.09.2019 in connection with the enactment of the Law of Ukraine "On the Electricity Market".</p> <p>The law also provides mechanisms for stimulating the production and consumption of energy generated from alternative sources, which include: the use of economic instruments and incentives provided by the legislation on energy saving and environmental protection; creation of favorable economic conditions for the construction of alternative energy facilities.</p>
On alternative fuels	Law	VRU	2000	<p>The law defines the legal, social, economic, environmental and organizational principles of production (extraction) and the use of alternative fuels, as well as encouraging an increase in their share of use up to 20 percent of the total fuel consumption in Ukraine by 2020. In particular, the Law defines the features of alternative fuels, including liquid ones; the procedure for determining the fuel as alternative is established.</p> <p>The law provides for that financing of measures to stimulate production (extraction) and consumption of alternative fuels can be carried out at the expense of enterprises, institutions, organizations, regardless of ownership forms, state and local budgets, and other sources not prohibited by law.</p>
On combined production of heat and power (cogeneration) and utilization of waste power potential	Law	VRU	2005	<p>The law defines the legal, economic and organizational principles of the activity of the entities of energy saving in relation to the use of cogeneration units, regulates relations related to the peculiarities of production, transmission and supply of electric and thermal energy from cogeneration units.</p> <p>The law provides for that financing for the development of projects, the purchase of technological equipment and the construction of cogeneration units is carried out at the expense of own and borrowed funds of enterprises, the partial use of funds of special accounts of techno parks, individuals, including foreign investors, credits of energy service companies, as well as at the expense of the corresponding budgets.</p> <p>The law establishes stimulating measures for the creation of cogeneration units. In particular, when creating a cogeneration unit with the involvement of an investor's investor, such an investor may acquire the rights of the owner (co-owner) of the cogeneration unit on the terms specified in the investment agreement. Owners of cogeneration units, regardless of the installed electric power, have the right of unimpeded access to local (local) electric networks.</p>
On heat supply	Law	VRU	2005 (218)	<p>The law defines the basic legal, economic and organizational principles of activity at the objects of the heat supply sector and regulates relations related to the production, transportation, supply and use of heat energy in order to ensure Ukraine's energy security, increase energy efficiency of the operation of heat supply systems, create and improve the market heat energy and protection of the rights of consumers and workers in the field of heat supply.</p>

				<p>The law defines the powers of local government bodies in the field of heat supply, which include: approval of local development programs in the field of heat supply, participation in the development and implementation of state and regional programs in this area; approval, taking into account the requirements of the legislation in the sphere of heat supply of the draft city-planning programs, general plans of development of settlements, heat supply schemes and other city-planning documentation; control over the provision of consumers with heat in accordance with regulatory requirements; approval for locating within the relevant administrative-territorial unit of new or reconstruction of existing heat supply facilities and promotion of the development of heat supply systems in the respective territory; approval of investment programs for heat supply objects in communal ownership, except for those producing heat energy at CHP plants, TPPs, NPPs, cogeneration units and installations using non-traditional or renewable energy sources; assistance in conducting investment activity in the field of heat supply.</p> <p>In accordance with the Law, design, construction, reconstruction of objects in the field of heat supply is carried out on the basis of heat supply schemes, state building norms and regulatory acts for the construction works.</p> <p>The law states that financing of capital construction, reconstruction and maintenance of heat supply facilities intended for the common needs of the heat generating organization and enterprises of other industries is carried out at the expense of customers. The customer may be the owners of the specified objects or their authorized persons. Equipping of construction and heat supply facilities at the expense of budget funds is carried out on a tender basis.</p> <p>According to the Law, state support in the field of heat supply is provided in accordance with the amount of funds provided by the law on the State Budget of Ukraine and local budgets for the relevant year, as well as funds for carrying out research works on the improvement of heat supply systems and energy saving.</p> <p>At the same time, in case of implementation of energy saving measures by heat-generating or heat supply organizations which led to energy saving in the production of heat energy, to reduction of losses during its transportation and supply, the executive body, which regulates heat energy tariffs by law, for three years leaves the tariffs at the level set before the implementation of these measures. If during the payback period energy prices change, then the level of the tariff is adjusted accordingly.</p> <p>The law stipulates that heat supply entities shall comply with the requirements of environmental protection legislation, bear responsibility for its violation and carry out technical and organizational measures aimed at reducing the harmful effects of objects in the area of heat supply on the natural environment. In order to ensure the safety of the population living in the district of the location of the heat supply facilities, security zones are established, the sizes and procedure of use of which are determined by regulatory and legal acts and projects of these objects, approved in accordance with the procedure established by the legislation.</p>
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Table A1.1.6 – Water

Water				
Name	Type	Author	Year	Summary Findings
On drinking water, drinking water supply and sanitation	Law	VRU	2002 (2018)	<p>The law defines the legal, economic and organizational principles for the operation of water supply and sanitation systems. The law stipulates that the networks, facilities, equipment of centralized drinking water supply and sanitation of settlements are especially important objects of life support and are not subject to privatization.</p> <p>The powers of the local governments in this area in accordance with the Law include: approval and implementation of local programs in the area of drinking water, drinking water supply and sanitation; granting consent to the placement on the territory of new or reconstruction of operating facilities, activity of which may harm the sources and systems of drinking water supply and / or sanitation systems; approval of local rules for sewage water reception to centralized sanitation systems of the corresponding settlements; introduction of centralized sanitation in settlements; control over the quality of drinking water, use and protection of sources and systems of drinking water supply and sanitation; informing the population about the quality of drinking water and the state of drinking water supply and sanitation; setting tariffs for centralized water supply and sanitation services (except for the tariffs for these services, which are set by the national commission that carries out state regulation in the field of energy and utilities); restriction, temporary prohibition of activity of enterprises in case of violation by them of requirements of the legislation in the sphere of drinking water, drinking water supply and sanitation in the limits of their powers; approval of investment programs for water supply and sanitation facilities in communal ownership.</p> <p>The law stipulates that state support in the field of drinking water and drinking water supply is provided in accordance with the amount of funds allocated by the law of Ukraine on the State Budget of Ukraine for the relevant year, to finance activities in the field of construction and reconstruction of drinking water supply, sanitation and wastewater treatment systems, as well as for carrying out research works on improvement of drinking water supply and resource saving.</p> <p>Investment programs are developed by economic entities in the area of centralized water supply and sanitation. Payments under investment programs, including under those implemented at the expense of funds attracted from the IFI, are carried out through special accounts opened by the subjects of management in the area of centralized water supply and sanitation in accordance with the procedure set by law.</p> <p>The enterprises of drinking water supply are obliged to carry out the primary control of the quality of drinking water and to carry out commercial accounting of services for centralized drinking water supply.</p>
On housing and communal services	Law	VRU	2018	<p>The law defines the powers of local governments in providing housing and communal services, including, in particular, the approval and implementation of local programs in the sphere of housing and communal services; setting prices / tariffs for housing and communal services in accordance with the law; approval of norms of consumption of communal services; informing the population about the state of implementation of local programs in the sphere of housing and communal services, as well as on the conformity of quality of housing and communal services to norms, standards and rules; monitoring of the state of implementation of local housing and communal services development programs.</p>
On peculiarities of transfer into lease or concession of objects	Law	VRU	2011 (2014)	<p>The law determines the peculiarities of transfer into lease or concession of objects of heat supply, water supply and sanitation that are in communal ownership</p>

of heat supply, water supply and sanitation that are in communal ownership				
On State Target Program "Drinking water of Ukraine" for 2011-2020	Law	VRU	2005 (2012)	<p>The purpose of the Program is to ensure citizens' rights for adequate living standards and environmental safety by providing drinking water in the required volumes and in accordance with established standards.</p> <p>The program, in particular, provides for: construction and reconstruction of water and sewage treatment plants in order to reduce the volume of untreated sewage discharged into water bodies, as well as the utilization of sediments; implementation of the construction and introduction of stations (units) for the purification of drinking water and places of its bottling with the use of the latest materials, technologies, equipment, devices and research and development; development of schemes for optimization of central water supply systems operation; equipping laboratories for quality control of water and sewage with modern control and analytical equipment;</p> <p>The financing of the Program activities should be carried out at the expense of: funds of the State Budget of Ukraine; funds of local budgets; funds of drinking water supply and sanitation utilities; external and internal borrowing, grants from international organizations, funds from international programs, charitable contributions.</p>
National report. Sustainable Development Goals: Ukraine	Strategy	CMU, UNDP	2017	<p>The National Report identifies the Sustainable Development Goals adapted to the Ukrainian conditions by 2030.</p> <p>In order to achieve the SGD 6, "Clean water and proper sanitary conditions," the report intends to achieve the following indicators: the share of urban population with access to safe drinking water in 2020 should be 95%, in 2025 -100% (at the time of preparation of the report - 90%); the proportion of urban population with access to economically accessible drinking water of guaranteed quality should be 100% in 2020 (90% at the time of writing); the proportion of urban population with access to centralized water supply should reach 90% by 2020, 95% in 2025, and 100% by 2030 (89.8% at the time of writing); the share of urban population with access to centralized sewage systems should reach 90% in 2020, 100% in 2025 (87.1% at the time of the report's preparation); the volume of discharges of polluted wastewater in water facilities in 2020 should be 725, in 2025 - 557, in 2030 - 279 million cubic meters (at the time of the preparation of the report - 875); the share of discharges of polluted sewage into water bodies in the total amount of discharges in 2020 should be 13%, in 2025 - 10%, in 2030 -5% (at the time of preparation of the report - 15.7%); water capacity of GDP in 2020 should be 3.2, in 2025 - 2.9, in 2030 - 2.5 cubic meters of used water for 1000 UAH GDP (at the time of preparation of the report - 3.6 cubic meters); water capacity of GDP in 2020 will be 90%, in 2025 - 80%, in 2030 - 70% comparatively with 2015 (at the time of the report's preparation 100%).</p>
Draft National Report on the quality of drinking water and the state of drinking water supply in Ukraine in 2017	Report	MinRegi on	2018	<p>The National Report on the quality of drinking water and the state of drinking water supply is prepared annually, approved and made public by the Ministry of Regional Development.</p> <p>This report contains official data on the state of surface and underground sources of drinking water, water supply and sanitation systems, quality of drinking water on the results of its monitoring, the composition of wastewater discharged into water bodies and its impact on the environment, the results of public health surveillance systems of water supply emergencies in centralized water supply and sanitation, their causes, consequences and the measures taken, the state of reform and development of water and sanitation. Information is provided on the whole in Ukraine and by its regions.</p>

Table A1.1.7 – Solid Waste

Solid Waste				
Name	Type	Author	Year	Summary Findings
On Waste	Law	VRU	1998 (2018)	<p>The law defines the legal, organizational and economic basis of activities related to the prevention or reduction of volumes of waste generation, collection, transportation, storage, sorting, treatment, utilization and disposal, as well as the prevention of the negative impact of waste on the natural environment and human health in the territory of Ukraine.</p> <p>The law stipulates that territorial communities are the owners of waste formed on communal property objects or are located in their territory and do not have the owner or the owner of which is unknown.</p> <p>In accordance with the Law, local governments in the field of waste treatment in particular ensure: development and approval of schemes for sanitary cleaning of settlements; the organization of collection and disposal of household waste, including waste from small producers, the creation of landfills for their disposal, as well as the organization of separate collection of useful components of these wastes; approval of local and regional waste management programs and control over their implementation; taking measures to stimulate business entities that carry out activities in the field of waste management; resolving issues regarding the placement of waste management facilities in their territory; control over the rational use and safe handling of waste in its territory; elimination of unauthorized and uncontrolled waste landfills; granting consent to locate in the villages, towns, cities of places or facilities for the storage and disposal of waste. Local governments take decisions to divest land for waste placement and the construction of waste management facilities.</p> <p>The law stipulates that the collection and removal of household waste within a certain territory is carried out by a legal entity that is authorized for this by the body of local government. Storage and disposal of waste are carried out in accordance with environmental safety requirements and methods that ensure maximum utilization of waste or transfer to other consumers. Storage and disposal of waste are carried out in places designated by the local governments taking into account the requirements of land and environmental legislation.</p> <p>In accordance with the Law, during the design of residential buildings, public, industrial, warehouse and other structures, it shall be provided for the construction and equipment of container sites for the separate collection and storage of household wastes and household waste bins.</p> <p>The financing of waste management activities is carried out at the expense of producers of waste and their owners. To finance these activities, funds from local budgets, environmental funds, voluntary contributions of enterprises, institutions, organizations, citizens and their associations, as well as funds of the State Budget of Ukraine allocated for events, may be attracted.</p> <p>In order to stimulate measures on waste utilization and reduction of their volume, economic entities that implement technologies aimed at reducing the amount of waste generated, utilize waste in the process of production, carry out its treatment, construction of enterprises and workshops, and organize the production of equipment for waste disposal, take part in the financing of waste management measures and reduce the volume of their education, could be provided in accordance with the law of Ukraine with: privileges for the taxation of profits from the sale of products made with the use of</p>

				waste; priority state lending; special state subsidies for reducing interest on bank loans related to investments; grants from the State Budget of Ukraine and local budgets for the transportation of waste (secondary raw materials) or semi-finished products derived from these wastes; grants from environmental protection funds and other sources; privileges for replenishment of working capital of enterprises, institutions and organizations - economic entities engaged in harvesting and harvesting, processing (recycling) and utilization of waste as secondary raw materials. Local executive bodies and local governments may determine, within their authority, additional measures related to the promotion of waste utilization and reduction of waste generation.
National Strategy of Waste Management in Ukraine up to 2030	Strategy	Resolution of CMU dated 8 November 2017 No.820-p	2017	<p>The aim of the Strategy is to create conditions for raising the standard of living of the population by introducing a systemic approach to waste management at the state and regional level, reducing the amount of waste generation and increasing the volume of their processing and reuse.</p> <p>Among the tasks of the Strategy, the following are specified in particular: involving the population in the separate collection of household waste and encouraging such collection; increase in the population's coverage of household waste collection and disposal; increasing the level of domestic waste recycling; ensuring the commissioning of waste sorting lines and waste recycling plants; introduction of composting of the organic component of household waste in private households in rural areas, as well as suburban areas of cities; creation in the framework of pilot projects of facilities for the production of fuels from domestic waste on the basis of objects of mechanic and biological treatment, provided they are approached to the cement plants; preparation by local executive authorities and local governments of priority plans for the closure of landfills / landfills that do not meet environmental requirements; preparation by local governments of plans for measures to bring the landfills in line with environmental requirements; ensuring of construction of the first stage of the network of regional landfills for the disposal of domestic waste (the optimal coverage (cluster) should include the territory in which about 400 thousand people live, such facilities should have a minimum capacity of about 50 thousand tons per year, optimal capacity - 100 thousand tons per year, per population, which is not less than 150 thousand people); to provide in areas where new regional landfills will be organized and operate, the termination of operation, the closure and reclamation of landfills that do not meet the requirements of environmental safety; construction of a network of waste reloading stations (200 units) in order to reduce overall transport costs (the number and location of waste disposal plants will depend on the location of regional landfills and will be clarified when developing regional waste management plans).</p>
National report. Sustainable Development Goals: Ukraine	Strategy	CMU, UNDP	2017	<p>The National Report identifies the Sustainable Development Goals adapted to the Ukrainian conditions by 2030.</p> <p>In order to fulfil the SDG 12 "Responsible Consumption and Production", the report envisages achieving the following indicators: the volume of generated waste per unit of GDP in 2020 should be 950, in 2025 - 880, in 2030 - 800 kg per 1000 USD (at the time of preparation of the report - 977.4 kg); the share of burned and recycled waste in the total amount of waste generated in 2020 should be 35%, in 2025 - 45%, in 2030 - 50% (at the time of preparation of the report - 30%).</p>

Table A1.1.8 – Land Use and Biodiversity

Land Use				
Name	Type	Author	Year	Summary Findings
No national level laws, strategies and plans for Land Use				
Biodiversity				
Name	Type	Author	Year	Summary Findings
Concept of the National Program for the Conservation of Biodiversity for 2005 - 2025	Concept	CMU Order No. 675-r of September 22, 2004	2004	<p>The Concept defines the basic principles of the National Program for the Conservation of Biodiversity for 2005-2025. According to the Concept, the Program's goal is to: reduce the degradation of the environment for living species; increase awareness of social activities that can negatively influence biodiversity and the environment; to improve the state of natural resources and green spaces to encourage biodiversity.</p> <p>The financial support of the Program is planned to be carried out at the expense of the State budget, State and local funds of the environmental protection and other sources. The amount of funds necessary for the implementation of the Program will amount to about UAH 50 million annually.</p> <p>The National Program for the Conservation of Biodiversity by 2025 in accordance with the approved Concept has not been approved by this time.</p>

Table A1.1.9 – Resilience

Resilience				
Name	Type	Author	Year	Summary Findings
National report. Sustainable Development Goals: Ukraine	Strategy	CMU, UNDP	2017	<p>The National Report identifies the Sustainable Development Goals adapted to the Ukrainian conditions by 2030. In order to implement the CSD 11 "Sustainable development of cities and communities", the report intends to achieve the following indicators: the share of regions that have approved and implemented regional development strategies and plans for their implementation, developed with the participation of the public, in 2020 should be 100% (per the moment of preparation of the report - 80%); the level of reconstruction of the national system of centralized alert for the population in 2020 should be 20%, in 2025 - 40%, in 2030 - 60% (at the time of preparation of the report, the state of this system is unknown).</p>

Annex 1.2 - Summary of Local Strategies and Plans

Table A1.2.1 – Cross Sectoral Initiatives

Cross Sectoral Initiatives				
Name	Type	Author	Year	Brief description
Integrated Environmental Program for 2017-2022	Program	City Council	2016	<p>Integrated Environmental Program for 2017-2022 for the City of Lviv</p> <p>https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>The program includes a description of the area of the City territory, number of inhabitants, population density, the housing stock of the area, provision of dwellings to the population on 01.01.2016. Analysis of ecological situation is undertaken. In section 1.1 "Atmospheric air", the total amount of pollutant emissions from stationary and mobile sources of the city recorded in 2015 were 37.7kT (49.7 kg per inhabitant). In section 1.2. "Water" it is indicated that there are 17 water intakes from 180 wells of the LCME "Lviv Vodokanal". Water supply uses 99 percent of underground water. As of 01.01.2015 volumes of purified water after wastewater treatment discharged to surface water facilities totalled 123 million m³ per year. In section 1.3 "Waste" it is indicated that the production of municipal waste reached 300.6 kg/year per capita in 2015. In section 1.4. "Green spaces and fauna" it is indicated that the total number of species of higher plants in Lviv is 988. The total area of green plantations in Lviv in different categories in 2012 was 33,286 hectares, including 3,403 hectares within the City boundaries. Today, the number of bird species within the Lviv administrative boundaries totalled 86 species. Chapter 3 contains the following goals and priorities.</p> <p>Priorities of urban environmental policy for 2017-2022:</p> <ol style="list-style-type: none"> 1. Development of the solid waste management strategy based on the Zero Waste concept, construction of waste processing plant and installation of ecologically safe landfill site. 2. Completion of the sewage installation for the city low-rise building area. 3. Reduction of atmospheric air pollution from mobile sources. 4. Increasing the area of green spaces along with improving the land quality and aesthetic attractiveness, developing the ecological network of the city, reducing the number of non-indigenous species. 5. Improving ecological awareness of residents. 6. Regulation of the centres of dangerous processes and the development of measures for their prevention.

Table A1. 2.2 – Air and Transport

Air				
Name	Type	Author	Year	Brief description
Integrated Environmental Program at 2017-2022	Program	City Council	2016	<p>Comprehensive Environmental Program for 2017-2022 years for Lviv City https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>The atmospheric air quality and the main causes of pollution are described in this document.</p> <p>Total emission of pollutants from stationary and mobile sources of the city in 2015 was 37.7k T (49.7 kg per inhabitant). From 2010 to 2015, a trend to gradually reduce the total amount of emissions into the city atmosphere was observed. Emissions from mobile sources account for the largest share of air pollution in the city. According to the statistical reporting, in 2015 they accounted for 35.1kT (93% of the total). Over the last 5 years, the number of motor vehicles in the city has increased by almost 15 per cent (respectively 133,099 additional vehicles in 2010 and almost 153,000 in 2015). More than 600 buses and minibuses are used for passenger services. Transit vehicles are also a major contributor to air pollution in the City.</p> <p>Among the stationary sources of pollution in the city, the highest percentage (around 45%) came from the Heating and Power companies. As of 01.01.2016, the Department of Ecology and Natural resources of Lviv regional state administration in Lviv issued 589 permits for the emission of pollutants into the atmosphere by stationary sources. Most of the air pollution is coming from 5 companies: LCCE "Lvivteploenergo" (including TPP-1, TPP-2, boiler house on Nadiina Street), LKP "Zaloznichteplenergo", PJSC "Iskra", LLC "Lviv Insulator Company" and "Galichpharm" PJSC.</p> <p>An excess of the maximum allowed concentrations for dust, formaldehyde and for nitrogen dioxide was observed at two monitoring station (sqr. Sobornaya, Zelena Street)</p> <p>Priority issues for improving the environmental situation are specified as:</p> <ul style="list-style-type: none"> • Reduction of transport load on the most polluted central part of the city due to completion of the new transport strategy; • Completion of the project "Reconstruction of the Automated Traffic Management System"; • Expansion of the use of electric transport (tram, trolleybus) for connecting with the central part of the town of Rvasne micro district; • Increasing the length of bicycle tracks and creating new bicycle rental stations; • Regulation of the air quality and chemical pollution of the atmosphere; • Further modernisation of the City's heat-power economy and the use of alternative sources of energy for the operation of individual boiler plants in preschool and school establishments. <p>In the future, the development of railways outside the City for moving transit cargoes, etc. will remain problematic.</p>

Transport				
Name	Type	Author	Year	Brief description
Bus purchase program	Program	City Council	2018	<p>Program for the purchase of buses on financial leasing terms from 22.03.2018 Application № 3106</p> <p>https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>The program states that according to the approved scheme on the city bus routes, the city of Lviv should run 630 buses on working days, and 427-434 buses on weekends. Instead, 480-500 buses are running on the routes on weekdays and 350-370 buses during weekends (according to the daily data from public transport services). According to simulations, the ideal would be 730 buses on the routes with a modified distribution of bus types.</p> <p>The purpose of the program is to develop public transport, to provide better quality of public transport services for consumers, to implement the concept of passenger transport development in Lviv, to create safe and comfortable transport conditions. To implement the program, it is proposed that Lviv Municipal Transport Enterprise № 1 leases 150 buses with a capacity of not less than 100 persons. The validity of the financial leasing contract is up to 36 months.</p> <p>The planned number of motor vehicles for 2020 is foreseen for the following types: Trams – 120 units, trolleybuses – 120 units, buses (12 metres) 340 units, bus (8 metres) 150 units.</p>
Regulation on Transport Management	Regulation	City Council	2006	<p>Regulation on transport and communication management of Lviv City Council and its structure from October 27, 2006 Decision № 1209</p> <p>https://www8.city-adm.lviv.ua</p> <p>The document describes the main tasks of the Transport Management Office: within the limits of its competence, to implement the policy of local self-government in the field of urban passenger transport, parking lots and vehicle parking.</p> <p>The following provisions of the Office's competences are stipulated:</p> <ul style="list-style-type: none"> • Management and coordination of the activities from urban passenger transport companies; • Preparation of proposals for opening new routes, location and equipment of stops; • Approval of schemes and timetables, organization of taxi drivers regulation; • Issue of permits for the transportation of passengers by public transport on city routes; • Organization and improvement of the taxi network, parking areas, car garages and parking lots, bus stations, other facilities of road infrastructure; approval of their location; management of the urban passenger transport stops.

Concept of Electric Mobility Development	Concept	City Council	2018	Concept of the electro mobility development of Lviv city from January 05, 2018 Decision № 2 https://www8.city-adm.lviv.ua/Pool/Info The objectives of the Concept are: <ul style="list-style-type: none"> • To increase the fleet of electric vehicles in the city; • To promote the expansion of the existing network of charging stations for electric vehicles; • To stimulate the development of public electric transport; • To improve air quality and reduce noise pollution in the city; • To stimulate the use of electric vehicles in the private sector.
Compensation Payment Program	Program	City Council	2019	Details of the 61 million UAH allowed from the program of compensatory payments for subsidised transport by road https://city-adm.lviv.ua/public-information?task=att_download&link_id=8645&cf_id=36
Compensation Payment Program	Program	City Council	2019	Details of the 165,000 UAH allowed from the program of compensatory payments for the subsidised transportation by electric transport https://city-adm.lviv.ua/public-information?task=att_download&link_id=8643&cf_id=36
Replenishment of the Statutory Fund	Program	City Council	2019	Details of the authorized capital of 100M UAH for ATP № 1 and 64.9M UAH For LvivElectrotrans https://city-adm.lviv.ua/public-information?task=att_download&link_id=8641&cf_id=36

Table A1.2.3 – Buildings

Buildings				
Name	Type	Author	Year	Brief description
"Warm House" Program	Program	City Council	2015	<p>Program of loan repayment received by the Association of Co-owners of an Apartment Building (ACMH), Housing and Communal services for implementation of measures on energy saving, reconstruction and modernization of apartment buildings in Lviv for 2015-2018 ("Warm House") of March 19, 2015 № 4413</p> <p>https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>Part of the loan for thermal rehabilitation of multi-storey buildings from the City budget is provided by ACMH and the Housing Fund up to 30% of the maximum amount of the principal loan, but not more than 400 thousand UAH. In 2019, the program's implementation in the City budget of Lviv was established at UAH 5.93M. The program has been operating in the city from 2015 year and lasts until 2020. As of February 2019, 1276 schemes were implemented across the City.</p>
"Energy Efficient Housing"	Program	City Council	2017	<p>Program of loans compensation received by individuals for the implementation of measures on energy-saving, reconstruction and modernisation of residential apartments and blocks of flats in Lviv for 2017-2020 years ("Energy Efficient Oselya") From 09.02.2017 Resolution № 1474</p> <p>https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>The Program provides compensation to borrowers (co-owners of credit funds) involved in the implementation of energy saving measures, reconstruction and modernisation of residential buildings.</p> <p>The expected results are:</p> <ul style="list-style-type: none"> • Improvement of energy efficiency of building structures and internal systems of heat and water supply of residential buildings, • Increase in comfort levels in the building; • Creation and further development of specialised new sources of financing and investment for energy efficient refurbishment of the City's housing stock.

