VILNIUS

GREEN CITY ACTION PLAN

CITY OF VILNIUS

EBRD GREEN CITIES

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FOREWORD FROM THE MAYOR OF THE CITY OF VILNIUS

Foreword from the Mayor of the City of Vilnius

Valdas Benkunskas

Mayor of the city of Vilnius

As the Mayor of Vilnius – a city defined by its rich history and forward-thinking spirit – I am pleased to introduce our Green City Action Plan (GCAP). From the historic streets of our UNESCO-listed Old Town to the modern skyline of the Business District, Vilnius has always been a city of contrasts, creativity, and resilience. Today, as we continue to grow and evolve, we carry forward the legacy of our past while paving the way for a greener, healthier, and more inclusive future.

Vilnius became the first city in the Baltics to join the EBRD Green Cities Programme in 2023, a milestone that reflects our commitment to addressing the pressing environmental challenges of our time. This continuous dedication has earned Vilnius the title of European Green Capital 2025, a recognition of our efforts to become “the greenest city in the making”. With over 600,000 residents, our city's rapid growth is both an opportunity and a responsibility – to ensure that this progress aligns with our vision for a city that is not just liveable but thriving.

The Vilnius GCAP represents a significant step in our journey towards climate neutrality, aligning our goals with broader European and global ambitions. Our target is clear: to achieve a reduction in greenhouse gas emissions of up to 80 % by 2030, and ultimately, to become a climate-neutral city. This ambitious plan, developed in close collaboration with residents, NGOs, businesses, and academic institutions, targets the transformation of key sectors – transport, energy, buildings, land use, waste, and water – while embracing the values that define Vilnius: creativity, openness, and a deep respect for nature.

Vilnius has long been a city of reinvention, from reclaiming its independence to transforming its economy and embracing digital innovation. The GCAP builds on this legacy by identifying the city's most pressing environmental challenges and outlining priority actions to address them. These priorities serve as a foundation for collaboration opportunities, opening doors to partnerships with institutions and stakeholders at local, national, and international levels. By integrating green spaces, enhancing biodiversity, improving air and water quality, and further developing sustainable mobility the plan not only aims to reduce emissions but also to create a more liveable, sustainable, and resilient city for all.

The journey ahead will undoubtedly be challenging. We must confront challenges ranging from heavy carbon intensity to traffic congestion and the efficient use of our resources. But I am fully confident that the people of Vilnius, with their resilience and determination, will embrace the opportunities that lie before us. Together, we will transform Vilnius into a green, inclusive, and climate-resilient city that inspires cities worldwide.

I would like to extend my sincere thanks to the European Bank for Reconstruction and Development and the TaiwanBusiness – EBRD Technical Cooperation Fund, whose support was vital in preparing this plan. Yet the success of our GCAP ultimately depends on the participation of every Vilnius resident. This is our city, our legacy, and our future to shape. Together, let us continue to build a Vilnius that we, and the generations to come, will be proud to call home.

Valdas Benkunskas
Mayor of Vilnius

EXECUTIVE SUMMARY

Executive summary

Introduction

The Green City Action Plan (GCAP) of Vilnius supports the city in its goal to become an inclusive and resilient climate-neutral city that embraces social diversity and gender equality. This document aims to support and inspire citizens, city authorities, institutions and NGOs by identifying different types and areas of action to address the city's key challenges and achieve its goal.

The GCAP builds on an assessment and prioritisation of the environmental challenges in a city and provides an action plan to tackle these challenges. Vilnius joined the European Bank for Reconstruction and Development (EBRD) Green Cities Programme in 2023, committing to addressing its environmental, social, and urban challenges.

GCAP Methodology

As part of the development of the GCAP, the methodology developed by the EBRD was applied.