Support Program for Energy Saving Measures	Program	City Council	2017	<p>Program for the support of energy-saving measures for 2017-2019 years. From 06.04.2017 Resolution № 1797 https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>The program, considers the provision from Ukraine's energy strategy for the period up to 2030 years, approved by Decree of the Cabinet of Ministers of Ukraine dated July 24, 2013 № 1071, the Program of Sustainable Energy Development of Lviv until 2020, approved by the City Council dated July 14, 2011 № 663, is an integral part of the comprehensive strategy of Lviv develop. until 2025, approved by the City council in November 20, 2011 № 861.</p> <p>The program includes the following actions:</p> <ul style="list-style-type: none"> • Supporting the daily monitoring and analysis of energy consumption; • Ordering energy audit services; • Running information campaigns among residents. <p>The expected results are:</p> <ul style="list-style-type: none"> • Reduction of energy consumption and carbon emissions; • An increase of the share of renewable energy sources in the energy balance of the City; • Improvement of the welfare of the population through improvement of living conditions.
Program for the Promotion of Capital Repairs	Program	City Council	2017	<p>Pilot project on implementation of the Program to financially assist the repairs of structural elements of multi-apartment buildings, which are under the management of condominiums of Lviv for 2018 from June 21, 2018 Resolution № 3612 https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>The program regulates the execution of major repairs of certain structural elements of multi-apartment buildings, which are under the management of condominiums, at the expense of the city budget.</p> <p>The expected results are:</p> <ul style="list-style-type: none"> • Improvement of the technical and physical condition of the apartment buildings; • Improving living conditions and rising value of apartments. <p>If the pilot project is successful, based on the experience gained, the program of assistance to repairs of individual structural elements of the apartment buildings which are under the management of condominiums will be introduced at the expense of local budgets.</p>
Program of Co-financing Capital and Current Repairs of Buildings	Program	City Council	2015	<p>Program of co-financing capital and current repairs of buildings in Lviv for 2015-2020 from 21.5.2015 Res. 4630 https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>The program aims to create mechanism for implementing co-financing of capital and current repairs of buildings in the city and, as a result, increase the quantity and quality of residential buildings' refurbishment.</p> <p>Almost 60 percent of all houses in Lviv need to be repaired. The financing will take place proportionally – 70% of funds from Lviv city budget and 30 percent of the share from the residents' funds. The program fully supports the goals and objectives of the Integrated City Strategy until 2025 and the Integrated City Development Concept. The repairs will also improve the energy efficiency of the buildings.</p>

Table A1.2.4 – Industry

Industry				
Name	Type	Author	Year	Brief description
Program of Development of Industrial Zones in Lviv	Program	City Council	2018	<p>Program for long-term development of industrial zones in Lviv from 20.12.2018 Resolution № 4399 https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>The program aims to develop and increase investment attractiveness of Lviv's industrial territories, which should become modern, innovative and technological, improve the investment climate and modernise Lviv's industry, develop a modern production and market infrastructure, create new jobs and increase revenues for each social level.</p> <p>The program specifies the location of industrial zones on the Lviv map: "Syhnyvka" industrial zone; "Ryasne-2" industrial zone.</p> <p>Implementation of the program will facilitate:</p> <ul style="list-style-type: none"> • The creation of new industrial productions and enterprises with high level of competitiveness, that will process their product using innovative energy saving technologies; • The creation of new employment; • Increase of the Lviv City budget revenues; • The development of engineering, transport and logistics infrastructure of Lviv City.
Programs to attract investments to the City	Program	City Council	2017	<p>Programs of assistances in attracting investments to Lviv city for 2017-2019 from 09.02.2017 Resolution № 1466 https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>The program envisages preparation of quality investment products/projects, attraction of credit and grant funds of international financial organizations and funds, including for environmental improvement projects.</p> <p>Tasks and activities: Organization and participation in annual international investment events, reception of official delegations and business-missions, production and distribution of promotional materials, preparation, support and promotion of investment City's Projects/Products.</p>

Tourism Industry development Programs	Program	City Council	2016	<p>Program for the development of Lviv tourism sector for 2016-2022 from 04.02.2016 Resolution № 134 https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>Main objectives of the program: to improve tourism infrastructure; to upgrade professional standard of hospitality sphere's workers; to create a comfortable and safe environment for tourists and City guests; to organise, coordinate and conduct tourist attractive measures; to participate in international programs and projects for tourism development, to organize international cooperation in the tourism sector; to distribute tourist load on the public spaces of Lviv.</p> <p>Expected results: Increasing the number of tourists, their length of stay in the city (up to 3.5-5 days) and the amount of their expenditure; increase of employment, increase of population's living standards.</p> <p>This program will have a direct link with improving green spaces in the City</p>
Local Economic Development Plan	Plan	City Council	2019	<p>Local Economic Development plan, adopted by the city Council 14.02.2019.</p> <p>The plan has three directions: enterprise support, clusters support, and investments attraction support.</p> <p>The local economic development plan includes the following areas:</p> <ol style="list-style-type: none"> 1. Support the most promising economic clusters. 2. Entrepreneurship support. 3. Attraction of investments (investment promotion of the City and development of investment proposal in the form of prepared industrial parks, catalogues of greenfield and brownfield). <p>New businesses or clusters could include those in the environmental sector.</p>

Table A1.2.5 – Energy

Energy				
Name	Type	Author	Year	Brief description
Project to use biofuels for heat and electricity production	Loan Agreement	EBRD	2019	<p>Project to re-equip "Southern" CHP plant with alternative fuels using assistance from EBRD</p> <p>https://city-adm.lviv.ua/news/city/housing-and-utilities</p> <p>The aim is to substitute the CHP-2 and boiler-rooms "Kineshkop" by alternative fuels (woodchip), which will save an annual 36 million m³ of natural gas. Cost - UAH 560,370k.</p> <p>In 2017 a feasibility study was undertaken on the project "Construction CHP plant using the alternative type of fuel on the "Southern" boiler ("Kineshkop"). The feasibility study has been submitted to the European Bank for Reconstruction and Development for approval of a loan.</p>
Investment proposal "Construction of a 220 MW power complex with coal-fired boilers of the Central Electric Networks in the territory of Lviv "Southern"	Investment proposal	NJSC "Naftogaz Ukrainy"	2016	<p>Construction of 220 MW Power Complex (not implemented)</p> <p>http://www.naftogaz.com/files/Activities/Investproposition-Lviv-China.pdf</p> <p>In order to replace natural gas with coal of local extraction, it was proposed to construct two coal-fired power units with capacity of 110 MW per unit, with boilers using the circulating fluidized bed technology (CFB). As a fuel, it is planned to use the coal-grade "G" of Lviv-Volyn basin with the ability to burn up to 15% of biomass or solid household waste (SHW).</p> <p>In order to increase the heat output from the new power complex and to reserve the heat supply from the Lviv CHPP-1 it is proposed to construct a thermal transmission line from the new energy complex to the heat supply zone of the CHP-1 with a length of about 10.6 km.</p> <p>Estimated electricity output is 1588.4 million kWh/year. The thermal energy output is 557k Gcal/year. Annual coal consumption is 690.9kT/year for 2 power units. Replacement of annual gas consumption for the 2 units is 468.4 million m³.</p>

Table A1.2.6 – Water

Water				
Name	Type	Author	Year	Brief description
Comprehensive Sewerage Modernisation Program	Program	City Council	2012	<p>Comprehensive program of modernisation of sewerage system in Lviv for 2012-2015 from 20.09.2012 Resolution № 1742 (The program has been extended for 2016-2020 and amended in addition to the approval of 933-20160) https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>The state of the City sewerage system is described: 639.4 km of sewer networks; 13 Sewage Pumping Stations and sewage treatment plants.</p> <p>The expected results are:</p> <ul style="list-style-type: none"> • Improvement of the environmental situation in the city; • Increasing of the wastewater treatment efficiency; • Improvement of the reliability of existing plant operation; • Reduction of energy consumption; • Establishment of own thermal and electrical energy production; • Reduction of the cost of repair and maintenance work.

Table A1.2.7 – Solid Waste

Solid Waste				
Name	Type	Author	Year	Brief description
Municipal Infrastructure Development Program of Ukraine	Court	City Council	2016	<p>On definition of the LKP transport company "Lvivspetskomuntrans" for participation in the project "Municipal Infrastructure Development Program" and granting permission to conclude a loan transfer agreement from 30.06.2016 Resolution № 625</p> <p>https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>Law of Ukraine "On ratification of the Financial Agreement for the project "Municipal Infrastructure Development Program of Ukraine ".</p> <p>The project "Integrated Improvement of Solid Waste Management System in Lviv" is designed to pave the way for a loan of up to €45 million for the construction of a new landfill for solid domestic waste and an associated waste processing plant.</p>
Loan for Solid Waste Management Project	Court	City Council	2018	<p>On approval of the European Bank for Reconstruction and Development terms, for the implementation of the solid waste management project in Lviv from 19.04.2018 Resolution № 3261</p> <p>https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>The amount of the loan is €25 million of which €20 million is from EBRD general funds and €5 million is from the Clean Technology Fund.</p> <p>The project "Integrated Solution of Waste Management Problems" includes the rehabilitation of the waste dump in the village of Grybobychi and construction of a modern waste recycling complex. The feasibility study of the project was carried out by the French engineering company EGIS at the expense of the French government.</p>
Lviv Wastewater Biogas Project	Credit	EBRD	2017	<p>Project ID 45779. Funding source EBRD, E5P, NEFCO, JFN. Anaerobic Digestion Plant</p> <p>http://eco-forum-lviv.com.ua/wp-content/uploads/2018/10/3_6-Vankovych.pdf</p> <p>The biogas plant project consists of a station for digestion of sludge mixture and excessive active sludge. Gas from methane tanks is used, after purification, in gas generators (cogeneration units), which will produce electricity and heat. The total cost of the project is estimated at €31.5 million.</p> <p>€20 million were granted in the form of a loan from the EBRD (€15 million) and NEFCO (€5 million), and additional financing was provided in the form of grants from the Eastern European Partnership for Environment and Energy Efficiency (€7.5 million). €4 million was covered by local funding.</p>

Waste Management Program for Household Electronic and Electrical Equipment	Program	City Council	2018	<p>Integrated municipal waste management program of household electronic and electrical equipment on the territory of Lviv City Council for 2018-2021 from 25.01.2018 Resolution № 2910</p> <p>https://www8.city-adm.lviv.ua/inTEAM/Uhvaly.nsf</p> <p>The program describes the background to the program development:</p> <ul style="list-style-type: none"> • An urgent need for further improvement of waste management in the City; • The separation of hazardous waste from the general waste; • Improvement of service provision in the field of waste management; • Implementation of European standards in the sphere of Hazardous Waste (Waste classes I-III totalled 2,102 tonnes per year (tpa) of which: Class I - 30 tpa, Class II - 462 tpa, Class III - 1610 tpa). <p>An analysis of the existing state of waste management of household electronic and electrical equipment is described.</p> <p>The main priorities of the program are:</p> <ul style="list-style-type: none"> • Reduction of hazardous waste disposal; • Creation in the territory of Lviv City Council a uniform mechanism of waste management of household electronic and electrical equipment; • Introduction of an effective management system for household electronic and electrical equipment at the municipality level.
"Make Lviv Better" Project Support Program	Program	City Council	2016	<p>Programs to provide financial support to public organizations for the implementation of social and cultural projects "Make Lviv the Best" from 04.02.2016 Resolution № 130</p> <p>https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>The program provides financial support to public and other non-profit organizations for organisation and conducting of competitions and co-financing of social and cultural projects at the expense of Lviv municipal budget. These events could cover environmental issues.</p> <p>The expected results are:</p> <ul style="list-style-type: none"> • Expansion and improvement of the quality of social and cultural services received by residents of Lviv; • Establishment of partnership relations between government and non-governmental organizations.

Table A1.2.8 – Land Use and Biodiversity

Land Use				
Name	Type	Author	Year	Brief description
Parks Retention Programs	Program	City Council	2018	<p>Lviv city Parks' retention programs for 2018-2021 from 25.01.2018 Resolution № 2909 https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>The total area of urban parks in Lviv is 1,229.71 hectares, including those of the Natural Reserve Fund – 654.57 hectares.</p> <p>The program's objectives are: to create an ecological equilibrium between society and nature; to create proper conditions for short-term leisure of the population; to ensure compliance with cleanliness requirements for the maintenance of green economy facilities in the parks of the city; to strengthen the physical and mental health of city residents through the organisation of conditions for short-term recreation.</p> <p>The expected results of the program include:</p> <ul style="list-style-type: none"> • To increase the number and surface area of the green spaces in Lviv; • To provide timely and qualified care of trees and shrubs; • To ensure a systematic restoration of lawns and flower gardens; • To reduce the threat of falling trees due to strong wind and age of trees; • To reduce the damage to trees from pests and diseases.
"Scientific-Smart Micro-district" project	Program	City Council	2017	<p>Program of implementation of the innovative project "Scientific-Smart Microdistrict" from 29.06.2017 Resolution № 2154 https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>This project addresses the priority needs of the "Naukova" district's residents and will be implemented in accordance with the principles of "new urbanism", using innovative approaches and practices in the fields of infrastructure, landscaping, education, culture and medicine. The district includes 84 multi-apartment buildings, 22 public transport stops, 20 educational establishments (kindergartens, schools, colleges) 10 public spaces, 2 medical establishments, 9 shopping centres, 3 religious buildings, 3 business centres, Lviv City Employment Centre).</p> <p>The expected results are:</p> <ul style="list-style-type: none"> • Effective introduction of innovative technologies in the neighbourhood with further widespread roll out to the whole city; • Optimisation of traffic and public transport; • Increase the effectiveness of information systems; • Raise the education level, security, and comfort of the inhabitants up to European standards.

Biodiversity				
Name	Type	Author	Year	Brief description
Program of assistance to wild and exotic animals and birds	Program	City Council	2018	<p>The program of assistance to wild and exotic animals and birds in the city of Lviv for 2019-2023 from 08.11.2018 Resolution № 4157</p> <p>https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>An analysis of the situation in the field of wildlife and bird management, conducted by scientists, NGOs and Lviv City Children's Ecological and Naturalistic Centre (LMDEC) concluded that the current system of salvage and rescue of wild animals and birds in Lviv is not regulated and is ineffective.</p> <p>Mechanisms for ensuring the Program implementation include:</p> <ul style="list-style-type: none"> • Provision of qualified veterinary assistance to wild and exotic affected animals in specialised clinics; • Rehabilitation of the affected wild and exotic animals in shelters with subsequent return to their natural environment; • Transfer of wild animals and birds (including those listed in the Red Data Book of Ukraine), which are not able to return to their natural environment to certified zoological gardens/shelters and to regional environmental protection agencies; • The use of best practices of European countries to protect and assist wild animals and birds.
Landscape Reserve «Peat Bog Belogorsk»	Solution	MissьKa Council	2019	<p>Landscape Reserve of local importance "Peat Bog Bilogorsk"</p> <p>The local council agreed to the creation of a natural-reserved fund — Landscape Reserve of local importance "Peat Bog Belogorsk" with an area of 58.8 hectares which is not intended for property development or other uses.</p> <p>The aim of the resolution is to preserve the unique peat bog complexes with the deepest deposits of peat in the region.</p>

Table A1.2.9 – Resilience

Resilience				
Name	Type	Author	Year	Brief description
Major civil protection measures in 2019.	Plan	Executive Committee of the City Council	2019	<p>Plan of the main measures for civil protection of Lviv for 2019, and organizational and methodical guidelines for the preparation of the population of Lviv on how to act in emergency situations for 2019 (February 22, 2019)</p> <p>https://city-adm.lviv.ua/news/society/emergency/</p> <p>These measures aim to organise and implement plans with the objective of ensuring the readiness of the authorities, forces of civil protection, training of management personnel and specialists of executive bodies and local authorities whose activities relate to the organisation and implementation of civil protection measures, training of the population on how to act in the event of emergency situations, as well as monitoring the status of civil protection measures at the state , regional and local levels.</p>
Program for protection of people and territories from emergency situations	Program	City Council	2018	<p>Urban Target Program for the Protection of Population and Territories against Man-made and Natural Emergencies for 2018-2020 from 15.02.2018 Resolution № 3022</p> <p>https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf/</p> <p>In 2018 in Lviv, more than 100 personnel and 40 units of various types of fire and rescue equipment, which annually act on more than 2000 cases of different kinds of situations, are active. In the subordinate fire-rescue units of the Central Administrative Department of Ukraine in the Lviv region, located in the territory of Lviv City, there are 5 fire engines with lifting height up to 30m, as well as one modern 53m fire engine ladder.</p> <p>The program involves the purchase of European lightweight fire-fighting vehicles, a fire engine with a lifting height up to 30m, the purchase of fire-safety equipment, special clothing and equipment, the purchase of fire extinguishers and construction of a fire station.</p>

Program for the accumulation of radiation and chemical protection	Program	City Council	2017	<p>Programs for the accumulation of radiation and chemical protection facilities for officers of the city Council and the non-working population living in the projected zones of chemical contamination in the city, for 2018-2027 from 21.12.2017 Resolution № 2798</p> <p>https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>As of 01.01.2017 the provision of individual protection equipment for combatting poisonous substances in the case of the use of nuclear weapons and other weapons of mass destruction against Ukraine is very low. The provision of protection equipment to combat the release of chemicals from industrial premises is good for the workers in those industries but poor for the surrounding population. Provision of radiation detection and dosimetric control devices is only present in the civil protection agencies.</p> <p>The activities of the program include providing protection equipment to the non-working population living in the predicted zones of chemical pollution around chemical-hazardous facilities and to the employees of Lviv City Council. Education and support in the use of radiation and chemical protection and dosimetric and chemical control devices will also be provided.</p>
Program for provision of fire safety in cultural institutions	Program	City Council	2018	<p>Program of provision of Fire safety in Lviv cultural institutions for 2019-2023 from 20.12.2018 Resolution № 4408</p> <p>https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf</p> <p>This program aims to improve fire safety in Lviv cultural institutions through a phased program of measures from 2019-2023, in accordance with the requirements of regulatory documents on fire safety and protection of employees, visitors to cultural institutions and the general population in the case of emergencies.</p> <p>The main activities of the program are:</p> <ul style="list-style-type: none"> • Provision of suitable fire protection systems in establishments with a large presence of people; • Reduction of the emergency risks associated with fires that endanger life and health of workers and visitors to cultural institutions; • Timely intervention of fire stations notified through fire protection systems; • Provision of sufficient fire extinguishing equipment for elimination of fires by supplying water via fire hydrants, internal sprinkler systems, etc.

Annex 2 - Indicator Fact Sheets

Executive Summary

The table below provides a summary of the State, Pressure and Response Indicators for Lviv

Explanatory notes:

- Scope (source of data/information available)
- Note (Info means information provided by the Lviv City Council)
- Trend (favourable – **green**, unfavourable – **red**, not observable/stable – **blue**, no time series data available – empty cell)

State and Pressure Indicators

No	Indicator	Flag	Scope	Note	Trend
State					
1	Average_annual_concentration_of_PM2.5		City	Estimate	
1.1	Average annual concentration of PM10		City	Estimate	
1.1.1	Average annual concentration of TSP		City	Data	
1.2	Average daily concentration of SO2		City	Data	
1.3	Average daily concentration of NOx		City	Data	
2	Biochemical Oxygen Demand (BOD) in rivers and lakes		City	Data	
2.1	Ammonium (NH4) concentration in rivers and lakes		City	Data	
3	Percentage of water samples in a year that comply with national potable water quality standards		City	Info	
4	Number of contaminated sites		City	Data	
4.1.a	Concentration of mercury in soil				
4.1.b	Concentration of cadmium in soil		City	Data	
4.1.c	Concentration of zinc in soil		City	Data	
4.2	Concentration of mineral oil in soil (using infrared spectroscopy)		City	Data	
5	Water Exploitation Index		National	Estimate	
6	Open green space area ratio per 100 000 inhabitants		City	Estimate	
6.1	Share of green space areas within urban limits		City	Estimate	
7	Abundance of bird species (all species)		City	Estimate	
7.1	Abundance of other species				
8	Annual CO2 equivalent emissions per capita		Oblast	Data	
8.1	Annual CO2 emissions per unit of GDP		Oblast	Data	
9	Estimated economic damage from natural disasters (floods, droughts, earthquakes etc.) as a share of GDP		City	Estimate	
9.1	Percentage of public infrastructure at risk		City	Estimate	
9.2	Percentage of households at risk		City	Estimate	
Pressure					
10	Average age of car fleet (total and by type)		City	Estimate	
10.1	Percentage of diesel cars in total vehicle fleet		City	Data	
10.2	Fuel standards for light passenger and commercial vehicles		National	Data	
10.3	Share of total passenger car fleet run by electric, hybrid fuel cell, Liquefied Petroleum Gas (LPG) and Compressed Natural Gas(CNG) energy (total and by type)		City	Data	

No	Indicator	Flag	Scope	Note	Trend
11	Transport modal share in commuting (cars, motorcycles, taxi, bus, metro, tram, bicycle, pedestrian)		City	Data	
11.1	Transport modal share in total trips		City	Data	
11.2	Motorisation rate		City	Estimate	
11.3	Average number of vehicles (cars and motorbikes) per household		City	Estimate	
11.4	Kilometres of road dedicated exclusively to public transit per 100 000 population		City	Data	
11.5	Kilometres of bicycle path per 100000 population		City	Info	
11.6	Share of population having access to public transport within 15 min by foot		City	Estimate	
11.7	Frequency of bus service		City	Estimate	
12	Average travel speed on primary thoroughfares during peak hour		City	Estimate	
12.1	Travel speed of bus service on major thoroughfares (daily average)		City	Estimate	
13	Interruption of public transport systems in case of disaster		City	Estimate	
13.1	Efficiency of transport emergency systems in case of disaster		City	Estimate	
14	Electricity consumption in buildings			Estimate	
14.1	Electricity consumption in residential building		City	Data	
14.2	Electricity consumption in non-residential buildings			Estimate	
15	Heating / cooling consumption in buildings, fossil fuels residential buildings, fossil fuels				
15.1	Heating / cooling consumption in residential buildings, fossil fuels		City	Estimate	
15.2	Heating / cooling consumption in non-residential buildings, fossil fuels				
15.3	Share of city enterprises with ISO50001/EMAS certification or similar		City	Data	
15.4	Total value of projects with green building certification as a share of the total value of projects granted a building permit per year				
16	Electricity consumption in industries, per unit of industrial GDP		Oblast	Data	
17	Heat consumption in industries, per unit of industrial GDP		Oblast	Data	
18	Heavy metals (Pb) emission intensity of manufacturing industries		Oblast	Data	
18.1	Fossil fuel combustion in industrial processes, per unit of industrial GDP		Oblast	Data	
18.2	Share of industrial energy consumption from renewable energy		Oblast	Data	
19	Share of industrial waste recycled as a share of total industrial waste produced		City	Data	
20	Percentage of industrial wastewater that is treated according to applicable national standards		City	Info	
21	Share of population with an authorised connection to electricity		City	Info	
21.1	Annual average number of electrical interruptions per year, per customer		City	Info	
22	Share of population with access to heating / cooling		City	Data	
23	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))		National	Data	
24	Average share of population undergoing prolonged power outage in case of climatic extremes over the past 5 years		City	Info	
25	Water consumption per capita		City	Data	

No	Indicator	Flag	Scope	Note	Trend
25.1	Water consumption per unit of city GDP		Oblast	Data	
25.2	Unit of water consumed in power plants, per unit of primary energy generated				
25.3	Industrial water consumption as percent of total urban water consumption		City	Data	
26	Non-revenue water		City	Info	
26.1	Annual average of daily number of hours of continuous water supply per household		City	Info	
27	Percentage of residential and commercial wastewater that is treated according to applicable national standards		City	Info	
27.1	Percentage of buildings (non-industrial) equipped to reuse grey water		City	Info	
27.2	Percentage of wastewater from energy generation activities that is treated according to applicable national standards		City	Info	
28	Percentage of dwellings damaged by the most intense flooding in the last 10 years		City	Estimate	
28.1	Annual number of storm water/sewerage overflows per 100km of network length		City	Estimate	
28.2	Awareness and preparedness to natural disasters		City	Estimate	
29	Total solid waste generation per capita		City	Data	
29.1	GDP per domestic material consumption				
30	Share of the population with weekly municipal solid waste (MSW) collection		City	Info	
31	Proportion of MSW that is sorted and recycled (total and by type of waste e.g. paper, glass, batteries, PVC, bottles, metals)		City	Info	
31.1	Percentage of MSW which is disposed of in open dumps, controlled dumps, or bodies of water or is burnt				
31.2	Percentage of MSW landfilled disposed of in EU-compliant sanitary landfills		City	Info	
31.3	Percentage of collected MSW composted		City	Info	
32	Remaining life of current landfill(s)		City	Info	
33	Population density on urban land		City	Data	
33.1	Average commuting distance		City	Estimate	
33.2	Average commuting time		City	Estimate	
33.3	Proportion of the population living within 20 minutes to everyday services (grocery stores, clinics, etc.)		City	Estimate	
34	Average annual growth rate of built-up areas		City	Data	
34.1	Percentage of urban development that occurs on existing urban land rather than on greenfield land		City	Estimate	
35	Vacancy rates of offices		City	Estimate	
35.1	Share of multi-family houses in total housing units				

Response Indicators

Transport		
36	High-polluting vehicles are regulated / Energy-efficient vehicles are incentivised through fiscal instruments	
37	Extension and improvement of public and non-motorised transport is planned and supported through investment in place	
38	Public and non-motorised transport is promoted through Information and awareness campaigns	
39	Traffic demand is managed (congestion charges, smart technologies)	
40	Public transport emergency management (in publicly and/or privately run networks) is planned and tested	
Buildings		
41	Green building is promoted through standards and fiscal Incentives	
42	Public and private investment in energy efficiency in buildings	
43	Metering and billing for personal energy use is regulated	
Industries		
44	Energy efficient industrial machinery is regulated and incentivised through fiscal instruments (electricity, heat, industrial processes).	
45	Energy efficient industrial technologies (electricity, heat, industrial processes) is supported through private investment	
46	Material efficiency of new built industrial facilities and waste recycling is regulated and incentivised through fiscal instruments	
47	Industrial wastewater treatment / reuse / recycle is promoted through regulations and fiscal incentives	
Energy		
48	Coverage and quality of electricity and heat supply is improved through investment	
49	Renewable energy facilities in private buildings are incentivised through fiscal instruments	
50	Renewable energy technologies are developed and supported through public and private investment	
51	Renewable energy facilities are incentivised through awareness campaigns	
52	The resilience of electricity networks in case of disaster is tested and enhanced through investment	
Water		
53	Metering and billing for water use is regulated	
54	Water saving / reuse is encouraged through awareness campaigns	
55	Coverage and efficiency of water supply networks is improved through plans and investment	
56	Buildings' access to wastewater collection and treatment systems is improved through plans and investment	
57	Wastewater treatment is promoted through regulations and fiscal incentives	
58	Wastewater billing is regulated	
59	Drinking water pre-treatment is enhanced through plans and investment	
60	Drainage facilities are developed through plans and investment	
61	Business and community resilience is encouraged through awareness campaigns	
Waste		
62	Reduction of material consumption / solid waste generation is promoted through awareness campaigns	
63	Coverage of solid waste collection system is improved through plans and investment	

64	Littering and non-compliance to sorting systems is dis-incentivised through fines and penalties	
65	Composting, recycling and waste-to-energy facilities are developed through plans and investment	
66	Solid waste reuse, sorting and recycling is promoted through information and awareness campaigns	
67	Overcapacity issues in landfills are tackled through plans and investment	
Land Use		
68	Density is regulated	
69	Transit-Oriented Development is promoted	
70	Mixed-use development is promoted through zoning regulations / incentives	

Factsheets

The Factsheets below provide more information on the sources of data and the estimates made (where applicable)

State Indicators

Indicator 1

Core Indicator 1: Average annual concentration of PM_{2.5}

Introductory note: This fact sheet covers core indicator 1, optional indicators 1.1, 1.2 and 1.3 and additional indicator 1.1.1.

Data on concentrations of PM_{2.5} and PM₁₀ are not available for Lviv (and for the whole Ukraine) as only concentrations of TSP (total suspended particulates) are being monitored.

Measurements are being carried out by the specialized laboratory of the Lviv Municipal Enterprise “Administrative-technical Utility”. In 2013, 2014 and 2015, 100 periodic measurements were carried out annually at 25 cross-roads within the city. In 2016 and 2017, 120 periodic measurements were carried out annually at 30 crossroads.

Regional Hydro-meteorological Centre Lviv has carried out measurement at 4 sites (Yunakiva Street, Goroditska Street, Soborniy Street, Zelena street)

Available data for 2013 - 2017 (average annual concentrations and maximum daily concentrations) for TSP (dust), sulphur dioxide (SO₂) and nitrogen dioxide (NO₂) are presented in the following table:

Pollutant	Unit	2013	2014	2015	2016	2017	2018	Average
TSP – annual average	microg/m ³	170	180	170	158	154		166
TSP – maximum daily		n.a.	500	600	n.a.	n.a.		550
SO ₂ – annual average		29	16	14	15	12		17
SO ₂ – maximum daily		n.a.	58	85	n.a.	n.a.		72
NO ₂ – annual average		50	40	34	41	42		41
NO ₂ – maximum daily		n.a.	160	200	n.a.	n.a.		180

Source:

РЕГІОНАЛЬНА ДОПОВІДЬ ПРО СТАН НАВКОЛИШНЬОГО ПРИРОДНОГО СЕРЕДОВИЩА У ЛЬВІВСЬКІЙ ОБЛАСТІ В 2015, РОЦІ (State of the Environment Report of the Lviv Region for 2015). Lviv Regional Administration Lviv 2016. See https://loda.gov.ua/eco_stan_dovkillya (in Ukrainian language only)

ЗБІТ про результати моніторингу природного довкілля Львівщини за 2016 рік. (Report on the Results of Environmental Monitoring in the Lviv Region. Lviv Region Administration 2017,

See: <https://drive.google.com/file/d/0B5k29GLVONouNkVwYTIRTGtmY2s/view>

ЗБІТ про результати моніторингу природного довкілля Львівщини за 2017 рік. (Report on the Results of Environmental Monitoring in the Lviv Region. Lviv Region Administration 2018)

See: <https://drive.google.com/file/d/1SP1CDSlu6svQ1vFLU9efrO8erIGcQKPX/view?usp=sharing>

Trend: Favourable (decreasing) trend for all three air pollutants can be observed.

Extremely high values of TSP concentrations could be caused by the application of the obsolete Soviet methodology where samples were taken in daily time of working days only (i.e. nights and weekend days with much lower intensity of traffic were not covered by measurements).

Recalculation of TSP concentration to the concentrations of PM₁₀ and PM_{2.5} cannot be done easily due to the difference in monitoring methodologies between the EU and Ukraine.

However, as emissions from road transport represent huge majority (93 %) of total emissions of dust in Lviv (energy sector is based on natural gas and combustion of solid fuels is rather very low), concentrations of PM₁₀ and PM_{2.5} in the air can be considered equal to those of TSP (exhaust emissions include 100 % of PM_{2.5}). On the other side, a part of TSP from road transport could be attributed to the wear of brakes (cars, LDVs, HDVs, trams, trolleybuses, buses), tyres (cars, LDVs, HDVs, buses, trolleybuses), rails (trams) and road surfaces (cars, LDVs, HDVs, buses, trolleybuses).

As emissions of particles originated in wears of brakes, tyres, rails and road surfaces include not only PM_{2.5} but also considerable parts of PM₁₀ and TSP, real concentrations of PM₁₀ and PM_{2.5} are little lower, however quantification of particular concentrations is not possible due to the lack of data.

The presented values of PM₁₀ and PM_{2.5} concentrations used for indicators should be considered upper estimates.

Benchmark – 2014 - 2017

Pollutant	Unit	Latest	Average	Green	Amber	Red
TSP – annual average	□g/m ³	154	166	< 30	30 - 70	> 70
TSP – maximum daily value			550			
PM _{2.5} – annual average		154	166	< 10	10 - 20	> 20
PM _{2.5} – maximum daily value			550			
PM ₁₀ – annual average		154	166	< 20	20 - 50	> 50
PM ₁₀ – maximum daily value			550			
SO ₂ – annual average		12	17	< 20	20 - 50	> 50
SO ₂ – maximum daily value			72			
NO ₂ – maximum daily value			180			

Indicator 2

Core Indicator 2: Biochemical Oxygen Demand (BOD) in rivers and lakes

Introductory Note: This factsheet covers core indicator 2 Biochemical Oxygen Demand (BOD) in rivers and lakes and optional indicator 2.1 Ammonium in rivers and lakes.