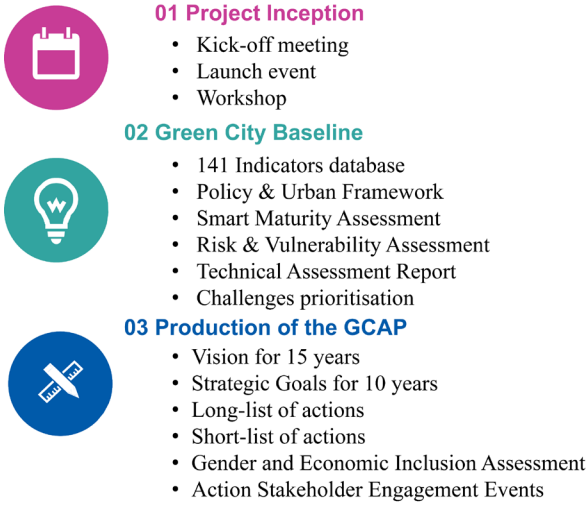


Figure 1 Stages of Vilnius GCAP preparation

The GCAP was prepared based on information and data obtained during 32 internal and external meetings, including various consultations and workshops with over 200 city representatives and external stakeholders. To address the current and future needs of different social groups – including city residents, NGOs, scientific societies, social organisations, as well as city companies and institutions – they were actively involved in the process.

Integration with Climate City Contract

The city of Vilnius, which was successfully selected as part of the EU's "100 Climate Neutral and Smart Cities by 2030" mission, has focused on developing a Climate City Contract (CCC). Together with the Net Zero Cities (NZC) Consortium and international consultants, the city has developed an Action Plan that sets ambitious goals for reducing the city's greenhouse gas (GHG) emissions. The Action Plan recommends a pathway for the city to achieve a reduction of up to 80% by 2030 (compared to 2021). The synergy and integration of this NZC programme with the EBRD's Green Cities programme will be an important leverage point in implementing the planned actions.

City's Key Challenges

As a result of the analysis and numerous workshops, the identified high-priority environmental challenges of Vilnius include:

MITIGATION OF GHG EMISSIONS
GREEN SPACES, BIODIVERSITY AND ECOSYSTEMS
RESILIENCE AND ADAPTATION
WATER BODIES
SOIL
DRINKING WATER / WATER USE
AIR QUALITY

Figure 2 Identified challenges in Vilnius, from high level of concern (red) to low level of concern (green)

On the next page, there is a summary of the related priority sectors, the challenges observed within them and the related issues in infrastructure and urban systems.

BUILDINGS from the 1960s–1990s are particularly energy inefficient, contributing significantly to GHG emissions and reducing their capacity for resilience and adaptation to climate change.

TRANSPORT contributes to environmental stress through GHG emissions, increased air and noise pollution & biodiversity loss - driven by urban sprawl, ageing vehicles, and the popularity of diesel fuels.

LAND USE increases environmental pressures and impacts quality of life due to inefficient urban development, lack of brownfield redevelopment and low urban density development.

ENERGY increases GHG emissions and reduces air quality, primarily due to remaining share of fossil fuels in the energy mix, inadequate energy storage infrastructure, and supply-demand imbalances.

INDUSTRIES contribute to environmental pressure due to the need for stronger regulatory frameworks to ensure compliance and promote responsible practices.

WATER creates environmental pressure through an inadequate stormwater drainage system, which is vulnerable to climate change impacts, impacting the quality of water bodies and biodiversity.

SOLID WASTE pressures the environment due to the lack of waste separation at the source, negatively impacting soil quality, green spaces, air quality, and limiting the mitigation of GHG emissions.

Vision and Strategic Goals

We developed our GCAP vision statement to provide a guiding light to the selection and development of individual actions. The vision was drafted to align with existing city and county core documents and with the input of the city's partners and wider community of stakeholder organisations and members of the public. The agreed Vilnius GCAP vision is that:

"We are creating a more comfortable and open Vilnius - the greenest capital of Europe - providing a healthy and happy life for everyone."

The GCAP strategic goals were developed from the vision to provide a set of clear outcomes to be achieved in each priority sector and environmental resource. The agreed strategic goals are shown in Figure 16.

GCAP Actions

As part of the GCAP, it was proposed to develop 28 actions that fit into the Strategic Goals, in six areas covering the following sectors: energy, transport, buildings, land use, solid waste, water.

These actions should be implemented by 2030 and will include different types of investments (new/upgrade/retrofit/pilot/capacity building).

The implementation of these actions should result in a total emission reduction of 598,868.89 tCO_{2e} annually. Together with the Climate City Contract Action Plan, this will enable Vilnius to achieve the combined goal of climate neutrality.

Table 1 Summary of GCAP Vilnius Actions

Sector	ID	Action	Timeline 25	26	27	28	29	30	tCO_{2e} reduction	Job creation potential (FTEs)	CapEx (EUR)	Annual OpEx (EUR)	Cost savings (EUR)
Energy	E1	Enhancing the use of renewable energy sources (RES) in district heating							312,184.39	200–300	61,505,000	3,570,000	–
	E2	Enhancing the use of renewable energy sources (RES) in non-centralised heating systems							70,180.41	5–10	43,345,000	–	9,078,000
	E3	Reconstruction of heating networks							2,620	10–15	156,500,000	396,300	6,972,000
	E4	Building Renewable Energy Community							–	5–10	211,530,000	222,700	–
	E5	Developing a flexible energy storage system							1,057	25–50	16,593,000	410,000	1,426,500
Transport	T1	Renewal and modernisation of public transport fleet and related infrastructure							43,433.45	100–200	317,327,800	8,945,950	14,126,300
	T2	Enhancing public transport routes efficiency							–	5–10	58,477,000	631,000	–
	T3	Expanding and integrating cycling infrastructure and pedestrian pathways							80,638.21	20–50	279,204,700	91,600	–
	T4	Development of infrastructure for multimodal points							–	100–200	15,394,000	717,100	–
	T5	Expansion of the network of public charging stations and charging points for electric cars							–	10–20	12,538,100	626,900	–
Buildings	B1	Upgrading municipal buildings and their systems							4,719.03	200–500	583,639,000	–	3,670,000
	B2	Promoting the modernisation of multi-apartment buildings							68,394.82	200–500	392,350,000	480,000	64,858,000
	B3	Integrate and enhance building condition and energy efficiency data							–	1–5	4,475,000	96,000	–
	B4	Promoting quarterly modernisation of residential buildings							–	200–500	100,000,000	2,122,000	–
	B5	Promoting panel modernisation of multi-apartment buildings							–	50–100	90,000,000	–	–

Sector	ID	Action	Timeline 25	26	27	28	29	30	tCO_{2e} reduction	Job creation potential (FTEs)	CapEx (EUR)	Annual OpEx (EUR)	Cost savings (EUR)
Solid waste	SW1	Preventing waste generation through raising awareness and education							–	10–20	4,346,700	240,000	–
	SW2	Expanding the network of DĖK'UI stations							–	5–10	1,000,000	264,000	–
	SW3	Further introduction of DGASA (lt. Didelių gabaritų atliekų surinkimo aikštelės) – bulky waste collection sites							–	20–50	9,500,000	1,795,000	–
	SW4	Upgrade of the local MBT facility							–	20–50	12,011,000	480,000	–
	SW5	Developing a smart municipal waste management system							–	10–20	7,477,000	1,017,000	–
Water	W1	Strengthen the city's resilience to surface water run-off							9,883.00	100–200	88,693,000	885,600	–
	W2	Power generation installations for water and sewage infrastructure facilities							2,011.00	10–50	98,323,000	1,363,600	1,076,200
	W3	Resilience of water supply system							–	50–100	48,574,000	480,500	–
Land use	LU1	Green streets and heat island – investment programme for decreasing perceptible temperature in summer							2,854.28	50–100	45,208,000	6,824,000	–
	LU2	Protection and restoration of valuable green areas							–	1–5	32,749,200	102,700	–
	LU3	Development of local plans and land use standards							–	1–5	811,400	–	–
	LU4	Redeveloping existing urban land to increase liveability							865.41	50–100	15,403,000	2,310,000	–
	LU5	Strengthening of the Public Participation in urban planning							27.89	5–10	9,891,000	109,000	–
TOTAL									**598,868.89**	**1,463–3,190**	**2,716,865,900**	**34,180,950**	**101,207,000**