At present 35 sampling points are located at the surface water bodies in Lviv. Available data of BOD₅ (in mg of O₂ /liter) and ammonium concentrations (in mg of N/liter) are presented in the following table:

	2010	2011	2012	2013	2014	2015	2016	2017	2018	Average
BOD ₅										
Max					75.55	34.85	27.50	25.0		40.73
Min					10.1	8.8	8.0	8.0		8.73
Mean					20.54	15.98	14.65	15.41		16.65
Ammonium										
Max					27.4	10.31	10.70	7.60		14.00
Min					0.12	0.24	0.24	0.30		0.23
Mean					3.78	2.92	2.83	4.52		3.51

Source:

РЕГІОНАЛЬНА ДОПОВІДЬ ПРО СТАН НАВКОЛИШНЬОГО ПРИРОДНОГО СЕРЕДОВИЩА У ЛЬВІВСЬКІЙ ОБЛАСТІ В 2015 РОЦІ (State of the Environment Report of the Lviv Region for 2015). Lviv Regional Administration Lviv 2016. See https://loda.gov.ua/eco_stan_dovkillya (in Ukrainian language only)

ЗБІТ про результати моніторингу природного довкілля Львівщини за 2016 рік. (Report on the Results of Environmental Monitoring in the Lviv Region. Lviv Region Administration 2017,

see <https://drive.google.com/file/d/0B5k29GLV0NouNkVwYTIRTGtmY2s/view>

ЗБІТ про результати моніторингу природного довкілля Львівщини за 2017 рік. (Report on the Results of Environmental Monitoring in the Lviv Region. Lviv Region Administration 2018,

See <https://drive.google.com/file/d/1SP1CDSlu6svQ1vFLU9efrO8erlGcQKPX/view?usp=sharing>

Note: In the case of “min” and “max” values, the lowest and highest value from all 35 sampling points is presented while in the case of “mean” values the arithmetic average of values from the sampling points is presented.

Benchmark

		Unit	Last	Average	Green	Amber	Red
2	BOD ₅	mg of O ₂ /liter	15.41	16.65	< 2	2 - 4	> 4
2.1	Ammonium	mg of N/liter	4.52	3.51	< 0.15	0.15 – 0.20	> 0.20

Additional information:

100 % of drinking water in Lviv comes from groundwater (180 artesian boreholes).

Indicator 3

Core indicator 3: **Percentage of water samples in a year which comply with national potable water quality standards**

According to Lviv Municipal Company “Vodokanal”, which supplies drinking water for Lviv, **98 - 99% of water samples is in accordance with the National health standards.**

Benchmark

Unit	Value	Green	Amber	Red
%	98	>97	90 - 97	< 90

Trend: **No time series available.**

Indicator 4

Core indicator 4: **Number of contaminated sites**

Optional indicators: **4.1a, 4.1.b, 4.1.c and 4.2**

Data for optional indicator 4.1.a is not available (concentrations of Hg in soil are not being measured).

Certain data for indicators 4, 4.1.b, 4.1.c and 4.2 for 2014 is available in “РЕГІОНАЛЬНА ДОПОВІДЬ ПРО СТАН НАВКОЛИШНЬОГО ПРИРОДНОГО СЕРЕДОВИЩА У ЛЬВІВСЬКІЙ ОБЛАСТІ В 2014 РОЦІ (State of the Environment Report of the Lviv Region for 2014). Lviv Region Administration Lviv 2015.

See https://loda.gov.ua/eco_stan_dovkillya (in Ukrainian language only)

Note: Contaminated site is understood as a site at which national standard is exceeded (amber colour in the table below)

Indicator	4	4.1.b	4.1.c	4.2
Site	Number	Cd in soil	Zn in soil	Oil products in soil
Units		mg/kg		
State Enterprise "Lviv State Aviation Repair Plant" (Lviv)	-		11.52	93.3
Lviv state-owned experimental enterprise of means of movement and prosthetics (Lviv)	-	0.85	4.23	230
OJSC "Lvivpikizol" (Lviv)	1 ¹	0.78	18.34	1590

Benchmark

For benchmarking, the worst (highest) values have been chosen.

Indicator	x	Unit	Value	Green	Amber	Red
4	Number of contaminated sites per 1000 inhabitants	#	1	< 10	10 - 20	> 20
4.1.b	Cd in soil	mg/kg	0.85	< 0.8	0.8 - 12	> 12
4.1.c	Zn in soil		18.34	< 140	140 - 720	> 720
4.2	Oil products in soil		1590	< 50	50 - 5000	> 5000

Indicator 5

Core indicator 5: Water Exploitation Index

National level

	Unit	2010	2011	2012	2013	2014	2015	2016	2017
Freshwater abstracted	Million km ³	14.85		14.65	13.63	11.82	9.70	9.91	9.92
Total Renewable Water Resources (TRWR)		175.3 (Long-term average)							
WEI	%	8.47		8.36	7.78	6.74	5.53	5.65	5.66

Sources:

Aquastat Country Fact Sheet !Ukraine

http://www.fao.org/nr/water/aquastat/data/cf/readPdf.html?f=UKR-CF_eng.pdf (TRWR)

Ukrstat: Fresh water abstraction: Statistical Yearbook Environment in Ukraine 2016

Benchmark

Unit	Latest value	Green	Amber	Red
%	5.66	< 20	20 - 40	> 40

Trend: Decrease followed by stabilisation.

WEI at national level is fairly below the threshold value of 20.

Conclusion

WEI value for Lviv cannot be estimated due to non-availability of data (TRWR). However, it can be estimated that is not so different from the national value and remains fairly below 20 (green benchmark).

¹ National standard for Pb exceeded.

Indicator 6

Core Indicator 6: Open green space area ratio per 100 000 inhabitants

Introductory note: This fact sheet covers core indicator 6 and optional indicator 6.1 (Share of green space areas within urban limits).

The standard land resources statistics include the following categories: agricultural land, built-up land, forest land, open marshy land, open land without vegetation, surface water areas. Forest areas were chosen as the best representative of open green space.

Between 2010 and 2015, 3 403 hectares of forest areas within the Lviv city area is presented by Ukrstat while the whole city area represents 17101 hectares.

According to the Lviv City Council, Department of Land resources, the total area of parks represents additional 1 075 hectares

Year		2010	2011	2012	2013	2014	2015	2016	2017	2018
Forest area	ha	3 403	3 403	3 403	3 403	3 403	3 403	3 403	3 403	3 403
Park area	ha	1 075	1 075	1 075	1 075	1 075	1 075	1 075	1 075	1 075
Total green spaces area	ha	4 478	4 478	4 478	4 478	4 470	4 478	4 478	4 478	4 478
city area	ha	17101	17101	17101	17101	17101	17101	17101	17101	17101
Population	million	0.762	0.760	0.758	0.759	0.758	0.759	0.758	0.759	0.758
Indicator 6	m ² /capita	58.8	58.0	59.1	59.0	59.1	59.0	59.1	59.0	59.1
Indicator 6.1	%	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2

Source: Ukrstat Lviv Database (available in English) – see <http://www.lv.ukrstat.gov.ua/eng/engl.php>

According to the Lviv City Council, recent area of open green spaces represents 26 % of total Lviv city area and counts for 65 m² per capita.

Benchmark- core indicator 6

Unit	Latest figure	Green	Amber	Red
m ² /capita	59.1	>10	7-10	<7

Benchmark – optional indicator 6.1

Unit	Latest figure	Green	Amber	Red
%	26.2	>50	30-50	<30

Indicator 7

Core indicator 7: Abundance of bird species (all species)

Data for optional indicator 7.1 (Abundance of all species) is at Lviv municipal level is not available.

According to information provided by Professor Bokotej from the Lviv National Museum of Natural History, the results of the long-term research on the abundance of bird species in Lviv are as follows:

Bird species	Nesting pairs			Dynamics
	1994	2006	2018	
Passer domesticus	18000	7000	3300	-445.45%
Columba livia	6000	7000	18000	200.0 %
Streptopelia decaocto	2500	1000	900	-177.78%
Apus apus	2000	1000	900	-122.22%
Delichon urbica	1300	900	600	-116.67%
Fringilla coelebs	900	900	600	-50.00%
Parus major	700	1400	1800	157.14%
Sturnus vulgaris	550	750	900	63.64%
Phoenicurus ochruros	450	900	1300	188.89%
Sylvia atricapilla	250	700	600	140.00%
Columba oenas	30	21	15	-100.00%
Sum	32 680	21571	28915	-11.5 %

It can be concluded that the annual change between 1994 and 2018 is at the level of 0.5 % (slight decline).

Benchmark – core indicator 7

Unit	Trend	Green	Amber	Red
Annual % of change	Slight decline	Positive or stable	Slight decline (0-2 %)	Strong decline (> 2 %)

Indicator 8

Core indicator 8: Annual CO₂ equivalent emissions per capita

Introductory note: This factsheet covers core indicator 8 and optional indicator 8.1 (Annual CO₂ emissions per unit of GDP)

Oblast level

Available data at the oblast level are presented in the following table (CO₂ emissions without LULUCF):

Note: GDP in current prices recalculated using respective exchange rates

	Unit	2010	2011	2012	2013	2014	2015	2016	2017
CO ₂ emissions from stationary sources	Mt CO ₂ eq.	2.20	3.10	3.70	3.90	3.40	3.4	3.5	3.9
CO ₂ emissions from mobile sources	Mt CO ₂ eq.	1.79	1.75	1.76	1.78	1.68	1.48	1.40	1.42
CO ₂ emissions total	Mt CO ₂ eq.	3.99	4.85	5.46	5.68	5.08	4.88	4.90	5.32
Population	million	2.547	2.543	2.541	2.540	2.538	2.536	2.534	2.532
6 Emissions per capita	Tons per capita	1.57	1.90	2.15	2.24	2.00	1.94	1.93	2.10
GDP (current prices)	UAH billion	41.65	52.19	61.96	63.33	72.92	94.69	114.8	

Exchange rate	UAH/USD	10.41	7.99	7.99	7.99	11.89	21.85	25.57	
GDP current prices)	USD billion	4.001	6.529	7.755	7.926	6.133	4.334	4.490	
6.1 Emissions per GDP	ton/USD million	0.001	0.0007	0.0007	0.0007	0.0008	0.0011	0.0011	

Source: Ukrstat Lviv Database – see <http://www.lv.ukrstat.gov.ua/eng/engl.php>

Supporting calculations – emissions from transport

Note: Conversion factors CO₂ / fuel 3.30 for petrol and 3.15 for diesel

	Unit	2010	2011	2012	2013	2014	2015	2016	2017
Consumption of petrol	kt	237.5	217.5	204.5	190.5	176.5	144.3	136.1	126.7
Consumption of diesel	kt	321.4	324.0	346.5	366.0	350.5	316.5	302.2	316.9
CO ₂ emissions from petrol vehicles	Mt CO ₂	0.78	0.72	0.67	0.63	0.58	0.48	0.45	0.42
CO ₂ emissions from diesel vehicles	Mt CO ₂	1.01	1.03	1.09	1.15	1.10	1.00	0.95	1.00
CO ₂ emissions from mobile sources	Mt CO ₂	1.79	1.75	1.76	1.78	1.68	1.48	1.40	1.42

Source: Ukrstat Lviv Database – see <http://www.lv.ukrstat.gov.ua/eng/engl.php>

Benchmark – core indicator 8, optional indicator 8.1 - oblast level

	Unit	Latest value	Green	Amber	Red
8 CO ₂ emissions per capita	t CO ₂ eq.	2.1	< 5	5 - 10	> 10
8.1 CO ₂ emissions per GDP	t CO ₂ eq. /USD mil	0.0011	< 0.35	0.35 – 0.8	> 0.8

Discussion:

Lviv represents around one third of the oblast population but its annual emissions of CO₂ from stationary sources represent only up to 13 %. **It can be concluded that the values of both indicators are lower than those presented at the oblast level.**

Comment: Indicator per GDP is influenced by serious change in UAH/USD exchange rate between 2010 and 2016 as well as by the impact of parity of purchasing power. Real values of “per GDP” indicator are probably 4 – 5 times higher.

Indicator 9

Core indicator 9: **Estimated economic damage from natural disasters (floods, droughts, earthquakes) as a share of GDP**

This factsheet includes optional indicators 9.1 (Percentage of public infrastructure at risk) and 9.2 (Percentage of households at risk).

Recent available information:

According to the City Council serious natural disasters do not appear. The only issue mentioned were sewerage overflows due to storms or intensive rainfalls which were said to occur 2 – 3 times per year.

Therefore, the following default values are used in the indicator database:

Estimated economic damage from natural disasters as a share of GDP: 0.01 %

Percentage of public infrastructure at risk: 1 %

Percentage of households at risk: 1 %

Benchmark – core indicator 9 Estimated economic damage from natural disasters as a share of GDP

Unit	Latest figure	Green	Amber	Red
% of GDP	0.01	<0.5	0.5-1	>1

Benchmark – additional indicator 9.1 Percentage of public infrastructure at risk

Unit	Latest figure	Green	Amber	Red
%	1	<10	10-2	>20

Benchmark – additional indicator 9.2 Percentage of households at risk

Unit	Latest figure	Green	Amber	Red
%	1	<10	10-2	>20

Pressure Indicators

Indicator 10

Core Indicator 10: Average age of car fleet (total and by type)

Introductory note: This fact sheet covers core indicator 10 and optional indicators 10.1 (Percentage of diesel cars in total vehicle fleet), 10.2 (Fuel standards for light passenger and commercial vehicles) and 10.3 (Share of total passenger cars run by electric, hybrid fuel cell, LPG, CNG energy).

Information at national level

In 2016, 9.121 million cars and light duty vehicles were registered in Ukraine. The average age is estimated at as 19.6 years. See: <https://gazeta.ua/articles/avto/v-ukrayini-zroslo-kilkist-avtomobiliv-na-tisyachu-osib/680260>

According to Lviv City Council (Lvivavtodor), the average age of cars in Lviv can be estimated between 12 and 14 years (average 13 years).

Benchmark – Core indicator 10: Average age of car fleet

	Unit	Average	Green	Amber	Red
Average vehicle age	year	13	< 6	6 - 12	> 12

Even in the case of substantial improvement, the value of indicator would remain in the red category (the value of this indicator is “resistant” in time).

Optional indicator 10.1: Percentage of diesel cars in total vehicle fleet

Between 2011 and 2016, the following break-down of vehicle fleet by fuel was observed in Lviv: petrol (65 %), diesel (27 %), gas (7.9 %) and electricity (0.1 %).

See: http://ena.lp.edu.ua:8080/bitstream/ntb/43243/2/2018_Fedevich_O_lu-Analiz_zabrudnennia_avtomobilnym_94-97.pdf

Benchmark – optional indicator 10.1: Percentage of diesel cars in total vehicle fleet

	Unit	Actual value	Green	Amber	Red
Share of diesel vehicles	%	27	< 20	20 - 30	> 30

Optional indicator 10.2: Fuel standards for light passenger and commercial vehicles

National standards: DSTU 7687:2015 “Automobile gasoline Euro. Specifications” and DSTU 7688:2015 “Diesel fuel Euro. Specifications” were developed and are in force in Ukraine. In those standards gasoline and diesel fuel of Euro-5 category parameters meet the general technical requirements for gasoline and diesel fuel established in the European standards EN 228: 2012 and EN 590: 2013, respectively. According to the Technical Regulations from 01/01/2018, the

use of gasoline and diesel fuel in the Ukraine's fuel market is allowed only for the Euro-5 category which comply with the general technical requirements for gasoline and diesel fuel, established in the European standards EN 228: 2012 and EN 590: 2013, respectively.

Benchmark – optional indicator 10.2: Fuel standards for light passenger and commercial vehicles

	Unit	Actual	Green	Amber	Red
Quality of fuels		EURO 5	EURO 6	EURO 5	EURO 4

Trend: **Positive** (changes in legislation)

Optional Indicator 10.3: Share of total passenger cars run by electric, hybrid fuel cell, LPG, CNG energy

Between 2011 and 2016, the following break-down of vehicle fleet by fuel was observed in Lviv could be divided among petrol (65 %), diesel (27 %), gas (7.9 %) and electricity (0.1 %). See: http://ena.lp.edu.ua:8080/bitstream/ntb/43243/2/2018_Fedevich_O_lu-Analiz_zabrudnennia_avtomobilnym_94-97.pdf

Benchmark – optional indicator 10.3: Share of total passenger cars run by electric, hybrid fuel cell, LPG, CNG energy

	Unit	Actual value	Green	Amber	Red
Share of total passenger cars run by electric, hybrid fuel cell, LPG, CNG energy	%	8	> 3	1 - 3	<1

Indicator 11

Core Indicator 11: Transport modal share in commuting (cars, motorcycles, taxi, bus, metro, tram, bicycle, pedestrian)

Introductory note: This factsheet covers core indicator 11 and optional indicators 11.1(Transport modal share in total trips), 11.2 (Motorisation rate), 11.3 (Average number of vehicles (cars and motorbikes) per household), 11.4 (Kilometres of road dedicated exclusively to public transit per 100 000 population), 11.5 (Kilometres of bicycle path per 100 000 population), 11.6 (Share of population having access to public transport within 15 min by foot) and 11.7 (Frequency of bus service).

Core Indicator 11: Transport modal share in commuting

According to the Lviv City Council (LvivAvtodor), the modal split in 2015 is presented in the following table (%):

	Walking	Cycling	Public transport	Cars
Workdays	21	2	54	23
Saturday	13	2	58	27
Sunday	34	1	42	23
Weighted average (rounded up)	22	2	53	24

Benchmark – Core Indicator 11: Transport modal share in commuting

	Unit	Latest value	Green	Amber	Red
Share of private car transport	%	24	< 30	30 – 50	> 50

Trend: **Negative** – increasing share of private car transport expected

Optional indicator 11.1: Transport modal share in total trips

Data for **optional indicator 11.1** is presented in the following table:

Passengers carried by general purpose transport types (million passengers)

	2010	2014	2015	2016	2017
Bus	145.9	125.1	109.6	93.3	90.4
Trolleybus	25.9	26.4	29.5	31.6	31.8
Tram	49.6	50.5	59.6	56.6	54.0
Total	221.4	202.0	198.7	181.5	176.2

Source: Ukrstat Lviv See http://database.ukrcensus.gov.ua/statbank_lviv/Dialog/statfile.asp?lang=1

Deducting walk and cycling, the shares of public transport and private cars in total trips could be estimated as 69 % and 31 %, respectively.

Benchmark – Optional Indicator 11.1: Transport modal share in total trips

	Unit	Latest value	Green	Amber	Red
Share of private car transport	%	31	< 30	30 – 50	> 50

Trend: **Negative** – increasing share of private car transport is expected

Optional indicator 11.2: Motorisation rate

According to AutoConsult (see https://gazeta.ua/articles/avto/_v-ukrayini-zroslo-kilkist-avtomobiliv-na-tisvachu-osib/680260), motorisation rate of Ukraine is 202 cars/1000 inhabitants and that of Kyiv 353 cars/1000 inhabitants. According to the Lviv City Authority, the total number of cars in Lviv can be estimated up to 200 000 which means that motorization rate of Lviv is 264/1000 inhab. (0.26).

Benchmark – Optional Indicator 11.2

	Unit	Latest value	Green	Amber	Red
Cars per capita - Lviv		0.26	< 0.3	0.3 – 0.4	> 0.4

Trend: **Negative** (increase)

Optional indicator 11.3: Average number of vehicles per household

Assuming that average household has 3 or 4 members, the number of households in Lviv can be estimated as 253 thousand or 190 thousand, the value of indicator accounts 0.79 – 1.05.

Benchmark – Indicator 11.3

	Unit	Latest value	Green	Amber	Red
Cars per household – 3 members		0.79	< 0.5	0.5 – 1	> 1
Cars per household – 4 members		1.05	< 0.5	0.5 – 1	> 1
Average		0.92			

Trend: **Negative** (increase)

It should be taken into account that the division of the total amount of cars between purely private ones and those used for business (taxi, corporate cars) is not available.

Optional indicator 11.4: Kilometres of road dedicated exclusively to public transport per 100 000 population

According to the Lviv City Council (LvivAvtodor) the total length of bus and trolleybus lanes accounts 5 km and tram lanes 19.4 km. The value of indicator is at the level of 3.2 km/100 thousand population.

Benchmark – Indicator 11.4

	Unit	Latest value	Green	Amber	Red
Kilometres of road dedicated exclusively to public transport per 100 000 population	Km/100 000 inhabitants	3.2	>40	10 – 40	<10

Trend: **Positive** (plans to increase the length)

Optional indicator 11.5: Kilometres of bicycle path per 100 000 population

According to the Lviv City Council (Lviavtodor) the total length of bicycle paths accounts 100 km. The value of indicator is at the level of 13.2 km/100 thousand population.

Benchmark – Indicator 11.5

	Unit	Latest value	Green	Amber	Red
Kilometres of bicycle path per 100 000 population	Km/100 000 inhabitants	13.2	>25	15 – 25	<15

Trend: **Positive** (plans to increase the length)

Optional indicator 11.6: Share of population having access to public transport within 15 minutes by foot

According to the Lviv City Council (Lviavtodor) accessibility of bus, trolleybus or tram stations within 15 minutes by foot represents 98 % of the city population.

Benchmark – Indicator 11.6

	Unit	Latest value	Green	Amber	Red
Share of population having access to public transport within 15 minutes by foot	%	98	>80	60 – 80	<60

Trend: **No time series**

Optional indicator 11.7: Frequency of bus service

According to the Lviv City Council (Lviavtodor) the average operating interval is 10 minutes which represents 6 passages of station per hour.

Benchmark – Indicator 11.7

	Unit	Latest value	Green	Amber	Red
Frequency of bus service	Average number of passages at station per hour	6	>30	30 – 6	<6

Trend: **No time series**

Indicator 12

Core indicator 12: Average travel speed on primary thoroughfares during peak hours

Introductory note: This factsheet covers core indicator 12 and optional indicator 12.1

According to Lviv City Council (Lviavtodor) the obvious speed of thoroughfares during peak hours is 11 km/hour.

Benchmark – core Indicator 12

	Unit	Latest value	Green	Amber	Red
Average travel speed on primary thoroughfares during peak hours	Km/hour	11	>30	15 – 30	<15

Trend: **No time series**

Optional indicator 12.1 – Travel speed of bus service on major thoroughfares (daily average)

According to Lviv City Council (Lviavtodor) the estimate of daily average is at the level of 14 km/hour.

Benchmark – optional indicator 12.1

	Unit	Latest value	Green	Amber	Red
Travel speed of bus service on major thoroughfares	Km/hour	14	>25	15 – 25	<15

Trend: **No time series**

Indicator 13

Core indicator 13: Interruption of public transport systems in the case of disaster

Introductory note: This factsheet covers core indicator 13 and optional indicator 13.1 (Efficiency of transport emergency systems in case of disaster).

Assumption: According to the Lviv City Council (Lvivavtodor), disasters do not occur in the Lviv area. The only problem mentioned are the overflows of storm water or sewerage which occur two or three times per year.

The expected impact can be in temporary close down of certain roads or tram lanes which can be solved through temporary bypasses and the impact on the public transport system capacity is very low (less than 20 %).

Benchmark – core Indicator 13 and optional indicator 13.1

			Green	Amber	Red
	Unit	Latest value	Sufficient	Partial	Insufficient
Functioning of public transport system in the case of disaster	%	80	>80	30 – 80	<20

Indicator 14

Core Indicator 14: Electricity consumption in buildings

Introductory note: This factsheet covers core indicator 14 and optional indicators 14.1 (Electricity consumption in residential buildings) and 14.2 (Electricity consumption in non-residential buildings).

Note: Ukrainian statistics presents two figures for floor area in residential buildings: living rooms and all rooms.

Data for Lviv are presented in the following tables for both options:

Assumptions:

- Electricity consumption in residential buildings represents 53.5 % of total electricity consumption in buildings²
- Floor area of non-residential buildings is estimated at the level of 24 % of total floor area³
- 45 % of electricity in Ukraine is generated in fossil fuels fired plants (IEA)

² Information provided by Ukrenergo.

³ Average value for 29 European countries taken from <http://www.entranze.enerdata.eu/share-of-non-residential-in-total-buildings-floor-area.html>

Table A: Living rooms in residential buildings included in floor area

	Unit	2016	2017
Electricity consumption – all buildings	GWh	1467	1301
Floor area – all buildings	Million m ²	12.65	13.14
Electricity consumption – all buildings	kWh/m ²	116.0	99.0
Fossil electricity consumption – all buildings	kWh/m ²	52.2	44.6
Electricity consumption - residential buildings	GWh	784.8	696.0
Floor area residential buildings - living rooms	Million m ²	9.615	9.984
Electricity consumption - residential buildings	kWh/m ²	81.6	69.7
Fossil electricity consumption – residential buildings	kWh/m ²	36.7	31.4
Electricity consumption – non-residential buildings	GWh	682.2	605.0
Floor area – non-residential buildings	Million m ²	3.035	3.156
Electricity consumption – non-residential buildings	kWh/m ²	224.8	191.7
Fossil electricity consumption – non-residential buildings	kWh/m ²	101.1	86.3

Source: Ukrstat (floor area) See <http://www.lv.ukrstat.gov.ua/eng/engl.php>
Table B: All rooms in residential buildings included in floor area

	Unit	2016	2017
Electricity consumption – all buildings	GWh	1467	1301
Floor area – all buildings	Million m ²	18.519	19.377
Electricity consumption – all buildings	kWh/m ²	79.2	67.1
Fossil electricity consumption – all buildings	kWh/m ²	35.6	30.2
Electricity consumption - residential buildings	GWh	784.8	696.0
Floor area residential buildings - all rooms	Million m ²	15.484	16.221
Electricity consumption - residential buildings	kWh/m ²	50.7	42.9
<i>Fossil electricity consumption – residential buildings</i>	<i>kWh/m²</i>	<i>22.8</i>	<i>19.3</i>
Electricity consumption – non-residential buildings	GWh	682.2	605.0
Floor area – non-residential buildings	Million m ²	3.035	3.156
Electricity consumption – non-residential buildings	kWh/m ²	224.8	191.7
<i>Fossil electricity consumption – non-residential buildings</i>	<i>kWh/m²</i>	<i>101.1</i>	<i>86.3</i>

Benchmark – living rooms in residential buildings included in floor area

	Unit	Average	Green	Amber	Red
All buildings	kWh/m ²	107.5	< 47	47 - 75	> 75
Residential buildings		75.7	< 21	21 - 26	> 26
Non-residential buildings		208.3	< 122	122 - 213	> 213

Benchmark – living rooms in residential buildings included in floor area

	Unit	Average	Green	Amber	Red
All buildings	kWh/m ²	73.2	< 47	47 - 75	> 75
Residential buildings		46.8	< 21	21 - 26	> 26
Non-residential buildings		208.3	< 122	122 - 213	> 213

Indicator 15

Core indicator 15: Heating/cooling consumption in buildings, fossil fuels

Introductory note: This factsheet covers optional indicator 15.1 (Heating/cooling in residential buildings).

Data for core indicator 15 and optional indicators 15.2 (Heating/cooling consumption in non-residential buildings, fossil fuels) and 15.4 (Total value of projects with green building certification as a share of total) is not available.

Optional indicator 15.1 - Heating/cooling consumption in residential buildings, fossil fuels

Assumption: Heat is produced dominantly in gas fired plants.

According to LvivTeploenergo, this company supplies heat to 50 % of flats in Lviv. In 2015, LvivTeploenergo supplied 1190 GWh. It could be concluded that the total consumption of heat in residential sector of Lviv is at the level of at least 2400 GWh.

Data for Lviv for 2015:

	Unit	2015
Heat consumption - residential buildings – heating, hot water	GWh	2400
Floor area residential buildings - living rooms	Million m ²	9.588
Fossil fuels consumption - residential buildings – natural gas – heating, hot water – living rooms	kWh/m ²	250
Floor area – all rooms	Million m ²	15.363
Fossil fuels consumption - residential buildings – natural gas – heating, hot water – all rooms	kWh/m ²	156

Source: LvivTeploenergo, ZaluznychTeploenergo, Ukrstat (floor area) See <http://www.lv.ukrstat.gov.ua/eng/engl.php>

Benchmark – Optional indicator 15.1

	Unit	2015	Green	Amber	Red
Fossil fuels consumption - residential buildings – natural gas – heating, hot water – living rooms	kWh/m ²	250	< 96	96 - 126	> 126
Fossil fuels consumption - residential buildings – natural gas – heating, hot water – all rooms	kWh/m ²	156	< 96	96 - 126	> 126

Trend: **No time series.**

Optional indicator 15.3: Share of city enterprises with ISO50001/EMAS certification or similar

The number of city enterprises is zero (only less than 10 other enterprises have some kind of certification). Regardless benchmark thresholds for this optional indicator are not defined, red flag has been chosen.

Indicator 16

Core Indicator 16: Electricity consumption in industries as per unit of industrial GDP

As the data for the city is not available – data for oblast is used instead. Data on industrial GDP is not available – Gross Value Added (GVA) is used instead.

Oblast data for core indicator 16 is presented in the following table:

	Unit	2013	2014	2015	2016	2017
Electricity consumption - industry	TWh	1.19	0.936	1.07	1.33	1.50
GVA - industry	UAH billion	10.1	11.7	15.5	22.8	
Exchange rate	UAH/USD	7.99	11.9	21.8	25.6	
GVA - industry	USD billion Current rates	1.26	0.983	0.711	0.890	
Electricity consumption per industrial GVA	kWh/USD	0.944	0.952	1.50	1.49	

Source: UKRSTAT-Lviv See <http://www.lv.ukrstat.gov.ua/eng/engl.php>

Trend: **Increasing**

Benchmark – Oblast level

	Unit	Latest	Green	Amber	Red
Electricity consumption per industrial GDP	kWh/USD	1.49	< 0.3	0.3 – 0.4	> 0.4

Comment: Indicator per GDP is influenced by serious change in UAH/USD exchange rate between 2010 and 2016 as well as by the impact of parity of purchasing power. Real values of “per GDP” indicator are probably 4 – 5 times higher.

Indicator 17

Core Indicator 17: **Heat consumption in industries as per unit of industrial GDP**

As the data for the city is not available – data for oblast is used instead. Data on industrial GDP is not available – Gross Value Added (GVA) is used instead.

Oblast data for core indicator 17 is presented in the following table:

	Unit	2013	2014	2015	2016	2017
Heat consumption - industry	TJ	4.438	4.220	3.977	4.706	
GVA - industry	UAH billion	10.1	11.7	15.5	22.8	
Exchange rate	UAH/USD	7.99	11.9	21.8	25.6	
GVA - industry	USD billion Current rates	1.26	0.983	0.711	0.890	
heat consumption per industrial GVA	MJ/USD	3.52	4.51	5.59	5.29	

Source: UKRSTAT-Lviv See <http://www.lv.ukrstat.gov.ua/eng/engl.php>

Trend: **Increasing**

Benchmark – Oblast level

	Unit	Latest	Green	Amber	Red
Heat consumption per industrial GVA	MJ/USD	5.29	< 0.1	0.1 – 0.25	> 0.25

Comment: Indicator per GDP is influenced by serious change in UAH/USD exchange rate between 2010 and 2016 as well as by the impact of parity of purchasing power. Real values of “per GDP” indicator are probably 4 – 5 times higher.

Indicator 18

Core indicator 18: Heavy metals (Pb) emission intensity of manufacturing industries

As the data for the city is not available – data for Oblast is used instead. Oblast data for core indicator 18 is presented in the following table:

	Unit	2013	2014	2015	2016
Emissions of heavy metals (HM) from manufacturing industry	Kg	24000	21000	31000	28000
GVA – manufacturing industry	UAH million	6188	7314	10093	12033
Exchange rate - current	UAH/USD	7.99	11.9	21.8	25.6
GVA – manufacturing industry	USD million	744.5	614.6	463.0	470.0
Emissions of HM per industrial GVA	Kg HM/USDM	0.00003 22	0.0000342	0.0000670	0.0000596

Source: Ukrstat-Lviv:

[http://database.ukrcensus.gov.ua/statbank_lviv/Dialog/varval.asp?ma=24A0201_04&ti=24A0201_04.%20Air%20emission%20of%20pollutants%20from%20stationary%20pollution%20sources%20\(1\)&path=../Database/24PRYRODA/02/&lang=2&multilang=en](http://database.ukrcensus.gov.ua/statbank_lviv/Dialog/varval.asp?ma=24A0201_04&ti=24A0201_04.%20Air%20emission%20of%20pollutants%20from%20stationary%20pollution%20sources%20(1)&path=../Database/24PRYRODA/02/&lang=2&multilang=en)

Benchmark – core indicator 18 – Oblast level

	Unit	Average	Green	Amber	Red
Emissions of metals per industrial GVA	Kg HM/USDM	0.0000569	< 0.02	0.02 – 0.04	> 0.04

Trend: **Increasing**

Note: Statistical data on emissions include emissions of all metals from all stationary sources. Real result should be lower.

Optional indicator 18.1: Fossil fuel combustion in industrial processes as per unit of industrial GDP and 18.2: Share of industrial energy consumption from renewable energy

As the data for the city is not available – data for Oblast is used instead. Data in industrial GDP is not available – Gross Value Added (GVA) is used instead.

Assumptions: Industries do not generate own electricity (taken from the grid). All combustion could be aligned with the production of heat. Heat could be partially taken from external network (which is gas based). Share of fossil fuels and of renewables in combustion processes within industrial facilities is estimated from national data on heat production (see indicator 23). In the case of indicator 18.2, national estimate is applied.

Oblast data for optional indicators 18.1 and 18.2 is presented in the following table:

	Unit	2013	2014	2015	2016
Heat consumption - industry - total	TJ	4.438	4.220	3.977	4.706
Share of renewables (estimate)	% (see indicator 23)	1.9	2.3	3.2	4.9
Share of fossil fuels	%	98.1	97.7	96.8	95.1
Heat consumption - industry - fossil	TJ	4.354	4.123	3.850	4.475
GVA – industry	UAH billion	10.1	11.7	15.5	22.8
Exchange rate	UAH/USD	7.99	11.9	21.8	25.6
GVA – industry	USD billion Current rates	1.26	0.983	0.711	0.890
Fossil fuels combustion per industrial GVA	MJ/USD	3.45	4.19	5.41	5.03
Share of renewables in energy	%	5.30	4.54	4.46	5.72

Source: UKRSTAT-Lviv See <http://www.lv.ukrstat.gov.ua/eng/engl.php>

Benchmark – optional indicators 18.1 and 18.2 - Oblast level

	Indicator	Unit	Latest	Green	Amber	Red
18.1	Fossil fuels combustion in industrial processes per industrial GVA	MJ/USD	5.03	< 0.1	0.1 – 0.25	> 0.25
18.2	Share of industrial energy consumption from renewable energy	%	5.72	> 20	20 – 10	< 10

Comment: Indicator per GDP is influenced by serious change in UAH/USD exchange rate between 2010 and 2016 as well as by the impact of parity of purchasing power. Real values of “per GDP” indicator are probably 4 – 5 times higher.

Indicator 19

Core indicator 19: **Share of industrial waste recycled as a share of total industrial waste produced**

According to the Integrated Environmental Programme of Lviv 2017 – 2022 (see [https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf/\(SearchForWeb\)/90D7918C562FD4EDC225811D0045FBBF?OpenDocument](https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf/(SearchForWeb)/90D7918C562FD4EDC225811D0045FBBF?OpenDocument)), the share of recycled industrial waste is changing dramatically from year to year: in 2010 90 %, in 2015 6 %. **Average value 48 % is used.**

Benchmark – core indicator 19

Indicator	Unit	Latest	Green	Amber	Red
Share of industrial waste recycled	%	48	> 95	80 – 95	< 80

Indicator 20

Core indicator 20: **Percentage of industrial wastewater that is treated according to applicable national standards**

According to Vodokanal **all residential and commercial wastewater in Lviv is treated at WWTP (mechanical treatment only) but only 50 % is treated biologically (due to the low efficiency of obsolete equipment of WWTP).**

Benchmark – core indicator 20

	Unit	Value	Green	Amber	Red
Industrial waste water treated	%	50	> 60	40 – 60	< 60

Trend: **No time series**

Indicator 21

Core indicator 21: **Share of population with authorized connection of electricity**

According to the operator for electricity supply, **100% of population in Lviv have access to electricity connection.**

Benchmark – core indicator 21

	Unit	Value	Green	Amber	Red
Population connected to electricity	%	100	> 90	70 – 90	< 70

Trend: **No time series.**

Optional indicator 21.1: Annual average number of electrical interruptions per year per customer

Data for this indicator is not available. However, it can be estimated that the number is lower than 10 and a default value of 6 interruptions per year per customer is applied (once per 2 months).

Benchmark – optional indicator 21.1

	Unit	Value	Red	Amber	Green
Number of electrical interruptions	#	6	> 13	10 – 13	< 10

Trend: **No time series.**

Indicator 22

Core indicator 22: **Share of population with access to heating/cooling**

According to UKRSTAT 100% of population in Lviv have access to electricity connection. Access to central or individual heating is available to 88.5 % and to natural gas to 92.5 % of population. As a result, average value 91 % is used.

Source: Ukrstat Lviv see <http://www.lv.ukrstat.gov.ua/eng/engl.php>

Benchmark – core indicator 22

	Unit	Value	Green	Amber	Red
Population with access to heating/cooling	%	91	> 90	70 – 90	< 70

Trend: **No time series**

Indicator 23

Core indicator 23: **Proportion of total energy derived from RES a share of total city energy consumption (in TJ compared to benchmark of 20 % (links to EU target))**

National data on Total primary sources of energy (TPES) and the share of renewable energy therein is presented in the following table:

	Unit	2010	2011	2012	2013	2014	2015	2016
TPES	ktoe	132 445	126 561	122 524	116 153	105 719	92 879	94 383
Hydro		1 131	941	901	1 187	729	464	660
Geothermal, solar		4	10	53	104	134	134	124
Biofuels and waste		1 597	1 682	1 696	1 880	1 934	2 102	2 832
Total renewables		2 732	2 633	2 650	3 171	2 797	2 700	3 616
Share of renewables	%	2.06	2.08	2.16	2.73	2.64	2.91	3.83

Source: International Energy Agency, link: <https://www.iea.org/statistics/>

National data on electricity and heat production and the share of renewable energy therein is presented in the following table:

	Unit	2010	2011	2012	2013	2014	2015	2016
Electricity								
Total production	GWh	188 828	194 948	198 878	194 377	182 818	163 682	164 573
Biofuels		188	134	134	101	130	145	136
Hydro		13 152	10 946	10 994	14 472	9 321	6 971	9 304
Solar PV		0	30	333	570	429	477	491
Wind		51	90	288	639	1 130	1 084	954
Total renewables		13 391	11 200	11 749	15 782	11 010	8 677	10 885

Share of renewables	%	7.09	5.75	5.91	8.12	6.02	5.30	6.61
Heat								
Total production	GWh	172 863	169 008	166 508	162 847	123 289	105 058	124 315
Biofuels		2 340	2 519	2 774	3 161	2 889	3 318	5 632
Total renewables		2 340	2 519	2 774	3 161	2 889	3 318	5 632
Share of renewables	%	1.35	1.49	1.67	1.94	2.34	3.16	4.93
Electricity + Heat								
Total	GWh	361 691	363 956	365 386	357 224	306 107	268 740	288 888
Renewables		15 731	13 719	14 523	18 943	13 899	11 995	16 517
Share of renewables	%	4.35	3.77	3.97	5.30	4.54	4.46	5.72

Source: International Energy Agency, link: <https://www.iea.org/statistics/>

Trend: **Increasing**

Benchmark

	Unit	Latest	Green	Amber	Red
Share of renewables in total final production	%		> 20	10 – 20	< 10

Conclusion

It could be concluded that situation in Lviv is not different from the situation at national level and should be fairly below 10 %.

Indicator 24

Core indicator 24: **Average share of population undergoing prolonged power outage in case of climatic extremes over the past 5 years**

This problem has not been mentioned by the Lviv City Council at all. Default value 1 % has been chosen.

Benchmark

Unit	Latest value	Green	Amber	Red
%	1	< 10	10 - 25	> 25

Indicator 25

Core indicator 25: **Water consumption per capita**

Introductory note: This factsheet covers core indicator 25 and optional indicators 25.1 (Water consumption per unit of city GDP) and 25.3 (Industrial water consumption as percent of total urban water consumption)

Data on total water consumption in Lviv is presented in the following table:

	Unit	2010	2011	2012	2013	2014	2015	2016	2017	2018
Water consumption	Mill m ³	61.5			46.2	45.8	43.5	43.9	47.9	
Population	mill	0.762	0.760	0.758	0.759	0.758	0.759	0.759	0.758	
Consumption per capita per day	Litres /day	221			167	166	157	158	173	

Source: Ukrstat Lviv.

See http://database.ukrcensus.gov.ua/statbank_lviv/Database/24PRYRODA/databasetree_en.asp

Benchmark – core indicator 25

	Unit	Latest value	Green	Amber	Red
Water consumption per capita	l/day	173	<200	200 - 250	> 250

Trend: **Fluctuating (after 2010)**

Optional indicator 25.1: Waster consumption per unit of GDP – oblast level

Data on GDP at municipal level is not available, indicator is quantified at the oblast level.

Note: GDP in current prices recalculated using respective exchange rates

	Unit	2010	2011	2012	2013	2014	2015	2016	2017	2018
Water consumption	Mill m ³	174.7	173.7	157.8	156.9	151.1	119.7	118.8	122.6	
GDP	UAH billion	41.65	52.19	61.96	63.33	72.92	94.69	114.8		
GDP	USD billion	4.001	6.529	7.755	7.926	6.133	4.334	4.490		
Water consumption per GDP	l/day/USD	0.120	0.073	0.056	0.054	0.067	0.076	0.075		

Source: Ukrstat Lviv Database – see <http://www.lv.ukrstat.gov.ua/eng/engl.php>

Benchmark – optional indicator 25.1 – Oblast level

	Unit	Latest value	Green	Amber	Red
Water consumption per GDP	l/USD	0.075	< 0.022	0.022 – 0.055	> 0.055

Trend: **Fluctuating**

Comment: Indicator per GDP is influenced by serious change in UAH/USD exchange rate between 2010 and 2016 as well as by the impact of parity of purchasing power. Real values of “per GDP” indicator are probably 4 – 5 times higher.

Optional indicator 25.3: Industrial water consumption as percent of total urban water consumption

Data on industrial and total water consumption in Lviv is presented in the following table:

	Unit	2010	2011	2012	2013	2014	2015	2016	2017	2018
Water consumption in industry	Mill m ³	7.0			6.4	6.3	8.2	8.0	11.6	
Total water consumption	Mill m ³	61.5			46.2	45.8	43.5	43.9	47.9	
Share of industrial consumption in total consumption	%	11.4			13.9	13.8	18.9	18.2	24.2	

Source: Ukrstat Lviv. See

http://database.ukrcensus.gov.ua/statbank_lviv/Database/24PRYRODA/databasetree_en.asp

Benchmark – optional indicator 25.3

	Unit	Latest value	Green	Amber	Red
Share of industrial consumption in total consumption	%	24.2	< 17	17 – 50	> 50

Trend: **Increasing**

Data for optional indicators 25.2 (Unit of water consumed in power plants, per unit of primary energy generated) is not available.

Indicator 26

Core indicator 26: **Non-revenue water**

Introductory note: This factsheet covers core indicator 26 and optional indicator 26.1 (Annual average of daily number of hours of continuous water supply per household)

According to Vodokanal Lviv **non-revenue water share (water losses in the network) is estimated at the level of 50 %.**

Benchmark – core indicator 26

	Unit	Average	Green	Amber	Red
Non-revenue water	%	50	0 - 30	30 - 45	> 45

Trend: **No time series**

Optional indicator 26.1: **Annual average of daily number of hours of continuous water supply per household)**

According to Vodokanal Lviv **all households have 24 hours water supply. Water supply can be interrupted only few hours during accidents or maintenance works.**

Benchmark – optional indicator 26.1

	Unit	Average	Green	Amber	Red
Continuous water supply	Hours/day	24	>20	12 - 20	<12

Trend: **No time series**

Indicator 27

Core indicator 27: **Percentage of residential and commercial wastewater that is treated according to applicable national standards**

Introductory note: This factsheet covers core indicator 27 and optional indicator 27.1 (Percentage of buildings (non-industrial) equipped to reuse grey water).

Core indicator 27

According to Vodokanal **all residential and commercial wastewater in Lviv is treated at WWTP (mechanical treatment only) but only 50 % is treated biologically (due to the low efficiency of obsolete equipment of WWTP)**

Benchmark – core indicator 27

	Unit	Actual	Green	Amber	Red
Waste water treated	%	50	> 60	40 - 60	< 40

Trend: **No time series**

Optional indicator 27.1: Percentage of buildings (non-industrial) equipped to reuse grey water

According to Vodokanal **there is no reuse of grey water in Lviv.**

Benchmark – optional indicator 27.1

	Unit	Actual	Green	Amber	Red
Grey water used	%	0	> 80	80 - 60	< 60

Trend: **No time series**

Optional indicator 27.2: Percentage of wastewater from energy generation activities that is treated according to applicable national standards

According to Vodokanal all commercial wastewater in Lviv is treated at WWTP (mechanical treatment only) but only 50 % is treated biologically (due to low efficiency of obsolete equipment of WWTP)

Benchmark – optional indicator 27.2

	Unit	Actual	Green	Amber	Red
Waste water treated	%	50	> 60	40 - 60	< 40

Indicator 28

Core indicator 28: Percentage of dwellings damaged by the most intense flooding in the last 10 years

Optional indicator 28.1: Annual number of storm water/sewerage overflows per 100 km of network length

Optional indicator 28.2: Awareness and preparedness to natural disasters

Recent available information:

According to the City Council serious natural disasters do not appear. The only issue mentioned were sewerage overflows due to storms or intensive rainfalls which were said to occur 2 – 3 times per year (total length of sewerage is 800 km)

Therefore, the following default values are used in the indicator database:

- 0 % of dwellings damaged
- 1 overflow per year
- Awareness is low due to non-existence of natural disasters

Benchmark – core indicator 28, optional indicators 28.1 and 28.2

	Unit	Value	Green	Amber	Red
28: Percentage of dwellings damaged	%	0	<0.5	0.5 - 1	> 1
28.1: Number of overflows	#/year	1	<20	20 - 50	> 50
28.2: Awareness		No	Full	Partial	No

Indicator 29

Core indicator 29: Total solid waste per capita

This factsheet covers core indicator 29 and optional indicator 29.1 (GDP per domestic material production)

Data on total solid waste generation in Lviv is presented in the following table:

	Unit	2012	2013	2014	2015	2016	2017	2018	Average
Waste generation	Mill tons	0.331	0.192	0.239	0.228	0.217	0.393	0,250	
Population	mill	0.758	0.759	0.758	0.759	0.759	0.758	0,758	
Waste generation per capita per year	kg/cap /year	438	252	316	301	286	519	330	349

Source: 2012 - 2017 Ukrstat Lviv. See http://database.ukrcensus.gov.ua/statbank_lviv

2018 City Hall statistics

Note: Taking into account the methodology used by UKRSTAT (statistical form 1-waste filled by operators of collecting companies in the case of MSW), the presented figures could not include all MSW generated. This could also explain annual fluctuation of figures).

Benchmark – core indicator 29

	Unit	Average	Green	Amber	Red
Solid waste per capita	kg/year	349	< 300	300 - 500	> 500

Optional indicator 29.1: GDP per domestic material production

Data is not available for this indicator.

Indicator 30

Core indicator 30: Share of the population with weekly municipal solid waste (MSW) collection

According to the Lviv City Council, more than 90 % of clients is served at least once per week (default value 91).

Benchmark – core indicator 30

	Unit	Actual	Green	Amber	Red
Population served	%	91	90 - 100	80 - 90	<80

Indicator 31

Core indicator 31: Proportion of MSW that is sorted and recycled

According to the Lviv City Council, 2 – 3 % of municipal solid waste is recycled. Benchmark – core indicator 31

	Unit	Actual	Green	Amber	Red
MSW recycled	%	3	>25	15 - 25	<15

Optional indicator 31.1: Percentage of MSW which is disposed of in open dumps, controlled dumps, or bodies of water or is burnt

Data for this indicator is not available at this moment

Optional indicator 31.2: Percentage of MSW landfilled disposed of in EU-compliant sanitary landfills

According to the Lviv City Council 0 % of MSW landfilled is disposed of in EU-compliant sanitary landfill.

Benchmark – optional indicator 31.2

	Unit	Actual	Green	Amber	Red
Sanitary landfill of waste	%	0	90-100	80 - 90	< 80

Optional indicator 31.3: Percentage of collected MSW composted

According to the Lviv City Council, municipal solid waste is practically not composted.

Benchmark – optional indicator 31.3

	Unit	Actual	Green	Amber	Red
MSW composted	%	0	>25	15 - 25	<15

Indicator 32

Core indicator 32: Remaining life of current landfill(s)

According to the Lviv City Council, existing city landfill is out of operation (due to fire) and MSW is being sent to be disposed at 4 landfills located outside the city area.

Benchmark – core indicator 32

	Unit	Actual	Red	Amber	Green
Remaining life of landfill	Year	0	< 5	5-8	>8

Indicator 33

Core indicator 33: Population density on urban land

Year		2010	2011	2012	2013	2014	2015	2016	2017	2018	Aver
city area	km ²	171	171	171	171	171	171	171	171	171	
Population	million	0.762	0.760	0.758	0.759	0.758	0.759	0.759	0.758		
Density	#/km ²	4456	4444	4433	4439	4433	4439	4439	4433		4440

Source: Ukrstat Lviv Database (available in English) – see <http://www.lv.ukrstat.gov.ua/eng/engl.php>

Benchmark – core indicator 33

	Unit	Actual	Green	Amber	Red
Population density	%	4440	7000-20000	4000-7000 20000-25000	<4000 >25000

Optional indicator 33.1: Average commuting distance

Provided that the city area is transposed into circle with radius 7.4 km, average commuting distance could be estimated as this radius

Benchmark – optional indicator 33.1

	Unit	Actual	Green	Amber	Red
Average commuting distance	%	7.4	< 5	5-10	>10

Optional indicator 33.2: Average commuting time

Provided that average speed in city is 14 km/hour, average commuting time can be assessed at the level of 32 minutes.

Benchmark – optional indicator 33.2

	Unit	Actual	Green	Amber	Red
Average commuting time	%	32	< 30	30-60	>60

Optional indicator 33.3: Proportion of the population living within 20 minutes to everyday services (grocery stores, clinics, etc.)

Taking into account optional indicators 33.1 and 33.2, it may be concluded that more than 75 % lives within 20 minutes (default 76 %)

Benchmark – optional indicator 33.3

	Unit	Actual	Green	Amber	Red
Proportion of the population living within 20 minutes to everyday services	%	76	>75	50-70	<50

Indicator 34

Core indicator 34: **Average annual growth rate of built up areas**

	Unit	2010	2011	2012	2013	2014	2015	2016	2017	Aver.
Built-up area	ha	11612	11616	11666	11680	11694	11718			
Total area	ha	17101								
Growth rate	%		0.02	0.43	0.12	0.12	0.21			0.18

Source: Ukrstat Lviv Database (available in English) – see <http://www.lv.ukrstat.gov.ua/eng/engl.php>

Benchmark –core indicator 34

	Unit	Actual	Average	Green	Amber	Red
Growth rate of built up areas	%	0.21	0.18	< 3	3-5	>5

Optional indicator 34.1: Percentage of urban development that occurs on existing urban land rather than on greenfield land

According to the Lviv City Council, 90 % of urban development occurs at existing urban land as green fields lie outside the city area.

Benchmark – optional indicator 34.1

	Unit	Actual	Red	Amber	Green
Development on urban land	%	90	< 20	20-40	>40

Indicator 35

Core indicator 35: **Vacancy rates of offices**

According to the estimate by the Lviv City Council (Chief Architect of the City), vacancy rate could be at the level of 3 %.

Benchmark – core indicator 35

	Unit	Value	Green	Amber	Red
Vacancy rate of offices	%	3	< 6	6 - 10	> 10

Optional indicator 35.1: **Share of multi-family houses in total housing units**

Benchmark cannot be carried out as benchmark thresholds are not defined.

Response Indicators

Indicators 36 – 40

Transport

Green benchmark	Existing and well implemented, and there is no significant need to further expand this type of response
Amber benchmark	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake
Red benchmark	Not existing

No	Indicator	Response	Flag
36	High-polluting vehicles are regulated. Energy-efficient vehicles are incentivised through fiscal instruments.	New transport strategy and Sustainable Urban Mobility Plan are in progress Purchase of new additional trams, busses and trolleybuses is planned to continue	
37	Extension and improvement of public and non-motorised transport is planned and supported through investment in place	New transport strategy and Sustainable Urban Mobility Plan are in progress Extension of bicycle paths and tram rails planned Increase in the number of parking lots (Park and ride) and bus stops	
38	Public and non-motorised transport is promoted through Information and awareness campaigns	Campaigns are included in the Integrated Environmental Programme of Lviv	
39	Traffic demand is managed through congestion charges or smart technologies	Project "Reconstruction of the automated control system of traffic" is in progress	
40	Public transport emergency management in publicly and or privately run networks is planned and tested	Transport emergency management is not in place (Information by LvivAvtodor)	

References – sources of information

Integrated Environmental Programme of Lviv 2017 – 2022 (Document adopted by the City Council of Lviv in 2016)

<https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf>

Priority issues:

- reducing traffic intensity in the most polluted central part of the city due to the completion of the implementation of the new transport strategy;
- expansion of the use of electric transport (tram, trolley bus);
- increasing the length of bicycle paths and creating new stations for bicycle rental;
- completion of the project "Reconstruction of the automated control system of traffic";
- completion of the city by-pass.

Section 3. Purpose, priorities and main objectives of the Program:

2. Reduction of atmospheric air pollution:

2.1. In the field of public transport by increased passenger transportation by ecologically clean types of electric vehicles and optimization of traffic of large buses and transit buses.

2.2. In the field of private motor transport by limitation of traffic through the central part of the city, parking facilities, creating conditions for the proper operation of the bicycle paths network within the city and the associated infrastructure (bicycle parking places and rental facilities).

Program for the purchase of buses through financial leasing (Document adopted by the City Council of Lviv in 2018)

<https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf>

The Program states that in accordance with approved passports of the city public bus routes, the city of Lviv should run 630 units of buses on working days and 427-434 units of buses on weekends. There are actually 480-500 units of buses on the routes on working days and 350-370 units on weekends (according to the daily data of dispatching services of carriers). According to the simulation, there should be 730 units of buses on routes with modified distribution.

The purpose of the Program is:

- to further develop public transport,
- to provide citizens with the appropriate quality of public transport services,
- to implement the concept of passenger transport development in Lviv,
- to create safe and comfortable transport conditions.

The Lviv Municipal Transport Company No. 1 proposes to purchase 150 buses with a passenger capacity of at least 100 persons each through financial leasing. The term of the financial lease agreement is up to 36 months. Up to 2020, purchase of the following types of vehicles is planned: tram - 120 units, trolley bus - 120 units, bus (12 meters) 340 units, bus (8 meters) 150 units.

The Concept of the Development of Electro-mobility in the City of Lviv (Document adopted by the City Council of Lviv in 2018)

<https://www8.city-adm.lviv.ua/Pool/Info>

The objectives of the Concept are:

- to contribute to the increase of the fleet of electric vehicles in the city;
- to promote the expansion of the existing network of charging stations for electric vehicles;
- to stimulate the development of public electric transport;
- to improve air quality and reduce noise in the city;
- to stimulate the use of electric vehicles in the city by the private sector.

Bicycle Network Development Program for 2011-2019 (Document adopted by the City Council of Lviv in 2011). By 2020, the city should have 268 km of bicycle paths.

Indicators 41 – 43

Buildings

Green benchmark	Existing and well implemented, and there is no significant need to further expand this type of response
Amber benchmark	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake
Red benchmark	Not existing

No	Indicator	Response	Flag
41	Green building is promoted through standards and fiscal Incentives.	Law on Energy Efficiency of buildings Law on new investment opportunities	
42	Public and private investment in energy efficiency in buildings	programs "Warm House" and "Energy Efficient Home"	
43	Metering and billing for personal energy use is regulated	Metering is in place in the case of electricity. Regulated payments are possible in the case of introduction of energy efficiency measures.	

References:

Integrated Environmental Programme of Lviv 2017 – 2022 (Document adopted by the City Council of Lviv in 2016)

<https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf>

Priority issue:

Reducing the overall energy consumption of the city through the implementation of the energy saving program of multi-apartment buildings and increasing the share of alternative energy sources for heating and water heating.

Legislation

- 2017 Law on energy efficiency of buildings <https://zakon.rada.gov.ua/laws/show/2118-19>
- 2015 Law on introduction of new investment opportunities, guaranteeing rights and legitimate interests of business entities for large-scale energy modernization <http://zakon3.rada.gov.ua/laws/show/327-19>

Programs

- Program of the Lviv City Council "Warm House" for housing stock <http://www8.city-adm.lviv.ua/inTEAM/Uhvaly.nsf/>
- Program of the Lviv City Council "Energy Efficient Home" for individuals <http://www8.city-adm.lviv.ua/inteam/uhvaly.nsf/>

Subsidies

- Subsidy is provided if the income level of the family is not sufficient value for payment of utility services, incl. services for heat supply, hot water, gas and electricity. <https://www.msp.gov.ua/content/subsidii.html>
- There are several options for regulating payments for heat supply:
 - a) for condominiums - installation of individual heat points with weather dependent heat supply in a multi-flat building; an additional reduction of energy consumption is possible with the introduction of thermo-modernization
 - b) for private houses - thermo-modernization of the house, including the possibility of switching to a more energy efficient heat source

Indicators 44 – 47

Industries

Green benchmark	Existing and well implemented, and there is no significant need to further expand this type of response
Amber benchmark	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake
Red benchmark	Not existing

No	Indicator	Response	Flag
44	Energy efficient industrial machinery is regulated and incentivised through fiscal instruments (electricity and or heat industrial processes)	Legislation and energy efficiency standards are in place at national level.	
45	Energy efficient industrial technologies (electricity and or heat industrial processes) is supported through private investment	Private investments are in place – however their extent is limited.	
46	Material efficiency of new built industrial facilities and waste recycling is regulated and incentivised through fiscal instruments	Material efficiency is not regulated	
47	Industrial wastewater treatment or reuse or recycle is promoted through regulations and fiscal incentives.	Wastewater treatment is regulated by national legislation as well as through permitting process	

References:

Integrated Environmental Programme of Lviv 2017 – 2022 (Document adopted by the City Council of Lviv in 2016)

<https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf>

Priority issue:

Implementation of environmentally friendly production, stimulation of enterprises in the industrial and municipal sectors to introduce resource-saving and energy-efficient technologies, widespread use of ecological and economic instruments, active use of environmental management, audit and certification.

Legislation

The Decree of the Cabinet of Ministers of Ukraine dated November 25, 2015 No. 1228-r approved the **National Energy Efficiency Action Plan for the period until 2020** and approved the Plan of Measures for its implementation which envisages up to 2020 increase in energy efficiency by 9% by implementing measures in 4 main sectors: residential sector - 50%; transport - 9%; service sector - 16%; **industry - 25%**.

National standards of Ukraine regulating energy management, energy auditing and energy saving

- DSTU 4065-2001 (ANSI / IEEE 739-1995, NEQ) State standard of Ukraine. Energy Saving. Energy audit. General technical requirements.
- DSTU 4472: 2005 National Standard of Ukraine. Energy Saving. Energy management systems. General requirements.
- DSTU 4715: 2007 National Standard of Ukraine. Energy Saving. Systems of energy management of industrial enterprises. The composition and content of works at the stages of development and implementation.
- DSTU 5077: 2008 National Standard of Ukraine. Energy Saving. Systems of energy management of industrial enterprises. Checking and controlling the effectiveness of the operation.
- DSTU 4713: 2007 National Standard of Ukraine. Energy Saving. Energy audit of industrial enterprises. Procedure and requirements for the organization of work.
- DSTU 4714: 2007 National Standard of Ukraine. Energy Saving. Fuel and energy balance of industrial enterprises. Methods of construction and analysis.