INTRODUCTION

1. Introduction

1.1 Context

The Vilnius GCAP ("the GCAP" or "the Plan") will be a key tool in the city's journey towards becoming a climate neutral, inclusive, green and resilient city. Based on a rigorous assessment of the city's environmental challenges and carbon emissions, the GCAP sets out a series of short-term actions that will accelerate the city's progress to achieve its environmental and climate goals. Building on the city and county's existing policy framework and strategic priorities (Figure 3), the GCAP considers investment projects and policy actions to make changes to city structures.

Figure 3 Documents guiding the development of the city and the region

The city of Vilnius joined the EBRD Green Cities programme on 16th October 2023, launched and run by the EBRD. The programme involves more than 50 cities and a key part of the whole process is the preparation of a GCAP.

The GCAP was prepared with technical assistance from the European Bank for Reconstruction and Development (EBRD) and financial support from the TaiwanBusiness-EBRD Technical Cooperation Fund.

The GCAP was coordinated by representatives of the city of Vilnius and the municipal company – VšĮ "Neutralus klimatui Vilnius" Technical support and GCAP production was provided by a team appointed by EBRD of international and local consultants from ARUP and its partners mmap.

1.2 Structure of Vilnius Green City Action Plan

The GCAP is divided into six sections:

Chapter 1. Introduction identifies and defines the main aims and objectives of the document.

Chapter 2. Preparation approach presents the methodological assumptions, describes the process of preparing the document and stakeholder involvement.

Chapter 3. Assessment of the existing state of the city presents a characterisation of the city's socio-economic conditions, a description of the environment and urban sectors.

Chapter 4. Green City Vision and Strategic Goals presents Vilnius' vision and a list of goals to support the city become a zero-emission, sustainable and attractive city for its citizens.

Chapter 5. Summary of actions provides an overview of the actions developed under the Action Plan, covering the environment, transport, buildings, land use, solid waste and water sectors.

Chapter 6. Monitoring and reporting provide methods to track the impact and effectiveness of the implementation of the document's objectives.

PREPARATION APPROACH

2. Preparation approach

2.1 GCAP process stages

The process of preparation of the Vilnius GCAP comprised the following stages:

Project Inception

- Kick-off meeting – 16th October 2023
- Launch Event – 1st February 2024
- First on-site sectoral meetings about the current state of the city – 2nd February 2024.

Green City Baseline

- Online sectoral meetings about the city's existing state and challenges – February and March 2024.
- The Consultant conducted a series of workshops with a range of stakeholders to gather their views on the city's priority challenges – April and May 2024 in Vilnius.
- The Consultant conducted a city-wide survey to define Vilnius environmental challenges and priorities that was launched online on the city's channels on 10th – 24th April 2024. The survey results were published in July 2024.
- Prioritisation report shared with the city – May 2024.
- The Steering Committee approved the GCAP Baseline – 19th June 2024.
- The City Baseline Summary Report officially published – September 2024.

Production of the GCAP

- The Consultant conducted workshops which aimed to discuss and agree on Green City Vision and Strategic Goals for the GCAP – 3rd and 4th July 2024.
- The Consultant combined ideas and action proposals into a preliminary longlist of actions. The sector experts assessed these against a multi-criteria analysis to produce the shortlist and select the actions to be included in the GCAP.
- Action development workshops (internal – July 2024 and external – September 2024) to discuss the proposed actions and agree on a final shortlist of actions that will be included in the GCAP.
- Approval of a final report by the City Council – Q1 2025.

Figure 4 Stages of Vilnius GCAP preparations

2.2 Inception

The inception phase sets out the implementation plan for the Vilnius GCAP. This includes the definition of the engagement principles and tools to be used throughout the project and the description of a formal kick-off event to launch the project process.

2.3 City baseline assessment

The Baseline Summary Report provides a qualitative and quantitative overview of the city's current situation and identifies key environmental and sectoral challenges. This baseline understanding is essential for shaping the GCAP vision, strategic goals and actions. By presenting data in a systematic way, the report allows the city to monitor progress against baseline data during the project implementation phase, ensuring continuous tracking of progress and effectiveness.