Indicators 48 – 52

Energy

Green benchmark	Existing and well implemented, and there is no significant need to further expand this type of response
Amber benchmark	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake
Red benchmark	Not existing

No	Indicator	Response	Flag
48	Coverage and quality of electricity and heat supply is improved through investment	Insufficient investments Investment program LvivOblenergo Investment program LvivTeploenergo Investment program ZalyznzchneTeplo-energo	
49	Renewable energy facilities in private buildings are incentivised through fiscal instruments	"Green" tariff for investing in solar energy on the basis of its own private house (it is possible to install up to 30 kW of solar power capacity)	
50	Renewable energy technologies are developed and supported through public and private investment	Support to renewable energy at national level was increasing for some time. Recently, quotas and gradual decrease of feed-in tariff were decided upon.	
51	Renewable energy facilities are incentivised through awareness campaigns	Promotion of renewable energy is carried out through: <ul style="list-style-type: none"> • Annual exhibitions • Conferences and fora • Grant programs • NGOs 	
52	The resilience of electricity networks in case of disaster is tested and enhanced through investment	Resilience is assured through investment plans of power companies.	

References:

Integrated Environmental Programme of Lviv 2017 – 2022 (Document adopted by the City Council of Lviv in 2016)

<https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf>

Priority issue:

Reducing the unproductive use of energy resources through the introduction of a financial incentive program to reduce energy consumption.

Investment programs

- Investment program “LvivOblenergo”
- Investment program LvivTeploenergo

<http://lte.lviv.ua/images/011020182.pdf>

- Investment program ZalyznzchneTeploenergo

http://www.nerc.gov.ua/data/filearch/Proekty/2018/pr_124/pr_124-2018.pdf

Green tariff – Lviv

- http://www.loe.lviv.ua/ua/zeleni_taryfy_pobut
- <http://loe.lviv.ua/ua/novyny~4160>

Support to renewable energy in Ukraine

- <http://saee.gov.ua/sites/default/files/VDE.pdf>

Awareness raising – renewable energy

- Exhibitions http://www.galexpo.com.ua/images/vustavku/bud-expo/2016/th_alter.jpg
- Conferences <https://loda.gov.ua/news?id=37557>
- Grants (<http://www.pl-by-ua.rescluster.eu>)
- NGOs <http://klaster-energy.blogspot.com/2018/07/>

Indicators 53 – 61

Water

Green benchmark	Existing and well implemented, and there is no significant need to further expand this type of response
Amber benchmark	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake
Red benchmark	Not existing

No	Indicator	Response	Flag
53	Metering and billing for water use is regulated	Metering and billing covers 50 % of produced water. 50 % of water is lost in network - non-revenue water.	
54	Water saving and or reuse is encouraged through awareness campaigns	Reuse of water is practically absent	
55	Coverage and efficiency of water supply networks is improved through plans and investment	Coverage is sufficient, efficiency is low (high losses). Plans to reduce losses exist.	
56	Buildings access to wastewater collection and treatment systems is improved through plans and investment	Priority of the Integrated Environmental Programme of Lviv 2017 – 2022	
57	Wastewater treatment is promoted through regulations and fiscal incentives	Integrated program for modernization of sewerage 2016 – 2020.	
58	Wastewater billing is regulated	National Commission on state regulation in the sector of communal services sets costs for water supply and wastewater treatment.	
59	Drinking water pre-treatment is enhanced through plans and investment	Treatment is carried out by LvivVodokanal at sufficient level put some of the population regard the water as not drinkable.	
60	Drainage facilities are developed through plans and investment	Priority of the Integrated Environmental Programme of Lviv 2017 – 2022	
61	Business and community resilience is encouraged through awareness campaigns	Conferences and seminars are being organized.	

References

Integrated Environmental Programme of Lviv 2017 – 2022 (Document adopted by the City Council of Lviv in 2016)

<https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf>

Integrated program for modernization of the sewerage system in Lviv for 2016-2020

<https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf>

Indicators 62 – 67

Solid waste

Green benchmark	Existing and well implemented, and there is no significant need to further expand this type of response
Amber benchmark	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake
Red benchmark	Not existing

No	Indicator	Response	Flag
62	Reduction of material consumption solid waste generation is promoted through awareness campaigns	Integrated Environmental Programme of Lviv 2017 – 2022 Solid waste management strategy	
63	Coverage of solid waste collection system is improved through plans and investment	Integrated Environmental Programme of Lviv 2017 – 2022 Solid waste management strategy	
64	Littering and non-compliance to sorting systems is dis-incentivised through fines and penalties	Integrated Environmental Programme of Lviv 2017 – 2022 Solid waste management strategy	
65	Composting, recycling and waste-to-energy facilities are developed through plans and investment	Integrated Environmental Programme of Lviv 2017 – 2022 Solid waste management strategy	
66	Solid waste reuse, sorting and recycling is promoted through information and awareness campaign	Integrated Environmental Programme of Lviv 2017 – 2022 Solid waste management strategy	
67	Overcapacity issues in landfills are tackled through plans and investment	Integrated Environmental Programme of Lviv 2017 – 2022 Solid waste management strategy	

The City currently does not have a municipal waste management plan. The Solid Waste Management Programme 2014-2018 expired last year, and the new Waste Management Plan is still under development. It is expected to be completed by the middle of 2019.

The plan will include new collection systems and recycling as well as new waste treatment facilities – which is consistent with one of the main priorities of Lviv's overall Integrated Environmental Programme for 2017-2020: Development of the solid waste management strategy based on a zero waste concept, construction of waste processing plant and installation of environmentally safe landfill site.

In order to address the issue of hazardous waste, a separate Waste Management Programme for Household Waste Electrical and Electronic Equipment (WEEE) was approved in 2018. Its goal is to reduce hazardous waste disposal through introduction of an effective management system for WEEE from households.

In next few years, the City will implement several specific investment projects, which have already been approved. The funding will be provided from EBRD and other donors (E5P, NFCO, JFN). These projects include:

- Construction of a new waste treatment facility based on mechanical and biological processes (MBT plant): The plant will deal with around 250,000 tonnes per year of waste. The outputs from the MBT plant will either be composted or sent to local cement plants to be burned as refuse-derived fuel (RDF);
- Reclamation of old landfill: The rehabilitation of the old landfill Hrybovychi will include extraction of methane gas for electricity generation and the installation of a leachate treatment system (capacity 250 m³/day).

- Construction of a biogas station: The project consists of a station for anaerobic digestion of sludge from Lviv's waste water treatment plant. Gas from methane tanks will be used, after purification, in cogeneration units to produce electricity and heat.

Construction of a new landfill is another investment project critical for the City. After closure of the Hrybovychi site in 2016, the City started to dispose of its waste at different landfills in Lviv Oblast area. However, this is a short term solution that has resulted in significantly increased costs for the City and also political tension between the City and the Oblast. A solution has been sought within the Waste Management Strategy in Lviv Oblast that foresees the construction of a new landfill. Nevertheless, the locality has not been chosen yet, and moreover, the City does not have any pre-agreement that the site will accept its waste.

Thus, improvement of the waste management situation remains one of the main environmental concerns of the City.

References:

Integrated Environmental Programme of Lviv 2017 – 2022 (Document adopted by the City Council of Lviv in 2016)

<https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf>

Priorities:

- Development of new waste management strategy based on the concept of Zero Waste
- construction of a waste processing plant
- construction of an environmentally safe landfill.

National Strategy for Waste Management in Ukraine until 2030

Order of the Cabinet of Ministers of Ukraine dated November 8, 2017 No. 820-p
<https://zakon3.rada.gov.ua/laws/show/820-2017-r>

Waste Management Strategy in the Lviv Oblast until 2030

<http://gw1.oblrada.lviv.ua/rada/rishennialor.nsf>

Solid Waste Management Strategy in Lviv City for 2017 – 2019

<https://www8.city-adm.lviv.ua/inteam/uhvaly.nsf>

Indicators 68 – 70

Land use

Green benchmark	Existing and well implemented, and there is no significant need to further expand this type of response
Amber benchmark	Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake
Red benchmark	Not existing

No	Indicator	Response	Flag
68	Density is regulated	Density is not regulated either in existing land use plan or in new city land use plan	
69	Transit-Oriented Development is promoted	Transit-oriented development is not promoted in existing land use plan but will be promoted in new city land use plan	
70	Mixed-use development is promoted through zoning regulations or incentives	Mixed use development is not promoted in existing land use plan but will be promoted in new city land use plan	

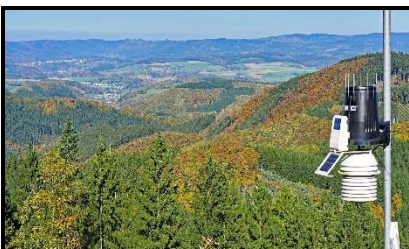
References:

Information promoted by the Lviv City Council (Chief Architect).


Annex 3 – Action Descriptions


This Annex provides more details of each Action, organised by Strategic Objectives

Strategic Objective 1 - Improve Air Quality in the City

 <p>T.7 – Installation of permanent air quality measuring stations and software system linked to City website and public information platform</p> <p>Measurements carried out during the last 5 years indicate high concentrations of suspended particulate matter (TSP, PM₁₀ and PM_{2.5}) and also increased concentrations of nitrogen oxides (NO_x). As more than 90 % of air pollution in Lviv is associated with the Transport sector, all transport measures to reduce emissions are presented under Strategic Objective 2 (Develop a Sustainable Mobility System in the City).</p> <p>The methodology of air quality monitoring currently applied is obsolete (concentrations of PM₁₀ and PM_{2.5} are not measured) and the results of measurements are not comparable with international standards. Moreover, neither the decision-makers nor public have information easily available on actual (near to real time) air quality.</p> <p>In order to enable efficient air quality management, the introduction of a network of automated monitoring stations complying with international standards and connected to an air quality information system is crucial. The outputs of this information system should be available to the public.</p> <p>This action will include the following steps:</p> <ul style="list-style-type: none"> • Develop and approve the concept of air quality monitoring and assessment system (according to the Directive 2008/50/EC) • Develop feasibility study • Purchase equipment and software • Implement the whole system (testing year) • Start of regular operation 	Strategic Objective 1 - Improve air quality in the City.			
	Sector:	Air &Transport	Location:	Several monitoring sites spread across the City
	Category of Measure:	Investment project	Current status:	New measure
	Difficulty of implementation:	Political 1	Financial 1	Social 1
	Economic benefits:	<ul style="list-style-type: none"> • Nothing significant 		
	Social benefits:	<ul style="list-style-type: none"> • Public health – 3 (Will lead to improved air quality) • Green behaviour and awareness – 3 (Information on actual air quality is significant for public awareness) • Community involvement – 3 (High interest of community can be expected) 		
	Environmental benefits:	<ul style="list-style-type: none"> • Air quality – 3 (Indirect benefit: evidence base for measures to reduce emissions) 		
	Estimated implementation cost:	Depends on the number and equipment of monitoring stations. Following are City estimates: Capital expenditure cost (CAPEX): EUR 1 million (UAH 26.5 million) Annual implementation cost (OPEX): EUR 1 million (UAH 26.5 million) over 5 years		
	Implementation timescale	Develop feasibility study in 2020; purchase and install equipment and software in 2021; test year in 2022; roll out in 2023		
	Potential sources of Funding	(1) Lviv City Budget (3) International Donors and Funds – EBRD, GEF, EIB		
	Competent Authority/Owner:	(1) City Department through the DH companies (Lviv TeploEnergo and Zalyznychne TeploEnergo).		

Strategic Objective 2 - Develop a Sustainable Mobility System in the City

 <p>T.1 – Completion of Sustainable Urban Mobility Plan (SUMP), its adoption implementation (in progress)</p> <p>Sustainable Urban Mobility Plan (SUMP) will focus on ‘green’ methods of transportation (trams, trolleybuses, electric cars, bicycles, scooters, walking etc.). The SUMP will be adopted by the end of 2019 and will cover all areas of transport infrastructure, operations and management including the following of particular relevance to the GCAP:</p> <ul style="list-style-type: none"> • Modernisation of tram, trolleybus and bus fleets; • Prioritisation of public transport (dedicated lanes); • Parking policy (including Park-and-Ride); • Pricing policy (including electronic tickets); • Optimisation of networks (roads, trolleybus lines, tram lines); • Development and optimisation of traffic management; • Construction of 100 km of bicycle lanes. <p>The SUMP will be implemented through 3-year action plans.</p>	SO.1 - Improve air quality in the City. SO.2 - Develop a sustainable mobility system in the City.			
	Sector:	Air &Transport	Location:	Lviv City and Oblast
	Category of Measure:	Legislation & Regulation changes ; Soft measures ; Investment projects; Technical assistance	Current status:	Ongoing
	Difficulty of implementation:	Political	Financial	Social
		1	3	2
	Economic benefits:	<ul style="list-style-type: none"> • Nothing significant 		
	Social benefits:	<ul style="list-style-type: none"> • Public health – 3 (Improvement of air quality and partial reduction of noise pollution) • Access to basic services - 3 (Higher efficiency and comfort for passengers) • Safety – 2 (Improved safety due to improved vehicle fleet and improved traffic management) • Gender equality – 2 (Jobs open to all) • Green behaviour and awareness – 3 (Improved public transport system will attract more passengers) • Community involvement - 3 (Improved municipal transport system in in interest of all citizens) 		
	Environmental benefits:	<ul style="list-style-type: none"> • Air quality – 3 (Reduction of exhaust emissions, emissions of PM from tyres, brakes and road surface wear and of noise pollution) • Energy use – 2 (Reduction of energy consumption due to higher efficiency of new vehicles) • Climate change mitigation – 3 (Reduction of CO2 due to higher efficiency of vehicles, increased use of renewables and better traffic management) 		
	Estimated implementation cost:	<ul style="list-style-type: none"> • Capital expenditure cost (CAPEX): Included in Actions T.2 to T.6 • Implementation cost (OPEX): Included in Actions T.2 to T.6 		
	Implementation timescale	SUMP adopted in 2019. Implementation of individual Actions over next 5 years		
	Potential sources of Funding	(1) Lviv City Budget; National Government (3) International Donors and Funds (including EBRD) – combination of financing instruments		
	Competent Authority/Owner:	(1) City Institute– responsible for preparation and implementation of 3-year action plan		

	T.2 – Completion of e-ticketing project (in progress)		SO.1 - Improve air quality in the City. SO.2 - Develop a sustainable mobility system in the City.	
	Sector:	Air &Transport	Location:	All of Lviv City
	Category of Measure:	Soft measures Investment project	Current status:	Ongoing
	Difficulty of implementation:	Political	Financial	Social
		1	2	1
	Economic benefits:	<ul style="list-style-type: none"> Economic returns for investors - 1 (Increased income, some cost savings) 		
	Social benefits:	<ul style="list-style-type: none"> Economic Growth - 1 (may improve mobility within the City) 		
	Environmental benefits:	<ul style="list-style-type: none"> Access to basic services - 3 (Improved accessibility to transport systems) 		
	Estimated implementation cost:	Based on City estimates: <ul style="list-style-type: none"> Capital expenditure cost (CAPEX): EUR 2 million (UAH 53 million) (remaining) Implementation cost (OPEX): Reduced compared to present system 		
<p>The process of introducing an automated payment system for travel in public transport (e-ticket) is in progress and is expected to be finalised by the end of 2021. The operator of the electronic ticket will be LME "LvivAvtodor". Timed tickets will be introduced - for a day, three days, a month, a year. Various methods of payment are planed – terminal, debit/credit card, special transport card, QR code – however the possibility to pay in cash will be retained. This action should have a positive impact on the attractiveness of public transport.</p> <p>The remaining capital requirement is around €2 million (UAH 53 million). Operating costs will be reduced compared with the current system.</p>	Implementation timescale	Ongoing. Completion in 2021.		
	Potential sources of Funding	(1) Lviv City Budget; National Government (3) International Donors and Funds (including EBRD) – combination of financing instruments		
	Competent Authority/Owner:	(1) City Institute and LvivAvtodor		



T.3 – Purchase of new buses, trolley buses and trams (in progress)

SO.1 - Improve air quality in the City.
SO.2 - Develop a sustainable mobility system in the City.

Sector:	Air &Transport	Location:	All Lviv City
Category of Measure:	Investment project	Current status:	Ongoing
Difficulty of implementation:	Political 1	Financial 3	Social 1
Economic benefits:	<ul style="list-style-type: none"> Economic returns for investors – 1 (Cost savings due to higher energy efficiency and related savings in fuels) Economic Growth – 1 (Extended transport system will support economic growth) Job creation/Employment – 1 (Related to the increased number of vehicles in service) 		
Social benefits:	<ul style="list-style-type: none"> Public health – 2 (Indirect impact via improved air quality) Access to basic services – 2 (Increased number of vehicles in service) Safety – 2 (Modern vehicles comply with higher safety standards) Green behaviour and awareness – 2 (Better quality of vehicles should attract more public transport passengers) Community involvement – 2 (Active interest of community can be expected) 		
Environmental benefits:	<ul style="list-style-type: none"> Air quality – 3 (Improvement of air quality, especially in the case of trolley buses and trams) Energy use – 2 (Higher energy efficiency of new vehicles) Climate change mitigation – 2 (Lower emissions of CO₂ related to higher energy efficiency of new vehicles) 		
Estimated implementation cost:	Based on City estimates: <ul style="list-style-type: none"> Capital expenditure cost (CAPEX): EUR 100 million (UAH 26.5bn) Implementation cost (OPEX): Reduced costs 		
Implementation timescale	Ongoing. Will continue for next 5 years		
Potential sources of Funding	(1) Lviv City Budget (3) International Donors and Funds – EBRD/IFC loan		
Competent Authority/Owner:	(1) City Transport Department (through LMC Lrivelektrotrans and LMC ATP-1)		

The Program for the purchase of buses through financial leasing (Document adopted by the City Council of Lviv in 2018) states that the City of Lviv should run 630 buses on working days and 427-434 buses at weekends. Currently there are 480-500 buses on the routes on working days and 350-370 units at weekends. According to recent modelling, the ideal would be 730 buses with modified distribution across the routes. The Lviv Municipal Transport Company proposes to purchase a further 150 buses and trolley buses with a passenger capacity of at least 100 persons each through financial leasing. Additional second hand trams will also be purchased. The purchase of new public transport vehicles will increase the attractiveness of public transport for those citizens who currently travel in and around the City by private car.

The capital expenditure for the next phase of this project is expected to be around **€100 million (UAH 2.65bn)**. This includes €48 million for 2020 via a loan already agreed with EBRD/IFC. Operational costs will be reduced compared with the current vehicles because of lower energy and maintenance costs.



T.4 – Feasibility study for extension of the tram and trolley bus network, including new depots and transport hubs

As a first stage in this project a feasibility study is proposed for the extension of the tram and trolley bus network, including new depots and transport hubs, with special attention paid to connection of the suburbs with the City centre. These extended mobility opportunities will increase the attractiveness of public transport. This action will be carried out in parallel with action T.5.


This action will include the following phases:


- Concept of extension
- Feasibility study
- Search for funding
- Stepwise implementation.

There is no capital expenditure associated with the Action but we will need an estimated **€200,000** (UAH 5.3 million) to develop the feasibility study.


SO.1 - Improve air quality in the City. SO.2 - Develop a sustainable mobility system in the City.

Sector:	Air &Transport	Location	All Lviv City
Category of Measure:	Investment project	Current status:	New measure
Difficulty of implementation:	Political 1	Financial 3	Social 1
Economic benefits:	<ul style="list-style-type: none"> • Economic returns for investors – 1 (Revenue from payments for additional routes) • Economic Growth – 2 (Extension of transport infrastructure should support economic growth) 		
Social benefits:	<ul style="list-style-type: none"> • Access to basic services – 3 (Improved mobility for citizens) • Green behaviour and awareness – 3 (Extended networks should attract more public transport passengers) • Community involvement – 2 (Active interest of community can be expected) 		
Environmental benefits:	<ul style="list-style-type: none"> • Air quality – 3 (Improved air quality because of shift of passengers from private cars to public transport) • Energy use – 2 (Higher energy efficiency because of shift of passengers from private cars to public transport) • Climate change mitigation – 2 (Lower emissions of CO2 related to higher energy efficiency) 		
Estimated implementation cost:	<ul style="list-style-type: none"> • Capital expenditure cost (CAPEX): Zero (for feasibility study) • Implementation cost (OPEX): EUR 200,000 (UAH 5.3 million) 		
Implementation timescale	Concept of network extension prepared in 2020, feasibility study in 2021, implementation from 2022 onwards		
Potential sources of Funding	(1) Lviv City Budget (3) International Donors and Funds – to be identified after feasibility study is completed		
Competent Authority/Owner:	(1) City Transport Department (LCE LvivAvtodor, LME LvivElektrotrans)		

 <p>T.5 – Feasibility study for the prioritisation of public transport, including dedicated lanes, traffic management and ‘smart’ traffic light systems</p> <p>Improvement of traffic management with the prioritisation of public transport is expected to reduce traffic congestion and journey times thus increasing the attractiveness of public transport and reducing the number of private cars in the City. This will also have positive impact on air quality. This Action will be coordinated with Action T.4.</p> <p>This action will include the following steps</p> <ul style="list-style-type: none"> • Selection of transport modelling tool and collection of actual data • Selection of parts of road at which concrete measures could be applied • Detailed proposal of concrete measures • Economic analysis • Finalisation of feasibility study <p>There is no capital requirement at this stage and OPEX to develop the feasibility study will again be around €200,000 (UAH 5.3 million).</p>	<p>SO.1 - Improve air quality in the City. SO.2 - Develop a sustainable mobility system in the City.</p>			
	Sector:	Air &Transport	Location	Across Lviv City
	Category of Measure:	Soft measure	Current status:	New measure
	Difficulty of implementation:	Political	Financial	Social
		1	1	1
	Economic benefits:	<ul style="list-style-type: none"> • Economic Growth – 1 (More efficient urban mobility could contribute to economic growth) 		
	Social benefits:	<ul style="list-style-type: none"> • Public health – 2 (Improved air quality due to reduction of congestion) • Access to basic services – 2 (Improved mobility for citizens) • Safety – 1 (Lower risk of accidents due to more efficient traffic management) • Green behaviour and awareness – 3 (Faster public transport will attract more passengers) 		
	Environmental benefits:	<ul style="list-style-type: none"> • Air quality – 3 (Shift to public transport, less congestion) • Energy use – 1 (Higher transport energy efficiency) • Climate change mitigation – 1 (Lower emissions of CO2 due to higher energy efficiency) 		
	Estimated implementation cost:	<p>Consensual estimate of the meeting</p> <ul style="list-style-type: none"> • Capital expenditure cost (CAPEX): Zero (for feasibility study) • Implementation cost (OPEX): EUR 200,000; UAH 5.3 million (for feasibility study) 		
	Implementation timescale	Feasibility study in 2020. Implementation in subsequent years if feasible		
	Potential sources of Funding	<p>(1) Lviv City Budget</p> <p>(3) International Donors and Funds – to be identified (also indicate whether a grant, sovereign loan, municipal loan, private sector loan)</p>		
	Competent Authority/Owner:	(1) City Transport Department (LCE Lvivavtodor, LME Lvivelektrotrans)		

 <p>T.6 – Construction of additional 100km of pedestrian and cycling routes</p> <p>The Bicycle Network Development Program for 2011-2019 (Document adopted by the City Council of Lviv in 2011) plans that by 2020, the City should have 268 km of cycle paths. The implementation of this Program has been delayed because of a lack of finance so that the current length of cycle paths is around 100 km. This Action is aimed at restarting the project.</p> <p>This action will include the following steps:</p> <ul style="list-style-type: none"> • Selection of localities at which concrete measures could be applied • Detailed proposal of concrete measures • Feasibility study • Implementation <p>Initially we will provide and additional €5 million (UAH 132.5 million) to restart the project and further financing will be sought from the international organisations. We will also require €1 million (UAH 26.5 million) of OPEX over the GCAP timescale for maintenance of the cycle paths.</p>	SO.1 - Improve air quality in the City. SO.2 - Develop a sustainable mobility system in the City.			
	Sector:	Air &Transport	Location	Across Lviv City
	Category of Measure:	Investment project	Current status:	Planned, funding being explored
	Difficulty of implementation:	Political	Financial	Social
		1	2	1
	Economic benefits:	<ul style="list-style-type: none"> • Economic Growth – 1 (New opportunities for SMEs) • Job creation/Employment – 1 (Some new jobs could be created) 		
	Social benefits:	<ul style="list-style-type: none"> • Public health – 3 (Encouraging walking and cycling) • Access to basic services – 2 (Additional options of mobility) • Safety – 2 (Some journeys shifted from car transport) • Green behaviour and awareness – 2 (Additional options for environment friendly mobility) • Community involvement – 3 (Active interest of community can be expected) 		
	Environmental benefits:	<ul style="list-style-type: none"> • Air quality – 2 (Improved air quality because of partial shift from private car transport) • Energy use – 1 (Reduction of energy consumption due to partial shift from private car transport) • Climate change mitigation – 1 (Reduction of CO₂ emissions due to partial shift from private car transport) 		
	Estimated implementation cost:	Based on City estimates: <ul style="list-style-type: none"> • Capital expenditure cost (CAPEX): EUR 5 million (UAH 132.5 million) • Implementation cost (OPEX): EUR 1 million (UAH 26.5 million) 		
	Implementation timescale	Planning starting 2020, implementation in subsequent years		
	Potential sources of Funding	(1) Lviv City Budget (3) International Donors and Funds – to be identified		
	Competent Authority/Owner:	(1) City Transport Department		

Strategic Objective 3 - Bring waste collection, reuse, recycling and treatment up to international standards

	SW.1 (i) Remediation of the old landfill	SO 3 – Bring waste collection, reuse, recycling and treatment up to international standards			
		Sector:	Solid Waste	Location:	Old landfill site
		Category of Measure:	Investment project	Current status:	(1) Ongoing (2) Planned and funding agreed
		Difficulty of implementation:	Political 2	Financial 2	Social 1
		Economic benefits:	<ul style="list-style-type: none"> N/A 		
		Social benefits:	<ul style="list-style-type: none"> Public health – 3 (Securing of the landfill will considerably reduce health-related risks from air emissions, leachate) Safety – 2 (Securing of the landfill will prevent further landslides and potential dangerous situations) 		
		Environmental benefits:	<ul style="list-style-type: none"> Water quality – 2 (Leachate collection and treatment will prevent leakages into soil and underground water) Soil quality – 2 (Leachate collection and treatment will prevent leakages into soil and underground water) Climate change mitigation – 2 (Reduction of GHG emissions from methane extraction and usage) 		
		Estimated implementation cost:	<ul style="list-style-type: none"> Capital expenditure cost (CAPEX): 17 million EUR (UAH 450 million) Annual implementation cost (OPEX): Zero (City data on actual costs) 		
		Implementation timescale	Ongoing. Due to be completed by 2022		
		Potential sources of Funding	(1) Lviv City Budget (3) International Donors and Funds – EBRD loan		
		Competent Authority/Owner:	(1) City Waste Department; (2) LME Green City		


With the aim to address the immediate problems the City has been facing in the waste management and treatment area, the LME “Green City” is currently working on the project of remediation of the old landfill site. It includes extraction of methane gas for electricity generation and the installation of a leachate treatment system;


Steps:


- Continue with rehabilitating the old landfill
- Raise additional finance if necessary


Note & Comment:


- Funding secured
- Tender is on-going

 <p>SW.1 (ii) Construction of the MBT plant</p> <p>With the aim to address the immediate problems the city has been facing in the waste management and treatment area, the LME “Green City” is currently working on the project of construction of a new waste treatment facility. The plant will be based on mechanical and biological processes (MBT plant), and its outputs can be either composted or sent to local cement plants to be burned as refuse-derived fuel.</p> <p>Steps:</p> <ul style="list-style-type: none"> Building the MBT plant Raise additional finance if necessary <p>Note & Comment:</p> <ul style="list-style-type: none"> EBRD funding secured; applied for EIB funding Contract for technical consultant signed Contractor to be selected by March 2020 	SO 3 – Bring waste collection, reuse, recycling and treatment up to international standards			
	Sector:	Solid Waste	Location	Old landfill site
	Category of Measure:	Investment project	Current status:	(1) Ongoing (2) Planned and funding agreed
	Difficulty of implementation:	Political	Financial	Social
		3	2	2
	Economic benefits:	<ul style="list-style-type: none"> Economic returns for investors – 2 (Business model based on sale of recyclables to recycling/reprocessing companies) Economic inclusion – 2 (Several new jobs in MBT plant will be available for less educated citizens) 		
	Social benefits:	<ul style="list-style-type: none"> Gender equality – 2 (Jobs in recycling sector will be available to men and women) Green behaviour and awareness – 3 (Recycling-related activities considerably contribute to green awareness and behaviour) 		
	Environmental benefits:	<ul style="list-style-type: none"> Material use – 3 (Instead of being landfilled, valuable materials will be sorted and provided for further use) 		
	Estimated implementation cost:	<ul style="list-style-type: none"> Capital expenditure cost (CAPEX): 31 million EUR (UAH 822 million) Implementation cost (OPEX): 9 million EUR (UAH 238 million). Offset by electricity generation revenues. (City data on actual costs)		
	Implementation timescale	Start early 2020, completion by end of 2021		
	Potential sources of Funding	Lviv City Budget International Donors and Funds – EBRD loan + EIB loan		
	Competent Authority/Owner:	City Department – LME Green City		


	SW.1 (iii) Construction of a new landfill	SO 3 – Bring waste collection, reuse, recycling and treatment up to international standards			
		Sector:	Solid Waste	Location	Site yet to be agreed. Will be in Lviv Oblast
		Category of Measure:	Investment project	Current status:	Planned, funding being explored
<p>Following the closure and remediation of the old landfill, a new landfill site for the city needs to be identified for disposal of residual waste. The solution has already been sought within the Waste Management Strategy to 2030 in Lviv Oblast.</p> <p><u>Steps:</u></p> <ul style="list-style-type: none">Identify and agree location of a new landfill site with Lviv OblastCommence construction of new landfill <p>Note & Comment:</p> <ul style="list-style-type: none">EIB seems to be ready to finance itLocation still has not been found	Difficulty of implementation:	Political 3	Financial 2	Social 3	
	Economic benefits:	<ul style="list-style-type: none">Economic returns for investors – 2 (Profit generated from payments for waste disposal will provide good economic return over the whole lifetime of the landfill)Economic inclusion – 2 (Several new jobs at the landfill will be available for less educated citizens)			
	Social benefits:	<ul style="list-style-type: none">Access to basic services – 3 (Long-term solution of a current problem with waste disposal at small landfills in Lviv Oblast)			
	Environmental benefits:	<ul style="list-style-type: none">Material use – 3 (New landfill is part of the solution to better use of waste materials)			
	Estimated implementation cost:	<ul style="list-style-type: none">Capital expenditure cost (CAPEX): 14 million EUR (UAH 371 million)Implementation cost (OPEX): Zero (in GCAP timescale) (City data based on estimated costs)			
	Implementation timescale	Depends on agreeing site and gaining permits. Construction scheduled to start in 2023			
	Potential sources of Funding	(1) Lviv City Budget (3) International Donors and Funds – EIB loan			
	Competent Authority/Owner:	(1) City Department – LME Green City (2) Governmental Body or Ministry – Lviv Oblast authorities			

 <p>SW.2 Improve 'primary' infrastructure for separate waste collection – bringing containers closer to source</p> <p>Although separate waste collection has already been introduced to some extent and separate collection bins (plastics, paper, glass) are located at many points in the City centre, the recycling rate of municipal solid waste is still only 2-3%. The situation can be improved by intensification of separate collection points, i.e. bringing them closer to the citizens. Experience from cities where recycling is well developed shows that with improved accessibility, the involvement of citizens increases considerably. Improvement of the infrastructure needs to be accompanied by citizens' awareness raising about the possibilities and importance of waste separation. Consequently, the availability of separated materials can boost the development of local recycling businesses.</p> <p><u>Steps:</u></p> <ul style="list-style-type: none"> Identify localities where containers for separated waste can be placed; Gradually purchase and place containers at selected localities; Analyse demand for secondary materials, and sign contracts with relevant recycling businesses; Increase awareness of citizens on waste separation <p>The estimated cost of the new bins and developing the new sites is estimated to be €1-2 million (UAH 26.5-53 million) Operating costs are estimated at €500,000 per year, or €2million (UAH 53 million) over the GCAP timescale. Some of this will come from the City budget but most will be from the private waste collection companies.</p>	SO 3 – Bring waste collection, reuse, recycling and treatment up to international standards			
	Sector:	Solid Waste	Location:	Various points around the City
	Category of Measure:	Investment project	Current status:	Planned, funding being explored
	Difficulty of implementation:	Political	Financial	Social
		1	2	1
	Economic benefits:	<ul style="list-style-type: none"> Economic Growth – 2 (Primary waste separation will create favourable conditions for development of recycling and reprocessing industry) Economic inclusion – 2 (Stimulation of recycling and reprocessing industry, where also less educated citizens can find jobs) 		
	Social benefits:	<ul style="list-style-type: none"> Access to basic services – 2 (Considerable improvement of waste collection infrastructure and services) Green behaviour and awareness – 3 (Involvement in waste separation is one of primary means of increasing green behaviour) Community involvement – 2 (NGOs and community organisations can be involved into the new system, in particular in communication and awareness raising activities) 		
	Environmental benefits:	<ul style="list-style-type: none"> Material use – 3 (Instead of being landfilled, valuable materials will be separated and provided for further use) 		
	Estimated implementation cost:	<ul style="list-style-type: none"> Capital expenditure cost (CAPEX): 1-2 million EUR (UAH 26.5-53 million) Implementation cost (OPEX): 2 million EUR; UAH 53 million (increased costs compared to the current system) (Based on City data)		
	Implementation timescale	Additional bins provided from 2020 to 2022. Awareness raising throughout this period and beyond.		
	Potential sources of Funding	Private Sector – waste collection companies		
	Competent Authority/Owner:	(1) City Department – LME Green City (coordination) (2) Private Entity – waste management companies (operation)		

 <p>SW.3 Develop a network of official waste recycling centres</p> <p>The action consists of separate collection of those types of household and business waste, which can be recycled but are not suitable for collection through a network of separate collection bins situated on streets (e.g. bulky waste – furniture, mattresses;, construction and demolition waste; tyres; textiles; wood; electrical and electronic waste; etc.), and collection of hazardous waste. These types of waste will be accepted by so-called ‘waste recycling centres’ located at several places in the City. Operation of these centres should be supported by awareness raising activities.</p> <p><u>Steps:</u></p> <ul style="list-style-type: none"> Identify localities where the waste recycling centres can be built; Build and equip the recycling centres; Analyse the demand for secondary materials, and sign contracts with relevant recycling businesses; Increase awareness of citizens about the recycling centres and waste accepted. <p>Note & Comment:</p> <ul style="list-style-type: none"> Only 2 centres planned initially Problem with space for additional centres The City is pushing waste collection companies to build similar centres 	SO 3 – Bring waste collection, reuse, recycling and treatment up to international standards			
	Sector:	Solid Waste	Location	Four sites spread around the City (to be agreed)
	Category of Measure:	Investment project	Current status:	Planned, funding being explored
	Difficulty of implementation:	Political	Financial	Social
		1	1	1
	Economic benefits:	<ul style="list-style-type: none"> Economic Growth – 2 (Waste recycling centres will create favourable conditions for development of recycling and reprocessing industry) Job creation/Employment – 2 (Increased sorting and recycling activities will provide new employment opportunities) Economic inclusion – 2 (Less educated citizens can find jobs in waste recycling centres as well as in subsequent recycling and reprocessing industry) 		
	Social benefits:	<ul style="list-style-type: none"> Access to basic services – 2 (Considerable improvement of waste collection infrastructure and services) Gender equality – 2 (Jobs in waste recycling centres and recycling sector will be available to men and women) Green behaviour and awareness – 3 (Involvement in waste separation is one of the primary means of increasing green behaviour) Community involvement – 2 (NGOs and community organizations can be involved into the new system, in particular in communication and awareness raising activities) 		
	Environmental benefits:	<ul style="list-style-type: none"> Material use – 3 (Instead of being landfilled, valuable materials will be separated and provided for further use) 		
	Estimated implementation cost:	<ul style="list-style-type: none"> Capital expenditure cost (CAPEX): 3 million EUR (UAH 80 million) Implementation cost (OPEX): 3 million EUR (UAH 80 million) (City & consultant estimates) 		
	Implementation timescale	Sites identified in 2020 (first two centres); constructed in 2021; additional centres in 2021-2023; Awareness raising to start once centres are built (2021)		
	Potential sources of Funding	(1) Lviv City Budget (3) International Donors and Funds – EBRD loan		
	Competent Authority/Owner:	(1) City Department – LME Green City (3) Private Entity – waste collection companies/operators		

	SW.4 Develop a system for composting of organic waste		SO 3 – Bring waste collection, reuse, recycling and treatment up to international standards				
	Sector:	Solid Waste <i>Land Use & Biodiversity</i>	Location	At the site of the old landfill			
	Category of Measure:	(2) Soft measures (3) Investment project	Current status:	Planned, funding being explored			
	Difficulty of implementation:	Political	Financial	Social			
		1	1	2			
	Economic benefits:	<ul style="list-style-type: none">Economic returns for investors – 1 (Small economic return as compost values are low)					
	Social benefits:	<ul style="list-style-type: none">Access to basic services – 2 (Improvement of waste collection infrastructure and services)Green behaviour and awareness – 3 (Involvement in waste separation activities is one of primary means of increasing green behaviour)Community involvement – 2 (The system will provide for possibilities of community composting. Furthermore, NGOs and community organisations can be involved into communication and awareness raising activities)					
	Environmental benefits:	<ul style="list-style-type: none">Material use – 3 (Instead of being landfilled, organic waste will be turned into valuable compost)					
	Estimated implementation cost:	<ul style="list-style-type: none">Capital expenditure cost (CAPEX): 3 million EUR (UAH 80 million)Implementation cost (OPEX): 3 million EUR (UAH 80 million) (City data on actual costs)					
	Implementation timescale	First composting plant to be built in 2020; wider green waste management systems implemented by 2021; awareness raising from 2020 to 2022					
Potential sources of Funding	(1) Lviv City Budget (3) International Donors and Funds – EBRD loan						
Competent Authority/Owner:	(1) City Department – LME Green City						

<p>Instead of being landfilled, the organic waste generated in the city should be used for production of compost in a municipal composting plant as well as at citizens’ homes (home or communal composting). The system would include both municipal green waste from parks and other public places (grass, leaves, branches, etc.) and organic waste from households. Also private sector businesses (in particular from the hospitality sector) could have the possibility to use the municipal composting plant with appropriate charging mechanisms.</p> <p><u>Steps:</u></p> <ul style="list-style-type: none">Set up a system for collection of green waste from parks and other public places;Analyse possible options of organic household waste management;Set up a system of organic household waste management;Build and equip the composting plant;Increase awareness of citizens and private sector about possibilities of composting. <p>Note & Comment:</p> <ul style="list-style-type: none">Green waste from parks + household waste (input from “wet mix” container) + WWTP waste (output from biogas station)Located next to the MBT plant35,000 tonnes/yearComposter distributed free of charge to interested citizens (condominiums)						
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<div></div> <div>PAY AS YOU THROW</div>		SW.5 Introduction of “pay-as-you-throw” (PAYT) principle		SO 3 – Bring waste collection, reuse, recycling and treatment up to international standards			
<p>The action consists of introduction of charges for waste collection service that take into account the amount of waste generated by the citizens. They will be given a possibility to separate waste for free (measures SW.2 – SW.4) and will be charged only for the amount of residual mixed waste produced. In order to prevent illegal dumping of residual waste (with the aim to decrease the charge), it may be necessary to introduce penalties and involve the City’s enforcement capacities.</p> <p><u>Steps:</u></p> <ul style="list-style-type: none">Analyse possible options of PAYT principle implementation (how charges can be introduced);Set up a system of charges, and approve relevant local regulations;Communicate the regulations to citizens; <p>Establish a team of enforcement officers.</p> <p>Note & Comment:</p> <ul style="list-style-type: none">Goal is to have one administrator that charges all customers (citizens, companies) and has contracts with waste facilities operatorsThen PAYT can be considered; now citizens are charged per m²Different types of PAYT systems exist; from simple ones based on payment per container volume + frequency to more complex based on weighing of containers		Sector:	Solid Waste	Location	City wide		
		Category of Measure:	Legislation & Regulation changes	Current status:	New measure		
		Difficulty of implementation:	Political	Financial	Social		
			2	2	2		
		Economic benefits:	• N/A				
		Social benefits:	• Green behaviour and awareness – 2 (PAYT system is based on economic motivation of citizens to environmental behaviour - reduction of waste generation and increase of separation)				
		Environmental benefits:	• Material use – 2 (The system motivates citizens to minimize residual waste, which means that valuable materials will be separated and provided for further use)				
		Estimated implementation cost:	• Capital expenditure cost (CAPEX): 1-4 million EUR; UAH 26.5 to 106 million (depending on type of PAYT scheme selected) • Implementation cost (OPEX): 400,000 EUR (UAH 10.6 million) (Consultant calculation based on Czech experience)				
		Implementation timescale	Agree and design system in 2020; implement in 2021. Communication with citizens ongoing from 2021 onwards				
Potential sources of Funding	Lviv City Budget Private Sector – waste collection companies/operators						
Competent Authority/Owner:	City Department – LME Green City Private Entity – waste collection companies/operators						



SW.6 Support educational, awareness raising and communication activities

The City should support communication and awareness raising activities in waste management area in order to involve citizens and stimulate their environmental friendly behaviour. The City can organise its own activities; however, it can also make use of knowledge and capacities of external organisations (NGOs, schools, educational centres, etc.) including their regular financial support.

Steps:

- Establish a system for support of educational, awareness raising and communication activities of external organisations;
- Provide regular support to external organisations;
- Organise own communication and awareness raising activities.


Note & Comment:


- Support for NGOs already exists – 50 thous. EUR/year

SO 3 – Bring waste collection, reuse, recycling and treatment up to international standards


Sector:	Solid Waste	Location	City wide
Category of Measure:	Soft measures (awareness raising)	Current status:	Ongoing
Difficulty of implementation:	Political	Financial	Social
	1	1	1
Economic benefits:	<ul style="list-style-type: none"> • N/A 		
Social benefits:	<ul style="list-style-type: none"> • Gender equality – 2 (Educational activities will be equally available to men and women) • Green behaviour and awareness – 3 (Direct activities to increase green behaviour and awareness of citizens) • Community involvement – 3 (NGOs and community organizations are supposed to deliver educational activities) 		
Environmental benefits:	<ul style="list-style-type: none"> • Material use – 2 (Education activities will focus on motivation of citizens to separate waste; thus, valuable materials will not be landfilled but provided for further use) 		
Estimated implementation cost:	<ul style="list-style-type: none"> • Capital expenditure cost (CAPEX): Zero • Implementation cost (OPEX): 400,000 EUR; UAH 10.6 million (for designing and running the programme) 		
Implementation timescale	Design programme in first half of 2020. Implement from second half of 2020 and ongoing after that		
Potential sources of Funding	Lviv City Budget Private Sector – waste collection companies/operators, large enterprises (as their PR)		
Competent Authority/Owner:	City Waste Department; NGOs		


Strategic Objective 4 - Develop a sustainable City water and wastewater management system


 <p>W.1 Reconstruction and renovation of the Wastewater Treatment Plant (WWTP)</p> <p>The Lviv wastewater treatment plant (WWTP) was built in the 1960s and at the moment it works at 40-50% of its capacity. The WWTP has fully functional mechanical and partially functional biological treatment stages. There are also problems with the input pumping station and blowers with their associated control systems that are causing overflows into the Poltva River with consequent pollution. Work is already under way to resolve these problems and to bring the WWTP up to full capacity and international standards with the assistance of a loan from EBRD. This work is expected to be completed by 2020.</p> <p>The cost of the reconstruction is €30 million (UAH 795 million) and funding has already been agreed with EBRD. The operating costs will be significantly reduced due to improved energy efficiency (and hence reduced costs) from replacing or upgrading major electrical equipment such as pumps, fans and blowers. LvivVodokanal is responsible for implementing this project.</p>	SO 4 - Develop a sustainable City water and wastewater management system			
	Sector:	Water	Location:	Existing WWTP
	Category of Measure:	Investment project	Current status:	Ongoing
	Difficulty of implementation:	Political 1	Financial 1	Social 1
	Economic benefits:	<ul style="list-style-type: none"> N/A 		
	Social benefits:	<ul style="list-style-type: none"> Public health – 2 (A fully operational WWTP will reduce harmful discharges to the River Poltva and improve public health) Access to basic services – 3 (Improved WW treatment will be of benefit to all citizens) Safety – 2 (A fully operational WWTP will reduce harmful discharges to the River Poltva and improve public safety) 		
	Environmental benefits:	<ul style="list-style-type: none"> Water quality – 3 (Significant positive effect on water quality in the River Poltva and downstream) Energy use – 2 (An efficient WWTP will use less energy and will also generate electricity (Action W.2)) Climate change mitigation – 2 (Reduction in energy use directly impacts climate mitigation) 		
	Estimated implementation cost:	<ul style="list-style-type: none"> Capital expenditure cost (CAPEX): 30 million EUR (UAH 795 million) Implementation cost (OPEX): Reduced because of lower energy usage and maintenance costs Based on LvivVodokanal estimates		
	Implementation timescale	Ongoing. Should be completed in 2020		
	Potential sources of Funding	International Donors and Funds – EBRD (agreed)		
	Competent Authority/Owner:	City LME– LvivVodokanal		


	W.2 – Construction of a biogas CHP unit from anaerobic digestion of sludge at the WWTP	SO 4 - Develop a sustainable City water and wastewater management system			
		Sector:	Water	Location	Existing WWTP
		Category of Measure:	Investment project	Current status:	Ongoing
	Difficulty of implementation:	Political	Financial	Social	
		2	2	1	
	Economic benefits:	• Economic returns for investors – 2 (Generation of electricity will reduce operating costs)			
	Social benefits:	• N/A			
	Environmental benefits:	• Soil quality – 2 (Digestate from biogas will be useful on land) • Energy use – 2 (Plant will generate electricity) • Land use – 2 (Digestate from biogas will be useful on land) • Climate change mitigation – 2 (Electricity will reduce energy demand and hence CO2 emissions)			
	Estimated implementation cost:	• Capital expenditure cost (CAPEX): 30 million EUR (UAH 795 million) • Implementation cost (OPEX): Reduced compared to present because of electricity generation Based on Lvivodokanal estimates. CAPEX may increase once additional work is fully assessed			
Implementation timescale	Construction should finish in 2021 and operation should start about 10 months later. Full energy production in 2022				
Potential sources of Funding	International Donors and Funds – EBRD				
Competent Authority/Owner:	City LME– LvivVodokanal				

Currently sewage sludge is dewatered and disposed of in fields for natural drying. A feasibility study has been carried out and work has commenced on building a biogas combined heat and power (CHP) plant based on anaerobic digestion of the sludge. However, since commencement of the work it has been discovered that it will be necessary to reconstruct the primary and secondary settling tanks and aeration systems in addition to the grit chambers. This will make it possible to achieve a project load of 120t of dry solids per day and efficiently implement the project. We are therefore currently seeking additional finance to complete this project to a satisfactory standard. This work is expected to be completed by 2021.
The total cost of the work has been assessed at €30 million (UAH 795 million) including the cost of the additional elements. Operating costs will be reduced because the electricity generated will supply the WWTP with any surplus exported to the grid. LvivVodokanal is responsible for implementing the project.
<p>Note & Comment:</p> <p>Ongoing projects on rehabilitation of part of the WWTP and construction of biogas station. Currently there is a budget of 30 million EUR from EBRD to construct the biogas station; however in order to operate it successfully, reconstruction of parts of the WWTP is necessary first.</p>


	W.3 – Replacement and/or mechanical cleaning of water supply pipes and fittings	SO 4 - Develop a sustainable City water and wastewater management system			
		Sector:	Water	Location	City wide
		Category of Measure:	Investment project	Current status:	Planned, funding being explored
<p>Currently there are around 50% of losses in the water distribution network. This means that 50% of all clean water produced is non-revenue, which we consider to be a major problem. The biggest single source of loss is from the distribution pipework, which includes pipework within buildings. VodoKanal management estimate that up to 80% of the leaks are ‘invisible’, i.e. they are mostly underground, making it more difficult to identify and fix the problem.</p> <p>The water supply system was built in 1960s and there has been little or no regular maintenance for the last 30 years. The pipework is made from cast iron and plastic. Due to the age and previously inadequate maintenance of the pipework, some sections of the water supply piping are clogged with mineral sediments which causes pressure problems and further leakages in the system.</p> <p>Dealing with this problem will be long-term and expensive because much of the pipework will need to be replaced, meaning major excavation works across the City. We are also investigating technologies that can remove sediments without the need to excavate the roads and pavements that could be useful on some sections of the distribution system. This technology is only applicable to pipework that is not in a state of disrepair so it will be necessary to undertake an evaluation of the pipework system by camera prior to starting work. Another alternative is to line the existing pipework with a flexible plastic sheath, though again this will only be possible on some sections of the distribution system where there are few junctions. Once solutions have been implemented it will also be necessary to install leakage detection systems to minimise losses in the future.</p> <p>As part of this project it will also be necessary to replace or upgrade the electrical equipment (transformers, switchgear, pumps, controls) at the pumping stations as much of the existing plant is very old (mid-20th century).</p> <p>Note & Comment:</p> <p>The daily capacity is about 170,000 m³. LvivVodokanal is the biggest electricity consumer in the City. There are 30 electricity transformer stations that have not been renovated since 1930. However, the work must be a part of an overall system of leakage detection.</p> <p>Water tariffs are set by national commission and are the same for citizens and companies (10UAH/m³ for water supply, 4 UAH/m3 for waste water). Economic price should be at least three times more. However, there is a political will to increase tariffs. But if losses are minimised, costs for water treatment will be reduced.</p>		Difficulty of implementation:	Political 1	Financial 3	Social 1
		Economic benefits:	<ul style="list-style-type: none">Economic returns for investors – 3 (Reducing water losses and non-revenue water will significantly reduce costs)Job creation/Employment – 2 (Jobs creation in the rehabilitation programme)		
		Social benefits:	<ul style="list-style-type: none">Public health – 2 (Reduction in leakage will reduce flooding incidents)Access to basic services – 3 (Fewer interruptions to water supply)		
		Environmental benefits:	<ul style="list-style-type: none">Water quality – 3 (Reduced leakage and better pipework will reduce contaminants in water)Water use – 3 (Significant reduction in water losses and use)Energy use – 3 (Less electricity used for pumping)Climate change mitigation – 3 (Less electricity used for pumping saves CO2)Climate change adaptation – 2 (Fewer localised flooding incidents)		
		Estimated implementation cost:	<ul style="list-style-type: none">Capital expenditure cost (CAPEX): 100 million EUR (UAH 2.65 bn) over 5 years (LvivVodokanal estimate)Implementation cost (OPEX): Reduced from present		
		Implementation timescale	Survey and plan in 2020; raise funds in 2021; work commences in 2022; will take around 15 years to complete		
		Potential sources of Funding	International Donors and Funds		
		Competent Authority/Owner:	City LME – LvivVodokanal		


	W.4 – Renovation/retrofitting of water pipework inside buildings	SO 4 - Develop a sustainable City water and wastewater management system			
		Sector:	Buildings & Energy Water	Location	City wide
<p>A second major source of leakage of drinking water is from pipework inside of buildings. In order to minimise costs and disruption to building occupants, renovation work or replacement of pipework should take place at the same time as thermal remediation of buildings (see Action B.1). Smart meters incorporating leak detection systems should be installed at the same time.</p> <p>The capital expenditure required is estimated at €10-20 million (UAH 265 – 530 million) but this is heavily dependent on how much work can be done in tandem with other building remediation activities. Operational costs will be reduced because of the lower costs for water supply and the reduction in damage to buildings. Funding for buildings remediation is expected from IFIs and donors and some of this can be used for renovation of internal water pipe work. Implementation will mainly be the responsibility of building owners and their contractors.</p> <p>Note & Comment: This Action will be implemented at the same time as thermal rehabilitation of buildings (Action B.1)</p>		Category of Measure:	Investment project	Current status:	Planned, funding being explored
		Difficulty of implementation:	Political	Financial	Social
			1	3	2
		Economic benefits:	<ul style="list-style-type: none"> Economic returns for investors – 3 (Reduction in water losses will significantly reduce costs) Job creation/Employment – 2 (Jobs creation in the rehabilitation of buildings) 		
		Social benefits:	<ul style="list-style-type: none"> Public health – 2 (Reduced water leakage in buildings) 		
		Environmental benefits:	<ul style="list-style-type: none"> Water use – 3 (Significant reduction in water leakage and usage) Energy use – 2 (Less electricity used for pumping) Climate change mitigation – 2 (Less electricity used for pumping leading to reduced CO₂ emissions) Climate change adaptation – 2 (Reduction in localised flooding) 		
		Estimated implementation cost:	<ul style="list-style-type: none"> Capital expenditure cost (CAPEX): 10-20 million EUR (UAH 265-530 million) Implementation cost (OPEX): Reduced Based on LvivVodokanal and consultant estimates 		
		Implementation timescale	Surveys and financing completed in 2020; implementation from 2021 spread over about 10 years		
		Potential sources of Funding	(1) International Donors and Funds (2) Private investors (building owners)		
		Competent Authority/Owner:	(1) LME – LvivVodokanal (2) Building Owners		


 <p>W.5 – All communal residential blocks and individual apartments fitted with water meters</p> <p>Around 93% of private flats and households, as well as all commercial and industrial enterprises, have water meters installed but there is no water metering at the entrance to communal residential building blocks. Water consumption per capita is around 25% higher where there is no meter. LvivVodokanal has already started on installing the additional meters in communal residential blocks and individual apartments.</p> <p>Tariffs for water supply are set by a National Commission but need to be around three times higher to cover the real cost of operating and maintaining the network. The shortfall is made up from the City budget. Complete metering of all consumers would allow accurate charging for water, though the tariff rates would need to be increased if the full costs are to be covered. Lower water consumption would also reduce the load on the WWTP.</p> <p>Once this project is complete we will launch a publicity/information campaign on actions to reduce water consumption. We may also need to upgrade the maintenance facility for meters as they need to be tested and calibrated every five years.</p> <p>Note & Comment: It will also be necessary to expand the capacity for meter repairs and maintenance</p>	SO 4 - Develop a sustainable City water and wastewater management system			
	Sector:	Water	Location	City wide
	Category of Measure:	Investment project	Current status:	Ongoing
	Difficulty of implementation:	Political	Financial	Social
		1	1	2
	Economic benefits:	<ul style="list-style-type: none"> Economic returns for investors – 2 (Meters will allow charging for water used. As a result water usage should reduce.) 		
	Social benefits:	<ul style="list-style-type: none"> Green behaviour and awareness – 2 (Awareness of water costs and potential for saving will encourage green behaviour) 		
	Environmental benefits:	<ul style="list-style-type: none"> Water use – 3 (Significant reduction in water usage) Energy use – 2 (Consequent reduced electricity usage for pumping) Climate change mitigation – 2 (Reduced electricity usage for pumping leads to lower CO2 emissions) 		
	Estimated implementation cost:	<ul style="list-style-type: none"> Capital expenditure cost (CAPEX): 1 million EUR (UAH 26.5 million) Implementation cost (OPEX): 1 million EUR (UAH 26.5 million) over 5 years (LvivVodoKanal and consultant's estimates) 		
	Implementation timescale	Installation should be complete by 2020; awareness campaign on using less water in 2021 along with discussions on raising tariffs; meter maintenance facility expanded in 2021		
	Potential sources of Funding	City/Vodokanal budget		
	Competent Authority/Owner:	City LME– LvivVodokanal		

	W.6 – Separate rainwater drainage system from the City sewerage system			
	SO 4 - Develop a sustainable City water and wastewater management system			
	Sector:	Water	Location	Most areas of the City
	Category of Measure:	Investment project	Current status:	Planned, funding being explored
	Difficulty of implementation:	Political	Financial	Social
		1	3	1
	Economic benefits:	<ul style="list-style-type: none"> Job creation/Employment – 2 (Jobs creation in the rehabilitation programmes) 		
	Social benefits:	<ul style="list-style-type: none"> Public health – 2 (Reduction in flooding incidents) Safety – 2 (Reduction in flooding incidents) 		
	Environmental benefits:	<ul style="list-style-type: none"> Energy use – 2 (Reduced electricity consumption at the WWTP) Climate change mitigation – 2 (Reduced electricity consumption leads to lower CO2 emissions) Climate change adaptation – 3 (Will reduce localised flooding events) 		
<p>Implementing this Action would be very difficult in the built-up areas of the City as it would require extensive excavation of roads and pavements. Separate systems already exist in three districts of the City and are planned for the new industrial zone at Syhniivka. It should be possible to separate the rainwater and sewerage water systems during reconstruction and certainly in new buildings and land development. As part of construction permits for new buildings and major refurbishments it will be mandatory to include Sustainable Urban Drainage Systems (SUDS) which would slow the release of rainwater into the drainage systems. Some of the collected rainwater could be used in City parks and gardens. This would ease the pressure on the WWTP and reduce localised flooding, thus contributing to our activities on Resilience.</p> <p>Capital expenditure if restricted to new developments and major refurbishments is likely to be €10-20 million (UAH 265-530 million) Operating costs would be reduced because of the lower loads on the WWTP and the reduced costs of dealing with the aftermath of localised flooding.</p> <p>LvivVodokanal would be responsible for overseeing the work required, working in close cooperation with contractors for the improvement schemes. City Hall and the National Government will need to be involved in drawing up regulations for SUDS.</p>	Estimated implementation cost:	<ul style="list-style-type: none"> Capital expenditure cost (CAPEX): 10-20 million EUR (UAH 265 – 530 million) if restricted to new developments Implementation cost (OPEX): Reduced costs at WWTP Based on LvivVodokanal estimates 		
	Implementation timescale	Assess all new developments for rainwater separation starting in 2020 and ongoing after that; draw up regulation for SUDS in all new buildings and major refurbishments in 2020, completion in 2021		
	Potential sources of Funding	International Donors and Funds City/LvivVodokanal budget Private investors (in new developments)		
	Competent Authority/Owner:	City LME– LvivVodokanal		


Strategic Objective 5 - Proactive and informed municipal government leadership in energy efficiency and use of renewable energy sources


	E.1 Modernisation of street lighting to LED standards	Strategic Objective 5 - Proactive and informed municipal government leadership in energy efficiency and use of renewable energy sources			
		Sector:	Energy	Location:	City wide
		Category of Measure:	Investment project	Current status:	Ongoing pilot project Planned, funding being explored
<p>Street lighting is an essential public service typically provided by public authorities at municipal level. Street lighting modernisation projects have a substantial potential in energy & maintenance savings (up to 70%) and demonstrate great viability. The City of Lviv should invest in energy-efficient street lighting systems to replace its outdated system.</p> <p>High-quality LED lighting system</p> <ul style="list-style-type: none">improves visibility through better colour rendering and uniform illumination patterns;LED fixtures allow lighting to be dimmed when conditions are appropriate to receive even more cost savings;LED lighting can be more precisely controlled, minimising over-lit hot spots, and ensuring adequate illumination between luminaries and at the far edges of the space. <p>LED public lighting installation would bring significant savings in electricity consumption by 50-60%, operation and maintenance costs by 70-80%.</p> <p>The actions that are envisaged to bring significant energy efficiency in the street lighting sector:</p> <ul style="list-style-type: none">Intelligent Street Lighting Management CentreLED Light for Street LampsInstallation of LED traffic lights;LED light night illumination of public buildings. <p>Steps:</p> <ul style="list-style-type: none">Prioritise locations for street lighting upgrades from the lighting survey – a feasibility study to assess over lit vs low lit spotsInvestigate potential financing routes including IFIs and ESCOsCommence conversion of street lighting to LEDs	Difficulty of implementation:	Political 1	Financial 2	Social 1	
	Economic benefits:	<ul style="list-style-type: none">Economic returns for investors – 3 (Very good returns from energy & maintenance savings)Job creation/Employment – 2 (Job creation for modernization schemes)			
	Social benefits:	<ul style="list-style-type: none">Safety – 2 (Reliable and bright public lighting reduces accidents and crime and allows for economic activity after sunset)Green behaviour and awareness – 3 (Visible demonstration of City commitment to energy efficiency)			
	Environmental benefits:	<ul style="list-style-type: none">Energy use – 3 (Modern energy-efficient street-lighting technology lowers energy consumption as well as operation and maintenance costs)Climate change mitigation – 2 (Energy savings lead to CO2 savings)			
	Estimated implementation cost:	<ul style="list-style-type: none">Capital expenditure cost (CAPEX): EUR 20 million (UAH 530 million) for 30,000 lights. (City data - estimation)Implementation cost (OPEX): Significantly reduced energy and maintenance costs			
	Implementation timescale	<ul style="list-style-type: none">Ongoing – about 3-5% already done. Investigate new funding sources (incl. ESCOs) in 2020. Roll out programme over next 5 years			
	Potential sources of Funding	(1) Lviv City Budget (3) International Donors and Funds (4) Private Sector – potentially ESCO if current conditions are changed <i>Note: Use of EPC/ESCO scheme is currently not economically feasible due to low baseline consumption calculation; An EPC contract is considered as a municipal loan - higher indebtedness of the municipality.</i>			
	Competent Authority/Owner:	<ul style="list-style-type: none">(1) City Department. Role: Procure and implement the project.			