The EBRD's GCAP methodology defines 73 "Core" indicators and 68 "Optional" indicators based on international standards. The indicators are divided into three groups:

- **State indicators** describe the quality of environmental assets, the availability of natural resources, and the city's exposure to climate change.
- **Pressure indicators** describe the city's infrastructure and other physical systems and their effect on the environment.
- **Response indicators** describe the presence and effectiveness of relevant city and other government actions (policy, regulation etc.) to reduce or mitigate the effect of the city's pressures on its environment.

Most state and pressure indicators are based on measured and quantitative data, whereas the response indicators are all qualitative.

All indicators are accompanied by defined benchmark values which allow comparison against a "**traffic light**" system of **green**, **yellow** and **red** levels of concern for each of the indicators collected for Vilnius.

This assessment was combined with a further research and analysis of the city, including:

- review and analysis of existing policies, plans and other city's strategic documents,
- analysis of city sectors vulnerability and existing risks,
- analysis of the implemented city's smart solutions, existing policies and regulation,
- analysis of gender and economic inclusion conditions in the city.

2.4 Prioritisation of environmental challenges

Building on the baseline assessment, a combination of expert review and stakeholder engagement was used to identify a set of priority challenges and sectors of focus for action planning. Experts were drawn from the consultant team, EBRD subject matter experts, city and county officers and a Technical Expert Group drawn from utilities, service companies and other institutions in the city. Wider stakeholder input was obtained through an online survey and workshop exercises.

2.5 Green City Vision and Strategic Goals

The baseline results, together with a review of existing policies and strategies at both city and national level, contributed to the formulation of a draft vision and proposed strategic goals. A live event was then held where representatives from the city and utilities were asked to review the proposed material and co-create the final vision and strategic goals. This activity resulted in the creation of a final GCAP vision for 15 years and strategic goals for 10 years.

2.6 Development of GCAP Actions

The development of the actions took guidance from the priority challenges identified in key sectors of the city and a series of stakeholder consultations. The process began with the creation of a working list of actions ("longlist"), followed by several rounds of discussion on potential actions across various sectors. The developed actions were subjected to multi-criteria analysis based on six categories assessing whether the actions address the identified environmental problems, allow for inclusivity, social diversity and gender equality, contribute to the development of the city's smart potential and resilience, whether it has a positive impact on the well-being of residents and whether the municipality has a direct influence on the implementation. The insights and comments gathered during the stakeholder engagement process were crucial to the evaluation.
The criteria for evaluating the actions is shown in Figure 5.

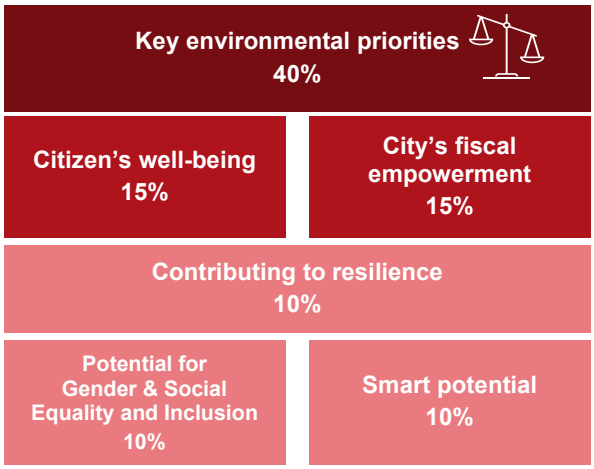


Figure 5 The criteria for evaluating the actions

Low-scoring actions were non-prioritised, while high-scoring ones were developed to create a concise list of actions ("shortlist").

This work was reviewed and discussed with stakeholders during an in-person engagement on 4th July 2024, involving municipal and utility companies. This meeting resulted in the creation of a final list of actions for the GCAP. It was further reviewed in follow-up sector-focused online meetings held between July and August 2024. Finally, the actions were subject to broad external stakeholder engagements on 26th September 2024 and 17th October 2024.