 <p>E.2 Insulation or replacement of DH distribution network plus modernisation of boiler houses, possibly including cogeneration</p> <p>District heating is often used for residential areas, industries and public buildings, and its use avoids the need to produce heat in individual buildings and pollute the environment locally.</p> <p>There are 1,800 heating points and more than 450 km of pipelines within the two City district heating networks. The action aims to upgrade the heat distribution network with pre-insulated pipes, change from 4-pipe to 2-pipe system together with modernisation of individual building sub-stations to modern plate heat exchangers with heating control system.</p> <p>This modernisation programme has already started using an EBRD loan (in 2015) to replace 3 km of DH pipeline and using Kyoto Protocol funds to upgrade 84 heating points in buildings.</p> <p>This type of investment project needs first to have a general strategy document to identify the goals, the actions needed to achieve these goals and all of the other critical elements such as financing. As boilers are upgraded, studies on the economic effectiveness of CHP need to be undertaken.</p> <p>As heat demand will continue to decrease mainly due to thermal modernisation of buildings, then harmonisation of DH system capacity needs to be in line with heat demand.</p> <p>Discussions should continue with the IFIs on the potential for further financing for DH improvements.</p> <p>Steps:</p> <ul style="list-style-type: none"> Identify the sections of the DH network most in need of repair and the least efficient boiler houses; Explore potential financing routes, including the IFIs; Investigate the economic case for CHP for upgraded boilers; Continue with DH upgrade programme 	Strategic Objective 5 - Proactive and informed municipal government leadership in energy efficiency and use of renewable energy sources			
	Sector:	Energy	Location	City wide
	Category of Measure:	Investment project	Current status:	Ongoing. Planned, funding being explored
	Difficulty of implementation:	Political	Financial	Social
		1	3	2
	Economic benefits:	<ul style="list-style-type: none"> Economic returns for investors – 2 (Good returns from energy and maintenance savings) Job creation/Employment – 2 (Many new jobs in refurbishment programme) 		
	Social benefits:	<ul style="list-style-type: none"> Access to basic services – 3 (Improved access to reliable heat supply) 		
	Environmental benefits:	<ul style="list-style-type: none"> Energy use – 3 (DH allows a broad range of energy sources including both fuels and flows to work together to provide heat, which increases reliability and efficiency within the City. There is an ability to increase efficiency of a fuel when a cogeneration plant is used and DH reduces labour and maintenance costs associated with individual heating systems. Modern DH system introduces opportunities for renewable energy sources which would otherwise not be economic or practical.) Climate change mitigation – 2 (Energy savings lead to CO₂ savings) 		
	Estimated implementation cost:	<p>Capital expenditure cost (CAPEX):</p> <ul style="list-style-type: none"> EUR 15 million (UAH 398 million) for replacement of 30% of DH pipelines EUR 20 million (UAH 530 million) for upgrade of heating points in buildings Implementation cost (OPEX): 5 million EUR Consultant estimates based on Czech experience 		
	Implementation timescale	<ul style="list-style-type: none"> 2020/21: Identify DH sections most in need of repair; 2021: explore new funding sources and investigate the case for CHP; 2020 onwards: continue refurbishment programme (likely to take up to 10 years) 		
	Potential sources of Funding	<ul style="list-style-type: none"> (1) Lviv City Budget (3) International Donors and Funds – EBRD, GEF, EIB 		
	Competent Authority/Owner:	<ul style="list-style-type: none"> (1) City Department through the DH companies (Lviv TeploEnergo and Zalyznychne TeploEnergo). 		


 <p>E.3 Convert district heating boiler plants to biomass firing</p> <p>Biomass boiler installations convert biomass, such as wood, straw or other organic residues that are available in large quantities, into heat. This measure should be carried out in parallel with Measure E.2 (Insulation or replacement of DH distribution network plus modernisation of boiler houses, possibly including cogeneration). Biomass firing (wood chip or pellets) should be considered for the DH boilers that are not converted to CHP.</p> <p>There is a current proposal to replace one gas boiler with a 25 MW biomass fired boiler. It will also be necessary to negotiate a secure supply of wood chip or pellets from reasonably local sources (ideally within the Lviv Oblast). Biomass boiler allows fuel flexibility, using sawdust to wood particles up to 15 cm, from moisture contents of 10% to 55%, even suitable for fuels with a low ash melting point. This action would demonstrate the City's commitment to make a transition to 100 % renewable energy sources in the city's energy balance by 2050.</p> <p>Steps:</p> <ul style="list-style-type: none"> Investigate the economic case for biomass firing for DH boilers not converted to CHP; Negotiate a secure supply of wood chip and/or pellets; Convert appropriate boilers to biomass firing. 	Strategic Objective 5 - Proactive and informed municipal government leadership in energy efficiency and use of renewable energy sources			
	Sector:	Energy	Location	City wide
	Category of Measure:	Investment project	Current status:	Planned, funding being explored
	Difficulty of implementation:	Political	Financial	Social
		1	3	1
	Economic benefits:	<ul style="list-style-type: none"> Economic returns for investors – 2 Using biomass as a fuel is more environmentally friendly and significantly cheaper than natural gas and diesel) 		
	Social benefits:	<ul style="list-style-type: none"> N/A 		
	Environmental benefits:	<ul style="list-style-type: none"> Energy use – 3 (Uses renewable energy) 		
	Estimated implementation cost:	Capital expenditure cost (CAPEX): <ul style="list-style-type: none"> EUR 60 million (UAH 1.6bn) for 3 x 25 MW biomass boilers Implementation cost (OPEX): EUR 5 million (UAH 132 million) over GCAP timescale (Based on actual costs for one boiler) 		
	Implementation timescale	<ul style="list-style-type: none"> 2020: Investigate the economic case for biomass firing for DH boilers not converted to CHP; 2021: Secure reliable supply of biomass fuel; 2022/23 convert appropriate boilers to biomass firing. Target is about 10% of renewable heat production in DH systems in Lviv by 2028 		
	Potential sources of Funding	<ul style="list-style-type: none"> Lviv City Budget International Donors and Funds – EBRD, GEF, EIB 		
	Competent Authority/Owner:	<ul style="list-style-type: none"> City Department through the DH companies (Lviv TeploEnergo and Zalyznychne TeploEnergo). 		


Strategic Objective 6 - Develop pleasant, comfortable and functional buildings with maximum energy efficiency and minimum CO₂ emissions


 B.1 Thermal rehabilitation of buildings including insulation, windows, boilers, control systems and small-scale renewables	Strategic Objective 6 - Develop pleasant, comfortable and functional buildings with maximum energy efficiency and minimum CO₂ emissions			
	Sector:	Building	Location	City wide
<p>The various elements of an energy efficiency retrofit should be performed as part of a whole building energy improvement plan. Improving energy efficiency of the existing buildings (public - schools, kindergartens, offices and residential) is essential not only for the achievement of energy efficiency, but also to meet objectives on climate change. Projects within the public building sector are complex thermal rehabilitation projects consisting mainly of:</p> <ul style="list-style-type: none"> significant improvements in wall, roof and floor insulation levels; higher efficiency gas fired boilers (also applies when replacing boilers) in buildings not connected to DH; independent time control of space heating zones and balancing of heating systems; individual heat consumption measurement systems; new double-glazed windows; new radiators; modernization of internal lighting system. <p>Energy surveys (or Energy audits) and assessment provide building owners with a basis for identifying appropriate options for energy efficient retrofit plans. It is recommended that an energy survey is performed on a building prior to making any improvements. It is recommended that where a number of phased upgrades are planned, expert advice is sought to coordinate these works.</p> <p>Energy efficiency in public buildings (and residential) covers innovations applied to each area of building energy services in an integrated fashion, including urban renewable systems, building fabric, lighting, heating, ventilation and air conditioning technologies. Success will require a defined policy and measures that are implemented efficiently and consistently.</p> <p>All products, materials and systems used for renovation should be fit for the use for which they are intended and be in conformity with relevant national building regulations, standards, Codes of Practice and product certification.</p>	Category of Measure:	Investment project	Current status:	Ongoing - currently some renovations are under implementation
	Difficulty of implementation:	Political 1	Financial 3	Social 2
	Economic benefits:	<ul style="list-style-type: none"> Economic returns for investors – 2 (Good returns on energy efficiency projects. Enhancement of buildings values) Economic Growth – 2 (Enhancement of buildings values) Job creation/Employment – 2 (Significant new job opportunities in refurbishment programmes) Economic inclusion – 2 (Many job opportunities for lower skilled workers) 		
	Social benefits:	<ul style="list-style-type: none"> Public health – 2 (Improved living conditions for occupants) Safety – 2 (Safer living conditions for occupants) Green behaviour and awareness – 2 (Demonstrating green actions) 		
	Environmental benefits:	<ul style="list-style-type: none"> Water use – 2 (Reduced water leakage in buildings) Energy use – 3 (Significant reduction in buildings energy use) Climate change mitigation – 3 (Reduced CO₂ emissions) Climate change adaptation – 3 (Reduced internal temperatures in hot weather. SUDS will reduce localised flooding) 		
	Estimated implementation cost:	<ul style="list-style-type: none"> Capital expenditure cost (CAPEX): EUR 20 million (UAH 530 million) over GCAP period (5 years) <ul style="list-style-type: none"> one standard public building renovation cost is EUR 0.53 million (UAH 14 million) for thermal insulation of the building envelope, internal building heating and water distribution systems, heat exchanger modernization. – City estimation. 3% annual public building renovation rate = 15 public buildings (approx. 30,000 m² / year) Implementation cost (OPEX): Reduced 		
	Implementation timescale	Some rehabilitations already in progress; 2020/21 Develop standards for new buildings and renovations and regulations for EPC/ESCO scheme; 2021/22 launch EPC ESCO scheme. Refurbishments ongoing throughout this period using other funding. Programme likely to continue for 15-20 years		
	Potential sources of Funding	(1) Lviv City Budget (2) National Government (3) International Donors and Funds (4) Private Sector – potentially ESCOs		
	Competent Authority/Owner:	(1) City Department – public buildings (3) Private Entity – residential buildings		

	B.2 - Introduction of advanced technical and environmental requirements for new construction and major renovations of public buildings	Strategic Objective 6 - Develop pleasant, comfortable and functional buildings with maximum energy efficiency and minimum CO₂ emissions			
		Sector:	Building	Location	City wide
<p>Introduction of advanced technical and environmental requirements will start with development of requirements to specific characteristics of building and systems aimed to include them into the Oblast Building Regulations and pass them through the approval procedure to put into force.</p> <ul style="list-style-type: none"> • Provide capacity building to the engineers, industry and controlling authorities about the new requirements for energy performance of buildings - calculation of energy use for space heating, cooling, ventilation, energy requirements for lighting, building automation and building management systems; • Start series of capacity building workshops about the main aspects of development general energy performance, requirements of different EN and ISO standards, primary energy factors. • Provide data for policymaking and program targeting. Baselineing and market tracking efforts utilize standardized data reporting systems; • Specification of requirements on quality of the building envelope and technical building systems with introduction of kWh/m² limitation for building totally, or its systems; • Specification of minimal Energy Performance requirements for buildings or building units/elements with a view to achieving cost-optimal levels requirements; • Provide efficiency project cost and saving data to all market actors; • Incorporate operations and behaviour, deploy robust energy management tools; • Start energy management certification. <p>Energy monitoring reduces energy consumption. It also better prepares municipality for raising energy costs.</p>		Category of Measure:	Legislation & Regulation Changes	Current status:	New measure
		Difficulty of implementation:	Political 2	Financial 1	Social 2
		Economic benefits:	<ul style="list-style-type: none"> • Economic Growth – 2 (Enhanced building values) • Job creation/Employment – 2 (Many new jobs in building refurbishment) • Economic inclusion – 2 (Jobs for lower skilled workers) 		
		Social benefits:	<ul style="list-style-type: none"> • Access to basic services – 2 (Better living conditions for citizens) • Green behaviour and awareness – 2 (Actions demonstrate green activities) 		
		Environmental benefits:	<ul style="list-style-type: none"> • Energy use – 3 (Significant reduction in energy usage) • Climate change mitigation – 3 (Lower energy usage leads to reduced CO₂ emissions) • Climate change adaptation – 3 (Lower internal temperatures in hot weather; SUDS will reduce localised flooding) 		
		Estimated implementation cost:	<ul style="list-style-type: none"> • Capital expenditure cost (CAPEX): Zero • Implementation cost (OPEX): EUR 500,00 (UAH 13.3 million) • OPEX to develop the regulations with external help plus ongoing training (Consultant estimate) 		
		Implementation timescale	Developed and adopted in 2020/21		
		Potential sources of Funding	(1) Lviv City Budget (2) National Government		
		Competent Authority/Owner:	(1) City Department – public buildings Governmental Body or Ministry		


<div> <div>Energy Audit</div> <div> <div>ESCO Project</div> <div> Planning Implementation Monitoring </div> </div> </div>	B.3 - Improvement programme aimed specifically at public buildings using the Municipal EPC/ESCO mechanism	Strategic Objective 6 - Develop pleasant, comfortable and functional buildings with maximum energy efficiency and minimum CO₂ emissions			
		Sector:	Building	Location	City wide
		Category of Measure:	Legislation & Regulation Changes	Current status:	New measure
<p>An EPC/ESCO scheme for municipal buildings renovation would be useful action to tackle energy efficiency in the public sector.</p> <p>A “Municipal ESCO” approach for municipal buildings is the option of an energy services market concentrated under the roof of a public-owned entity (e.g. “LvivESCO”) which would maintain control over the whole project lifecycle.</p> <p>The action proposes the establishment of a public “Municipal ESCO” which will be created under the roof of the City administration (e.g. Energy Management Office). Strong technical support for this scheme is anticipated.</p> <p>The main project steps would be:</p> <ol style="list-style-type: none"> 1. Municipality allocates funds to the LvivESCO public buildings energy saving program; 2. Local public authorities will apply for financing; 3. LvivESCO defines the project (initiation, evaluation, budgeting, energy performance contracting, etc.); 4. LvivESCO tenders for services provided by subcontractors; 5. Subcontractor provides the services under close monitoring or municipal LvivESCO; 6. LvivESCO performs commission test of achieved savings; 7. The Municipality directly seizes the budget of the beneficiary institution with the amount of achieved savings and repays the debt to the LvivESCO. <p>It could be initiated up to three years, requiring effort in amending the current municipal Energy Efficiency Sector and changing the existing operational setups.</p> <p>This should provide opportunities for investments and allow for EPC contracts in the public sector, especially for energy and thermal rehabilitation of schools, medical centres, etc.</p> <p>There is currently no specific government or local fund dedicated to providing financial incentives to the energy efficiency programmes for public buildings.</p>		Difficulty of implementation:	Political	Financial	Social
			2	3	2
		Economic benefits:	<ul style="list-style-type: none"> • Economic returns for investors – 2 (Good returns on energy efficiency measures) • Job creation/Employment – 2 (New jobs in buildings refurbishments) 		
		Social benefits:	<ul style="list-style-type: none"> • Green behaviour and awareness – 2 (Action demonstrates green credentials) 		
		Environmental benefits:	<ul style="list-style-type: none"> • Energy use – 3 (Significant energy savings) • Climate change mitigation – 3 (Energy and CO₂ savings) • Climate change adaptation – 3 (Reduced internal temperatures in hot weather. SUDS will reduce localised flooding) 		
		Estimated implementation cost:	<ul style="list-style-type: none"> • Capital expenditure cost (CAPEX): Included in Action b.1 but delivered via a Municipal ESCO Fund • Implementation cost (OPEX): EUR 1 million (UAH 26.5 million) over 5 years (Consultant estimate) 		
		Implementation timescale	ESCO scheme developed in 2020/21; scheme launched in 2022		
		Potential sources of Funding	(1) Lviv City Budget (2) National Government		
		Competent Authority/Owner:	(2) City Department – public buildings Governmental Body or Ministry		

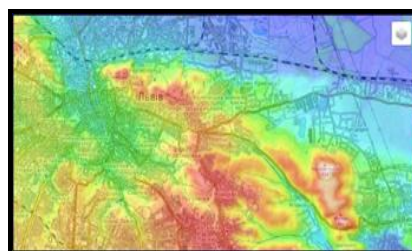
	B.4 - Wider use of the EPC/ESCO mechanism for financing and implementing energy efficiency improvements	Strategic Objective 6 - Develop pleasant, comfortable and functional buildings with maximum energy efficiency and minimum CO₂ emissions			
		Sector:	Building	Location	City wide
		Category of Measure:	Legislation & Regulation Changes	Current status:	New measure
<p>Using advanced schemes for implementation of energy saving measures for residential buildings and incentives for urban renewables involving private funds (EPC/ESCO scheme) is a modern energy efficiency and building renovation approach that increase investments from private investors.</p> <p>ESCOs can be expected to make a significant contribution, especially in the buildings measures, provided that the regulatory framework in Ukraine is fully developed for private building sector including first implemented pilot projects.</p> <p>In an energy performance contracting (EPC) arrangement, the Energy Service Company (ESCO) is responsible for optimising building services systems and system operations in existing buildings across all branches of construction and maintenance. The main service provided by the ESCO is a guaranteed level of savings over a defined period of time.</p> <p>Strong technical support for this scheme is anticipated.</p>		Difficulty of implementation:	Political 2	Financial 3	Social 1
		Economic benefits:	<ul style="list-style-type: none"> Economic returns for investors – 2 (Good returns on energy efficiency investments) Job creation/Employment – 2 (New jobs in building refurbishments) 		
		Social benefits:	<ul style="list-style-type: none"> Green behaviour and awareness – 2 (Demonstrates green activity) 		
		Environmental benefits:	<ul style="list-style-type: none"> Energy use – 3 (Significant energy savings) Climate change mitigation – 3 (Energy savings lead to CO₂ savings) Climate change adaptation – 2 (Lower internal temperatures in hot weather) 		
		Estimated implementation cost:	<ul style="list-style-type: none"> Capital expenditure cost (CAPEX): EUR 50 million (UAH 1.33bn) over 5 years (only private funds to be used) Implementation cost (OPEX): Zero (Based on consultant estimates) 		
		Implementation timescale	ESCO scheme developed in 2020/21; scheme launched in 2022		
		Potential sources of Funding	(4) Private Sector		
		Competent Authority/Owner:	Private Entity		

 B.5 - Use of 'Smart' metering and data sharing	Strategic Objective 6 - Develop pleasant, comfortable and functional buildings with maximum energy efficiency and minimum CO₂ emissions			
	Sector:	Building	Location	City wide
	Category of Measure:	Legislation & Regulation Changes	Current status:	Ongoing - currently some installations are under implementation
<p>Installation of SMART meters at customers of utility (electricity and heat) suppliers. Smart meters are tools used to manage and record heat and electricity consumption and performance of buildings. The SMART meters are able to provide detailed and accurate analytics on heat and electrical usage in real-time or at predetermined intervals, all without a technician. The energy saving potential of collecting a broad spectrum of information about buildings consumption includes the value of quick, accurate measurements and the elimination of estimates based on floor area or meter-reading by building visits. A smart meter can automatically send daily/monthly meter readings to utility supplier and the bill is paid accurately for the energy used. There is no upfront payment to have a smart meter installed - smart meters will be paid for through energy bills.</p> <p>Advantages of smart meters for public and private consumers:</p> <ul style="list-style-type: none"> • Far greater and more detailed feedback regarding energy use; • Ability to adjust habits in order to lower energy bills; • Allowing electrical appliances to be automatically controlled or reduce costs by increasing energy consumption during off-peak cheaper tariff periods. <p>Disadvantages of smart meters for public and private consumers:</p> <ul style="list-style-type: none"> • Additional fees for the installation of the new meter; • Privacy concerns for the personal data collected. <p>Advantages of smart meters for energy supply (LvivOblenergo, LvivTeploenergo and ZaliznychneTeploenergo) companies:</p> <ul style="list-style-type: none"> • Eliminates manual monthly/yearly meter readings; • Gain first-class data; • Detection of DH system leakages; • Influence the energy consumption of their users; • Encourages more efficient use of resources; • Provides responsive data for balancing loads; • Enables dynamic pricing. 	Difficulty of implementation:	Political 2	Financial 3	Social 2
	Economic benefits:	<ul style="list-style-type: none"> • Economic returns for investors – 2 (Reduces metering costs) 		
	Social benefits:	<ul style="list-style-type: none"> • Green behavior and awareness – 3 (Encourages energy savings through own actions due to better information) • Community involvement – 3 (Encourages energy savings through own actions due to better information) 		
	Environmental benefits:	<ul style="list-style-type: none"> • Energy use – 3 (Significant low/no cost energy savings) • Climate change mitigation – 2 (Energy savings lead to CO₂ savings) 		
	Estimated implementation cost:	<ul style="list-style-type: none"> • Capital expenditure cost (CAPEX): EUR 30 million UAH 797 million) incl. software and roll out over 5 years • Implementation cost (OPEX): Reduced (Consultant estimates based on Czech experience) 		
	Implementation timescale	Ongoing. Roll out will continue over 5 years		
	Potential sources of Funding	(1) Lviv City Budget (2) Private Sector		
	Competent Authority/Owner:	(1) City Department – public buildings (2) Private Entity – residential buildings		

 <p>B.6 - Skills/business development programme for building insulation and small scale renewable energy technologies installers and advisors</p> <p>With this action it is intended to overcome barriers and skills gaps or needs in various professions to provide a highly skilled workforce with relevant competencies towards effective implementation of the measures in the building sector and installation of small scale/urban renewable energy technologies.</p> <p>The training programme should focus on three main areas - building envelope, building heating and cooling, renewable energy building integration and use and efficient use of electricity, under which curricula will be developed, educational contents and respective materials to support training to installers in according the structure:</p> <ul style="list-style-type: none"> • Building envelope: installers of windows and installers of thermal insulation; • Heating and cooling: HVAC systems and solar thermal and biomass boilers; • Renewable energy systems and efficient use of electricity: lighting, photovoltaic and wind. <p>During the action the training for trainers and training courses to be carried out to test the supporting material developed and therefore create training opportunities, organized into short training units. These training actions will be developed for all the 3 main modules.</p> <p>Within the training process of the construction professionals and energy systems installers, the action will promote the cooperation between numerous entities representing the training centres in the construction industry, national and local business or industry associations, commercial and professional associations and other public or certification bodies of the construction sector.</p> <p>During the Training programme development dissemination activities will be foreseen also undertaken for the mobilization of the key players such as: dissemination and a public awareness campaign, designed for residential and non-residential buildings owners, in order to promote the energy efficiency use.</p>	Strategic Objective 6 - Develop pleasant, comfortable and functional buildings with maximum energy efficiency and minimum CO₂ emissions			
	Sector:	Building	Location	City wide
	Category of Measure:	(1) Soft measures - Awareness Raising (2) Technical assistance	Current status:	Ongoing - currently some training courses ongoing
	Difficulty of implementation:	Political	Financial	Social
		2	3	2
	Economic benefits:	<ul style="list-style-type: none"> • Job creation/Employment – 3 (Many new jobs in energy efficiency improvements) • Economic inclusion – 2 (Jobs available for lower skilled workers) 		
	Social benefits:	<ul style="list-style-type: none"> • Green behaviour and awareness – 2 (Enhances capacity for green behaviour) 		
	Environmental benefits:	<ul style="list-style-type: none"> • Energy use – 2 (Will enable more energy efficiency projects to be implemented) • Climate change mitigation – 2 (Energy savings lead to CO₂ savings) • Climate change adaptation – 2 (Reduced internal temperatures in hot weather) 		
	Estimated implementation cost:	<ul style="list-style-type: none"> • Capital expenditure cost (CAPEX): Zero • Implementation cost (OPEX): 1 million EUR (UAH 26.5 million) to design the programme and run over 5 years. (Consultant estimates) 		
	Implementation timescale	Programme designed in first half of 2021; rolled out from 2 nd half of 2021 then ongoing		
	Potential sources of Funding	(1) Lviv City Budget (2) International Donors and Funds (3) Private Sector		
	Competent Authority/Owner:	(1) City Department – Economic Development (2) Other - NGOs, Business Chambers, Associations - renewables, residential buildings and condominiums.		

Strategic Objective 7 - Enhance green spaces and introduce new green elements throughout the City to improve living conditions for citizens and to increase the diversity of flora and fauna within urban limits

 <p>L.1 - Complete the Integrated Urban Development Plan (IUDP) and commence implementation</p> <p>The IUDP has been under development by the City Institute and the consultants GIZ since 2018 and is due to be completed in October 2019. It will in effect be the new Master Plan for land use and development in Lviv. The IUDP will cover all necessary steps for sustainable and modern expansion of the City. Development of the SUMP is also being led by the City Institute and is described under Strategic Objective 2. Although it applies mainly to the Transport sector it will also have significant impacts on Land Use.</p> <p>Both of these concepts are key documents for crucial future development of the City in terms of land-use and transport. The final version of these documents will be finished by 2020 and approved by the City Council.</p> <p><u>Steps:</u></p> <ul style="list-style-type: none"> Accept and adopt IUDP and SUMP Explore financing options for priority actions Commence implementation of recommended actions <p><u>Notes & Comments:</u></p> <ul style="list-style-type: none"> Both IUDP and SUMP are under preparation and will be adopted in 2020 Detailed proposed measures in these documents were not available at the stage of development this GCAP Detailed CAPEX and OPEX will be confirmed in 2020 	SO 7 – Enhance green spaces and introduce new green elements throughout the City to improve living conditions for citizens and to increase the diversity of flora and fauna within urban limits			
	Sector:	Land-Use and Biodiversity	Location	City wide
	Category of Measure:	Legislation & Regulation Changes	Current status:	Ongoing
	Difficulty of implementation:	Political 2	Financial 2	Social 2
	Economic benefits:	<ul style="list-style-type: none"> Economic Growth – 2 (Better use of land will facilitate economic growth) 		
	Social benefits:	<ul style="list-style-type: none"> Safety – 2 (Remediation of derelict areas) Green behaviour and awareness – 2 (New green spaces will raise awareness of green actions) 		
	Environmental benefits:	<ul style="list-style-type: none"> Air quality – 3 (New green spaces will improve air quality) Soil quality – 2 (New green spaces will improve soil quality) Biodiversity – 2 (New green spaces will enhance biodiversity) Land use – 3 (The whole programme is aimed at better use of land in the City) Climate change mitigation – 2 (New green spaces and trees will absorb CO₂) Climate change adaptation – 3 (New green spaces and trees will reduce heat island effect and localised flooding) 		
	Estimated implementation cost:	<ul style="list-style-type: none"> Capital expenditure cost (CAPEX): EUR 30 million (UAH 795 million) over 3 years once implementation commences Implementation cost (OPEX): Zero (City data - estimation) 		
	Implementation timescale	IUDP completed in 2020. Implementation over 15 years (2020-2035)		
	Potential sources of Funding	(1) Lviv City Budget (2) International Donors and Funds – EBRD loan		
	Competent Authority/Owner:	(1) City Department – City Institute, Institute of Spatial Planning, Deputy Mayor for Urban Development, Urban Development Dept.		

	L.2 - Upgrade and modernise the GIS system – main focus on environmental parameters and ecology, including inventory of green areas, trees, shrubs, and fauna	SO 7 – Enhance green spaces and introduce new green elements throughout the City to improve living conditions for citizens and to increase the diversity of flora and fauna within urban limits			
<p>Updating the GIS database should be a priority as it represents the appropriate tool for further development of the IUDP and its future amendments. An updated GIS database (Lviv Geoportal) would provide the opportunity to see the system as a whole and to highlight environmental issues. The current GIS-based environmental map is obsolete and does not include the majority of environmental parameters, such as noise, fauna, flora, air pollution. The new GIS online database would be publicly available free of charge and should contain the most important sectors which have an impact on the environment. More detailed access to the GIS will have City representatives after login. A major part of this action is also inventory of green spaces, urban trees and fauna on the City level.</p> <p><u>Steps:</u></p> <ul style="list-style-type: none">• Undertake an inventory of green spaces, urban trees and fauna;• Add new elements and parameters into the online database tool;• Update the GIS system software;• GIS system upgraded and publicly available;• Staff training for GIS operation. <p>Notes & Comments:</p> <ul style="list-style-type: none">• Problem: obsolete legislation with regards to inventory, where no modern norms and standards are being implemented• Recommended to have an international tender for inventory and GIS database update in order to follow EU standards	Sector:	Land-Use and Biodiversity	Location	City wide	
	Category of Measure:	Investment project Technical assistance	Current status:	Ongoing - Planned, funding being explored	
	Difficulty of implementation:	Political 1	Financial 1	Social 1	
	Economic benefits:	<ul style="list-style-type: none">• N/A			
	Social benefits:	<ul style="list-style-type: none">• Green behaviour and awareness – 2 (Access to GIS will stimulate green behaviour)• Community involvement – 2 (Accredited organisations (e.g. NGOs) will have access to the GIS)			
	Environmental benefits:	<ul style="list-style-type: none">• Air quality – 2 (New green spaces will improve air quality)• Soil quality – 2 (New green spaces will improve soil quality)• Biodiversity – 2 (New green spaces will enhance biodiversity)• Land use – 2 (GIS will enable better use of land)• Climate change mitigation – 2 (New green spaces and trees will absorb CO₂)• Climate change adaptation – 3 (New green spaces will reduce heat island effect and localised flooding)			
	Estimated implementation cost:	<ul style="list-style-type: none">• Capital expenditure cost (CAPEX): EUR 800 000 (UAH 21 million)• Implementation cost (OPEX): Unchanged (City data, Expert estimation)			
	Implementation timescale	2020: Update the GIS; 2020/21: Inventory of urban trees and fauna; 2020-2022: Add new elements to the database			
	Potential sources of Funding	(1) Lviv City Budget (3) International Donors and Funds			
Competent Authority/Owner:	(1) City Department – City Institute, Institute of Spatial Planning, Deputy Mayor for Urban Development, Urban Development Dept.				



L.3 - Development of new 'Green Corridors' through the City and construction of 'Green City Line'

The City Institute together with a consultant team appointed by GIZ has started the development of project called 'Green City Line', which will connect the north and south parts of the City by green spaces and bicycle lanes. Green City Line will be a dynamic public space that addresses different targets that could share the same space - city commuters, urban recreation and suburban journeys. Green City Line will also be a route that could host entertainment programs and create a pleasant environment for a weekend trip or walk. The green corridors would also help to reduce the 'heat island' effect in the City.

Development of 'smart-park' areas through the City will help citizens to understand the importance of urban greenery and could become a place for social gatherings. Also this would mitigate the problem of urban-sprawl, which is becoming more and prevalent in recent years.

Steps:


- Completion of the pilot project 'Green City Line';
- Improvement of the central and most disconnected part of the Green City Line (located between Luhans'ka Street and Hutorivka Street);
- Continue with development of green corridors.
- Develop at least 50 km of new green corridors through the City

Notes & Comments:


- City estimate is that one kilometer of reconstructed route of the Green Line can cost up to 8 million UAH (~ 300,000 EUR)

SO 7 – Enhance green spaces and introduce new green elements throughout the City to improve living conditions for citizens and to increase the diversity of flora and fauna within urban limits


Sector:	Land-Use and Biodiversity	Location	City wide
Category of Measure:	Investment project	Current status:	Ongoing - Planned, funding being explored
Difficulty of implementation:	Political 1	Financial 3	Social 2
Economic benefits:	<ul style="list-style-type: none"> • Economic inclusion – 3 (Green corridors will be open to all citizens) 		
Social benefits:	<ul style="list-style-type: none"> • Public health – 3 (Better recreational areas and green spaces will improve public health) • Access to basic services – 2 (Improved access to green spaces) • Green behaviour and awareness – 3 (Will encourage green behaviour through use of recreational areas) • Community involvement – 2 (Community involvement will be high both in development stage and in using recreational areas) 		
Environmental benefits:	<ul style="list-style-type: none"> • Air quality – 3 (New green spaces will improve air quality) • Soil quality – 2 (New green spaces will improve soil quality) • Biodiversity – 3 (New green spaces will enhance biodiversity) • Land use – 3 (The whole programme is aimed at better use of land in the City) • Climate change mitigation – 2 (New green spaces and trees will absorb CO₂) • Climate change adaptation – 2 (New green spaces and trees will reduce heat island effect and localised flooding) 		
Estimated implementation cost:	<ul style="list-style-type: none"> • Capital expenditure cost (CAPEX): EUR 12 million (UAH 318 million) • Implementation cost (OPEX): EUR 200 000 (UAH 5.3 million) • (City data, Expert estimation) 		
Implementation timescale	2020: Completion of the pilot project 'Green City Line'; 2021/22: Improvement of the central part of 'Green City Line'; 2022 onwards: Continue with development of green corridors and smart green hubs (15 year project)		
Potential sources of Funding	(1) Lviv City Budget (2) International Donors and Funds (3) Private sector		
Competent Authority/Owner:	(1) City Department – City Institute, Institute of Spatial Planning, Deputy Mayor for Urban Development, Urban Development Dept.		


 <p>BUSINESS GROWTH</p>	L.4 - Development of support mechanisms for policy makers and relevant stakeholders, introduction to potential sources of finance and new green support programmes, including Development of a Green and Blue Strategy	SO 7 – Enhance green spaces and introduce new green elements throughout the City to improve living conditions for citizens and to increase the diversity of flora and fauna within urban limits			
		Sector:	Land-Use and Biodiversity	Location	City wide
	Category of Measure:	Legislation & Regulation changes Investment project Technical assistance	Current status:	Ongoing Planned and some funding agreed Planned, funding being explored	
	Difficulty of implementation:	Political	Financial	Social	
		1	1	1	
	Economic benefits:	• N/A			
	Social benefits:	• Public health – 3 (More and better green spaces will improve public health) • Green behaviour and awareness – 3 (New green spaces will raise awareness of green actions) • Community involvement – 2 (Many opportunities for community and NGOs involvement)			
	Environmental benefits:	• Air quality – 3 (New green spaces will improve air quality) • Soil quality – 2 (New green spaces will improve soil quality) • Biodiversity – 3 (New green spaces will enhance biodiversity) • Land use – 3 (Support programmes will be aimed at better use of land in the City) • Climate change mitigation – 2 (New green spaces and trees will absorb CO ₂) • Climate change adaptation – 3 (New green spaces and trees will reduce heat island effect and localised flooding)			
	Estimated implementation cost:	• Capital expenditure cost (CAPEX): Zero • Implementation cost (OPEX): EUR 200 000 (UAH 5.3 million) to develop the guidelines and strategy. (City data, Expert estimation)			
	Implementation timescale	2020: Develop Green Strategy; 2021/22: Develop Support Programmes; 2021 onwards: Systematic restoration of green spaces and water bodies (20 year programme).			
	Potential sources of Funding	Lviv City Budget International Donors and Funds Private sector			
	Competent Authority/Owner:	City Department – City Institute, Institute of Spatial Planning, Deputy Mayor for Urban Development, Urban Development Dept.			

<p>We have already started to implement specific actions with regards to green spaces and biodiversity in the City. These actions, which are also supported under this action include:</p> <ul style="list-style-type: none">• Increase the number and surface area of green spaces;• FS into remediation of existing rivers and lakes and the creation of new ponds and lakes and for orbital forest around Lviv;• Ensure compliance with cleanliness norms and requirements for the maintenance of green facilities in the parks of the City;• Provide timely and qualified care of trees and shrubs;• Ensure a complete and systematic restoration of parks, squares and flower gardens, together with the introduction of smart technologies and waterbodies (e.g. fountains).• Reduce the threat of falling trees due to strong winds and age of trees;• Reduce the damage to the trees from pests and diseases. <p>However, it is necessary to create transparent conditions for NGOs and other organisations to take part in developing new ideas with regards to improvement of green and blue spaces biodiversity in the City. This requires the introduction and development of support mechanisms for policy makers and relevant stakeholders, including an introduction to potential sources of finance and development of new green programmes for environmental improvements.</p> <p>We plan to develop guidelines for improvement of biodiversity in the city followed by a specific action plan and implementation process. This Green and Blue Strategy will better and more precisely define the steps necessary to increase the quality of green spaces, new ponds and lakes, and species diversity in the City, especially within the urban limits. Part of the Green Strategy will be a feasibility study to analyse the possibility of creating an orbital forest around City.</p> <p>The Green and Blue Strategy will also enhance cooperation mechanisms between the City and Oblast authorities in the creation of green and blue spaces. There is no capital cost associated with this Action since all implementation costs for the improvements are included in other Actions The operational cost for developing the guidelines is estimated as €200,000 (UAH 5.3 million).</p>	
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 <p>L.5 - Public awareness campaigns and expert training for stakeholders on the importance of urban land-use and biodiversity</p> <p>In order to support and enhance the above actions in the Land Use and Biodiversity sectors it will be necessary to prepare public awareness campaigns (posters, seminars, events) and to organise training for appropriate stakeholders to achieve the optimum results.</p> <p><u>Steps:</u></p> <ul style="list-style-type: none"> Public information campaigns designed and implemented; Appropriate training for stakeholders delivered; Develop promotional campaigns and education programmes; Run a promotional campaign on land use and biodiversity each year; Deliver training to appropriate stakeholders; Organise public display boards and monitors at all rehabilitated sites. <p>Notes & Comments:</p> <ul style="list-style-type: none"> City is lacking certified arborists City is lacking expert training on proper park and green spaces maintenance 	SO 7 – Enhance green spaces and introduce new green elements throughout the City to improve living conditions for citizens and to increase the diversity of flora and fauna within urban limits			
	Sector:	Land-Use and Biodiversity	Location	City wide
	Category of Measure:	Soft measures	Current status:	Planned, funding being explored
	Difficulty of implementation:	Political 1	Financial 1	Social 1
	Economic benefits:	<ul style="list-style-type: none"> N/A 		
	Social benefits:	<ul style="list-style-type: none"> Green behaviour and awareness – 3 (Information campaigns will encourage green behaviour) Community involvement – 3 (Extensive involvement of citizens and NGOs in information campaigns) 		
	Environmental benefits:	<ul style="list-style-type: none"> Biodiversity – 2 (Improved awareness of importance of biodiversity) Land use – 2 (Improved awareness of importance of green spaces) Climate change mitigation – 2 (Improved awareness of climate change and what steps to take for mitigation) Climate change adaptation – 2 (Improved awareness of climate change and what steps to take for adaptation) 		
	Estimated implementation cost:	<ul style="list-style-type: none"> Capital expenditure cost (CAPEX): None Implementation cost (OPEX): EUR 500,000 (UAH 13.3 million) (City data, Expert estimation) 		
	Implementation timescale	2020/21: Develop promotional campaigns and educational programmes; 2021 onwards: Deliver promotional campaigns and educational programmes (for at least 5 years)		
	Potential sources of Funding	Lviv City Budget National Government Private sector		
	Competent Authority/Owner:	City Department – Deputy Mayor for Urban Development, Urban Development Dept. Other (NGO, Agency...)		

Strategic Objective 8 - Lviv businesses meet high levels of sustainability and resource efficiency

	I.1 Environmental Support Programme for Businesses	SO8 - Lviv businesses meet high levels of sustainability and resource efficiency			
		Sector:	Industry & Business	Location	Lviv City and Oblast
		Category of Measure:	Awareness Raising Technical assistance	Current status:	New measure
<p>Businesses are not aware of the environmental impact of their activities, and many are not aware of relevant environmental regulations. They may also not be aware how to improve their environmental performance. Some improvements can be achieved through low cost or no cost measures or through measures that bring economic returns to companies through e.g. resource use efficiency, 'green' procurement and productivity increase.</p> <p>A pilot programme to support 200 businesses (mainly SMEs) to recognise and improve their environmental performance should be introduced, based on information and experience of similar programmes in other countries. The programme should focus on an integrated programme of support tailored to the needs of individual businesses including:</p> <ul style="list-style-type: none">Awareness raising City-wide programme to raise awareness of the environmental impact of industry and small businesses, and how to make improvements. Will include sectoral events, training workshops, seminars etc.Information and Guidance "How To" Guides on specific topics e.g. waste minimisation, carrying out an energy audit, energy saving lighting, efficient heating, financing measuresIndividual business support Trained advisers able to carry out environmental audits and make recommendations. Support service to help businesses make the financial case for improvements and implement measures.Recognition Green Business Award run annually to reward environmental improvements in the best companiesReporting Advice and support to encourage businesses to include environmental performance in annual reportingMonitoring City-wide monitoring of specific environmental indicators e.g. CO₂ emissions, energy use, waste generated, waste recycled per unit of output, incidence of exceeding pollution limits etc.	Difficulty of implementation:	Political	Financial	Social	
		1	2	1	
	Economic benefits:	<ul style="list-style-type: none">Economic returns for investors – 2 (Environmental improvements will focus on projects with a financial benefit/return on investment for the business e.g. waste reduction, energy saving)Job creation/Employment – 2 (Jobs creation in the support programme and potential for job growth in supported businesses)			
	Social benefits:	<ul style="list-style-type: none">Green behaviour and awareness – 2 (Improving green behaviour in business is key to this programme and likely to also contribute to green behaviour at home)			
	Environmental benefits:	<ul style="list-style-type: none">Water quality – 2 (Action will reduce harmful effluents discharged to the WWTP)Water use – 3 (Programme focus will be on water, energy and material use)Energy use – 3 (Programme focus will be on water, energy and material use)Material use – 3 (Programme focus will be on water, energy and material use)Climate change mitigation – 3 (Reduction in energy demand and material use directly impacts climate mitigation)			
	Estimated implementation cost:	<ul style="list-style-type: none">Capital expenditure cost (CAPEX): ZeroImplementation cost (OPEX): EUR 1 million (UAH 26.5 million) for setting up and running the programme. (Figures based on similar programmes in the UK adjusted for number of companies assisted)			
	Implementation timescale	Start to set up the programme from Q3 2020 and continue throughout the GCAP timeline			
	Potential sources of Funding	(1) Lviv City Budget – start-up funding to establish the programme (2) International Donors and Funds – grants (e.g. UNDP, EU Accession Funds) to help run the programme (3) Private Sector – for implementing improvement measures (not included in OPEX above)			
	Competent Authority/Owner:	(1) City Department (Investment). <i>Role:</i> Establish and promote the programme (2) Centre for Cleaner Production; Business Club Ukraine; British-Ukrainian Chamber of Commerce (BUCC). <i>Role:</i> Provide business support and monitoring progress.			

	I.2 Develop a local recycling and reprocessing sector	S03. Bring waste collection, reuse, recycling and treatment up to international standards S09 - Lviv businesses meet high levels of sustainability and resource efficiency			
		Sector:	Industry & Business Solid Waste	Location	Lviv City and Oblast (possibly all of Western Ukraine)
		Category of Measure:	Investment project Technical assistance	Current status:	New measure
<p>The City is introducing new waste management practices including separate materials collection, two waste collection points and building an MBT plant. These will result in significant quantities of materials such as glass, paper & card, plastics, green waste, WEEE and items such as furniture and mattresses being collected. There will also be large amounts of construction and demolition (C&D) waste generated as a result of the reconstruction work happening in the City. All of these materials will need to be recycled or reprocessed into a state where they can find a ready market. Some small recycling operations already exist in the City and their activities could be expanded into greater volumes and/or other materials.</p> <p>For some materials (e.g. packaging) it may be necessary to wait for the introduction of Extended Producer Responsibility (EPR) legislation, which is currently under discussion at a national level. EPR will produce a revenue stream that could be used to provide subsidies to the recycling sector in order to make the businesses economically viable. However, for materials such as C&D waste and WEEE there is a ready market for the products so these businesses should be self-sustaining. Recycling these materials is also relatively non-controversial since they produce no odours so businesses can be sited on existing business parks or brownfield sites. For C&D waste there is a close synergy with ongoing new construction in the City so this sector would be a good place to start with development of the recycling sector.</p> <p>It is a requirement of the National Waste Management Strategy to 2030 that all waste materials such be recycled as close as possible to the source, i.e. within the Lviv Oblast or at least in Western Ukraine. This also makes economic sense as such wastes are expensive to transport over long distances and recycling locally creates new job opportunities.</p>	Difficulty of implementation:	Political 1	Financial 2	Social 1	
	Economic benefits:	<ul style="list-style-type: none">• Economic returns for investors – 3 (Recycling and reprocessing businesses can provide good economic returns)• Economic Growth – 3 (New businesses will increase GDP for the City and Region)• Job creation/Employment – 3 (New businesses and services will provide significant employment opportunities)• Economic inclusion – 2 (Many jobs in recycling will be available for less well-educated citizens)			
	Social benefits:	<ul style="list-style-type: none">• Public health – 2 (Reduction in illegally dumped waste)• Gender equality – 2 (Jobs in recycling will be available to men and women)• Green behaviour and awareness – 3 (Involvement in recycling is one of the primary means of increasing green behaviour)• Community involvement – 3 (NGOs and community organisations can be fully involved in recycling activities)			
	Environmental benefits:	<ul style="list-style-type: none">• Soil quality – 2 (Compost derived from waste will improve soil quality)• Energy use – 3 (Recycled materials require significantly less energy than producing new materials)• Land use – 2 (Compost derived from waste can be used in land remediation)• Material use – 3 (Recycling will significantly reduce the need for new materials production)• Climate change mitigation – 3 (Reduced energy usage will contribute to climate change mitigation)			
	Estimated implementation cost:	<ul style="list-style-type: none">• Capital expenditure cost (CAPEX): EUR 20 million (UAH 530 million) to set up new businesses, much of it from private investors• Implementation cost (OPEX): EUR 200,000 (UAH 5.3 million) for ongoing business support. Businesses themselves should be self-sustaining. <p>(Basis of figures – Consultant estimate based on UK experience)</p>			
	Implementation timescale	Start to establish and promote the programme in Q3 2020 and continue support throughout the GCAP timeline (5 years)			
	Potential sources of Funding	(1) Lviv City Budget – to establish and promote the programme (2) International Donors and Funds – grants for recycling initiatives (e.g. UNDP, EU Accession Funds) plus loans to private businesses (3) Private Sector – private investments to set up and run recycling businesses			
	Competent Authority/Owner:	(1) City Department & “Green City”. <i>Role:</i> Establish and promote the programme as a new business ‘cluster’. (2) Business Support Organisations. <i>Role:</i> Provide ongoing support to new recycling businesses (3) Private businesses and NGOs. <i>Role:</i> Set up and run recycling businesses			

Adaptation and Resilience to Climate Change



Action AR.1 – Develop a Climate Adaptation and Resilience Plan for the City.

Adaptation and Resilience to climate change cuts across all sectors and Strategic Objectives and many of the GCAP Actions will assist us in adapting to the effects of climate change and improving the City's resilience. Relevant Actions include:

- **Actions B.1 and B.2**, which will all lead to improved insulation standards in buildings and hence to lower internal temperatures during hot weather;
- **Actions L.1 and L.3** which will involve increasing the area and quality of green spaces and hence a reduction in the 'heat island' effect. The increase in green infrastructure will also be designed to produce wind barriers to reduce the effect of high winds;
- **Action L.2** which will provide details on the condition of urban trees and identify those most at risk of falling due to high winds;
- **Action W.6** which will provide improved drainage systems and so reduce the amount of surface water and flooding + sustainable urban drainage systems (SUDS) in the design of new buildings and major refurbishments. SUDS will help to collect and disperse excessive rainwater during periods of heavy rain and so reduce localised flooding.

This Action aims to coordinate the Adaptation and Resilience aspects of the above Actions and to build on the work already started by the Ecology Office.

Cross-Cutting

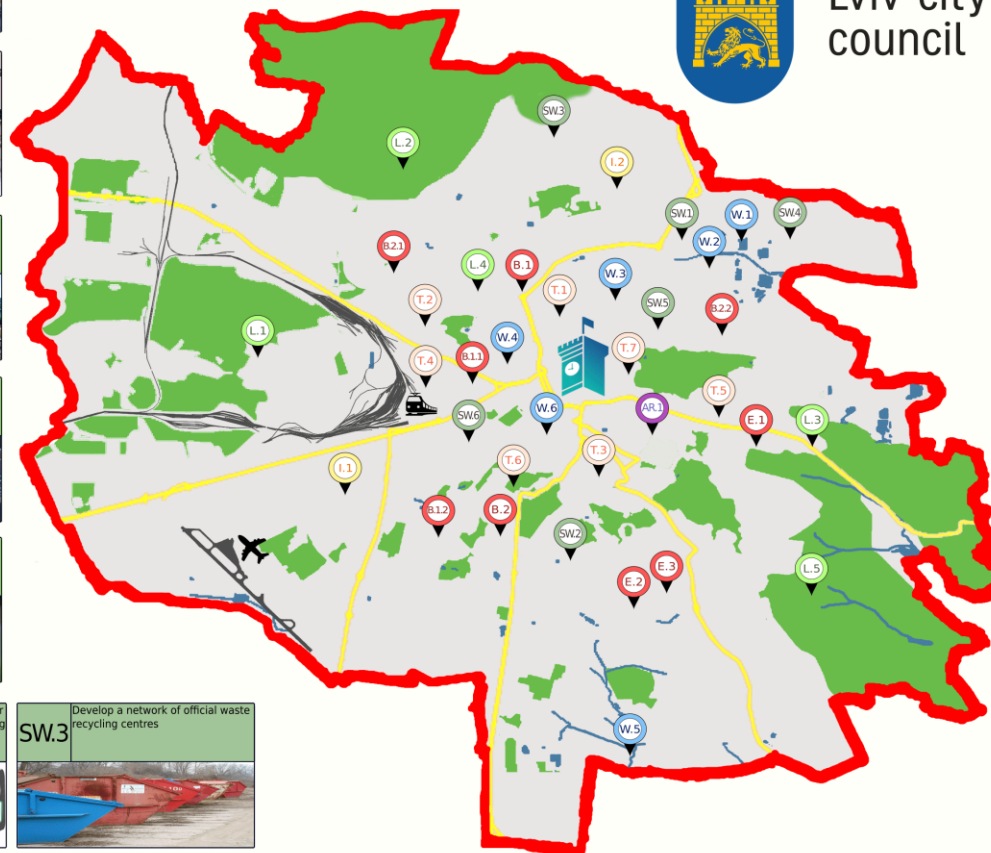
Sector:	All sectors	Location	City wide
Category of Measure:	Soft measure (Action Plan development)	Current status:	Planned, funding being explored
Difficulty of implementation:	Political 1	Financial 1	Social 1
Economic benefits:	• Job creation/Employment – 2 (Jobs creation in implementation of adaptation and resilience actions)		
Social benefits:	<ul style="list-style-type: none"> • Public health – 3 (Positive effects on public health by reducing the effects of climate change, especially flooding and excess heat) • Green behaviour and awareness – 2 (Adaptation and resilience programmes will increase awareness of climate change risks) 		
Environmental benefits:	<ul style="list-style-type: none"> • Energy use – 2 (Energy use is closely linked to climate change) • Climate change mitigation – 2 (Reduction in energy demand directly impacts climate mitigation) • Climate change adaptation – 3 (Main purpose of the Action) 		
Estimated implementation cost:	<ul style="list-style-type: none"> • Capital expenditure cost (CAPEX): Included in other Actions Implementation cost (OPEX): EUR 100,000 (UAH 2.65 million) for developing the programme.		
Implementation timescale	Develop the Plan in 2020 based on current work of the Ecology Office		
Potential sources of Funding	(1) Lviv City Budget		
Competent Authority/Owner:	New Ecology Office		



GREEN CITY ACTION PLAN - LVIV

OPEN TO THE WORLD

Lviv city council



T.1 Completion of Sustainable Urban Mobility Plan (SUMP), its adoption and implementation through short-term action plans

T.2 Completion of e-ticketing project (in progress)

T.3 Purchase of new buses, trolley buses and trams (in progress)

T.4 Feasibility study for extension of the tram and trolley bus network, including new depots and transport hubs

T.5 Feasibility study for the prioritisation of public transport, including dedicated lanes, traffic management and 'smart' traffic light systems

T.6 Development of additional 100km of pedestrian and cycling routes, including use of a 'green corridor' through the city

T.7 Installation of permanent air quality measuring stations and software system linked to City website and public information platform

L.1 Complete the Integrated Urban Development Plan (IUDP) and commence implementation

L.2 Upgrade and modernise the GIS system - main focus on environmental parameters and ecology, including inventory of green areas, trees, shrubs, and fauna

L.3 Development of new 'Green Corridors' through the City and construction of Green City Line

L.4 Development of support mechanisms for policy makers and relevant stakeholders, introduction to potential sources of finance and new green support programmes, including development of a Green and Blue Strategy

L.5 Public awareness campaigns and expert training for stakeholders on the importance of urban land-use and biodiversity

SW.1 (i) - Remediation of the old landfill
(ii) - Construction of the MBT plant
(iii) - Construction of a new landfill

SW.2 Improve 'primary' infrastructure for separate waste collection - bringing containers closer to source

SW.3 Develop a network of official waste recycling centres

SW.4 Develop a system for composting of organic waste

SW.5 Introduction of "pay-as-you-throw" (PAYT) principle

PAY AS YOU THROW

SW.6 Support educational, awareness raising and communication activities

AR.1 Develop a Climate Adaptation and Resilience Plan for the City

W.4 Renovation/retrofitting of water pipework inside buildings

W.5 All communal residential blocks and individual apartments fitted with water meters

W.6 Separate rainwater drainage system from the City sewerage system

I.1 Environmental Support Programme for Businesses

I.2 Develop a local recycling and reprocessing sector

B.1 Thermal rehabilitation of buildings including insulation, windows, boilers, control systems and small-scale renewables

B.2 Introduction of advanced technical and environmental requirements for new construction and major renovations of public buildings

B.3 Improvement programme aimed specifically at public buildings using the Municipal EPC/ESCO mechanism

ESCO Project

B.4 Wider use of the EPC/ESCO mechanism for financing and implementing energy efficiency improvements

B.5 Use of 'Smart' metering and data sharing

B.6 Skills/business development programme for building insulation and small scale renewable energy technologies installers and advisors

E.1 Modernisation of street lighting to LED standards

E.2 Insulation or replacement of DH distribution network plus modernisation of boiler houses, possibly including cogeneration

W.1 Reconstruction and renovation of the Wastewater Treatment Plant (WWTP)

E.3 Convert district heating boiler plants to biomass firing

W.2 Construction of a biogas CHP unit from anaerobic digestion of sludge at the WWTP

W.3 Replacement and/or mechanical cleaning of water supply pipes and fittings

ANNEX 7 – LVIV GCAP - Estimation of CO₂ and Water Savings

1. CO₂ Emissions

From Indicator Factsheet No 8 (Annual CO₂ equivalent emissions per capita):

Total CO₂ emissions in Lviv Oblast 2017 (excluding agriculture) were **5.32 million tonnes**

Oblast population is 2.532 million; Lviv population is 728,000 (28.75% of Oblast)

From this, estimate for Lviv (based on population) is **1.53 million tonnes CO₂**.

Estimated savings from GCAP Actions over 5 years – **10%**

Hence, total savings are $1,530,000 \times 0.1 = \underline{\mathbf{153,000 \text{ tonnes pa}}}$.

Estimated Sectoral Contributions (see table overleaf)

Buildings	78,000 tonnes pa (10% of current)
Industry	33,000 tonnes pa (10%)
Water Supply & Treatment	20,000 tonnes pa (40%)
Transport	22,000 tonnes pa (6%)

2. Water Savings

From Indicator Factsheet No 25 (Water consumption per capita):

Per capita consumption of water is 1.73 litres (0.173 m³) per day. Hence annual consumption is $0.173 \times 365 \text{ (days)} \times 728,000 \text{ (population)} = \mathbf{46 \text{ million m}^3 \text{ pa}}$

50% of supplied water is losses (per LvivVodokanal) so losses are ~ 23 million m³ pa and final consumption is also 23 million m³ pa

If GCAP reduces losses to 30%, then losses become $23 \times 0.6 = 13.8 \text{ million m}^3 \text{ pa}$

Hence new supplied volume is $(23 + 13.8) = 36.8 \text{ million m}^3 \text{ pa}$

Hence savings from reduced leakage are $(46 - 36.8) = \mathbf{9.2 \text{ million m}^3 \text{ pa}}$

If other Actions save 7% of end usage, this is $(23 \times 7\%) = \mathbf{1.6 \text{ million m}^3 \text{ pa}}$

Hence total savings are **10.8 million m³ pa**

Sectoral CO2 estimates						
		Emissions			Savings	
Buildings		tonnes CO2	%		tonnes CO2	%
Residential		541,408	35.4		54,141	10
Public		138,924	9.1		13,892	10
Services		98,163	6.4		9,816	10
		778,496	50.9		77,850	
Industry		333,965	21.8		33,397	10
Water supply & treatment		50,000	3.3		20,000	40
Transport		367,520	24.0		22,051	6
TOTAL		1,529,981			153,297	

Based on sectoral consumptions of electricity and natural gas in 2009 and heat in 2015 (latest available data)

Annex 8 – GCAP Contributors

Participants	
Name	Company / Organisation
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