2.7 Final Green City Action Plan

The last crucial step in the development of the GCAP involves the formal approval of the document by the Vilnius City Council in Q1 2025.

Check the link for the EBRD Green Cities Methodology.

2.8 Stakeholder engagement

Stakeholders played a key role in developing the Vilnius GCAP document. Participation in the plan-making process helps secure the legitimacy of the plan, and fosters constructive and long-term relationships between government agencies, commercial enterprises, and civil sector organisations. The process took into account gender inclusion and social diversity to ensure representation from various social groups. Consultations and workshops included engagement events, panel discussions in thematic groups, a survey to gather the opinions of different community groups, and additional meetings dedicated to municipal entities.
The following list includes organisations whose representatives took part in the GCAP process, categorised as internal and external stakeholders. The additional information and detail on the stakeholder engagement process is provided in the Appendix B.

Figure 6 Stakeholder engagement in numbers

Internal stakeholders

Vilniaus miesto savivaldybė, VMS (several departments), AB "Vilniaus šilumos tinklai, VŠT", SĮ "Susisiekimo paslaugos, JUDU", SĮ "Vilniaus atliekų sistemos administratorius, VASA", UAB "Grinda", UAB "ID Vilnius", VAATC, UAB "Vilniaus apšvietimas", UAB "Vilniaus vandenys", UAB "Vilniaus viešasis transportas, VVT", UAB "Vilniaus vystymo kompanija, VVK", VšĮ "Atnaujinkime miestą", VšĮ "Neutralus klimatui Vilnius", VšĮ "Vilniaus miesto parkai".

External stakeholders

AB "Civinity", AB "Energijos skirstymo operatorius", AB "Litgrid", AB "Swedbank", Dzūkijos - Suvalkijos saugomų teritorijų direkcija, Eksploatuoti netinkamų transporto priemonių tvarkytojų asociacija, GNLD Neolife, Kraštovaizdžio dendrologas, Lietuvos architektų sąjungos (LAS) Vilniaus skyrius, Lietuvos bankas, Lietuvos dviratininkų bendrija, Lietuvos geografų draugija, Lietuvos kraštovaizdžio architektų sąjunga, Lietuvos mokslo taryba, Lietuvos pėsčiųjų asociacija, Lietuvos Respublikos Seimas, Lietuvos žmonių su negalia sąjunga, MB "BLUMA Collective", MB "Studio Space/Time", Nacionalinė vartotojų federacija, Oxford University, Pavilnių Verkių regioninis parkas, Pelkių atkūrimo ir apsaugos fondas, S/B "Troleibusas", Sakalaičių seniūnaitija, Naujininkų seniūnijoje, Salininkų bendruomenės asociacija, Šiaurės ministrų tarybos biuras Lietuvoje, Susisiekimo ministerija, Talino technikos universitetas (TalTech), UAB "Ecoservice", UAB "Eika", UAB "Ekonominės konsultacijos ir tyrimai", UAB "Ekonovus", UAB "Energesman", UAB "Gaučė ir Ko", UAB "Idea prima", UAB "Technologinių paslaugų sprendimai", UAB "Tolimojo keleivinio transporto kompanija", UAB "Vesta Consulting", UAB "ZABolis Partners", UAB "313 architects", Valstybinės Kultūros Paveldo Komisija, Vartotojų aljansas, Vilniaus Gedimino technikos universitetas, Vilniaus kolegija, Vilniaus universitetas, Vokės bendruomenė, VšĮ "Gyvi gali", VšĮ "Žaliasis taškas", VšĮ CPO LT, VšĮ Kurk Lietuvai, VšĮ Mes Darom, Žaliųjų finansų institutas / ILTE, Žirmūnų Tuskulėnų bendruomenė, asociacija.

CITY BASELINE ASSESSMENT

3. City Baseline Assessment

3.1 City characteristics

Vilnius, the capital of Lithuania, is situated in the southeastern part of the country. The city of Vilnius occupies an area of about 400 km² of which approximately 20.2% is developed and the remainder is greenbelt (43.9% approx.), water (2.1% approx.) and others (arable land, roads, swamps, damaged land, unused land, drained land, abandoned land – 33.8% approx.).

3.2 Governance and institutional structures

The city of Vilnius has the authority to make decisions and enforce urban infrastructure and policy measures within its jurisdiction.

This includes:

1. **Urban planning:** Vilnius determines land use, zoning regulations, and development standards to shape the city's physical environment.
2. **Transportation infrastructure:** The city plans and manage roads, public transit systems, cycling lanes, and pedestrian pathways to ensure efficient and safe mobility for residents.
3. **Environmental policies:** Vilnius implements measures to promote sustainability, such as green building standards, waste management initiatives, and the preservation of green spaces.
4. **Housing policies:** The city enacts regulations to address housing affordability, quality standards and urban renewal projects to improve living conditions for residents.
5. **Economic development:** Vilnius implements policies to attract investment, support local businesses and promote job creation to stimulate economic growth and prosperity.
6. **Social services:** The city provides and regulates social services such as healthcare, education, and community facilities to meet the needs of residents.

Overall, Vilnius has the authority to shape the urban environment and implement policies that enhance quality of life, promote sustainability, and support economic and social well-being within the city.

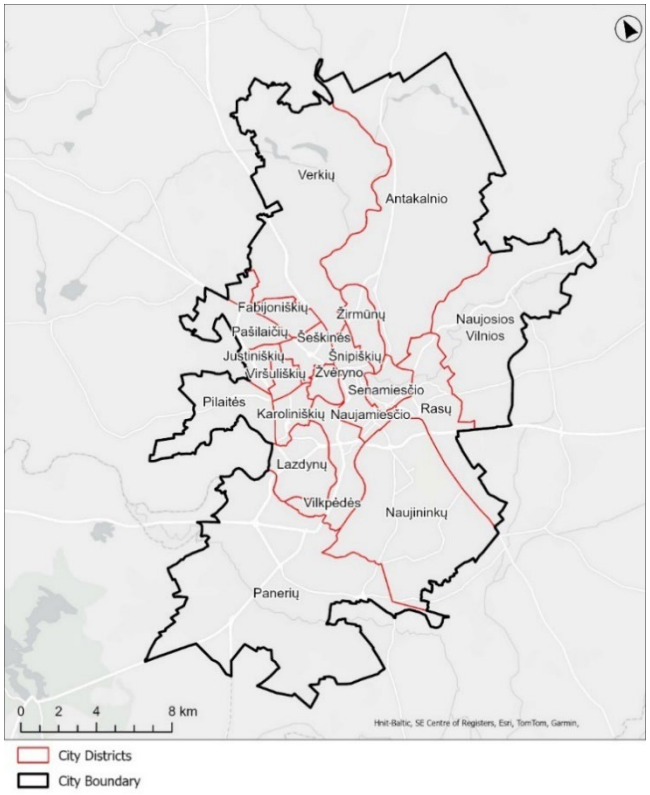


Figure 7 Districts in Vilnius

3.3 Gender equality and social inclusion

In general, the largest concentration of people is found in and around the capital city of Vilnius (ca. 593,436). Vilnius is the fastest growing city in the country. In 2020–2023 the population in the city has grown by 6%. The city is also the birthplace of one in three Lithuanian children, with an annual birth rate of around 6,700. However, as in the European Union in general, a steady decline in births has been observed since 2016.

The gender distribution in Vilnius is almost balanced, with females representing 53.7% of the population. The majority of residents are aged between 18 and 64 (63.1%), and the median age is the lowest in the country at 38 years.

The ethnic composition is primarily Lithuanian (67%), followed by Poles (15%), Russians (10%), Belarusians (3%), and other groups (5%).

Roman Catholics constitute the majority of the religious composition, comprising 77.2% of the population, followed by members of the Russian Orthodox Church, Old Believers, Evangelical Lutherans, and Evangelical Reformists, among other faiths.

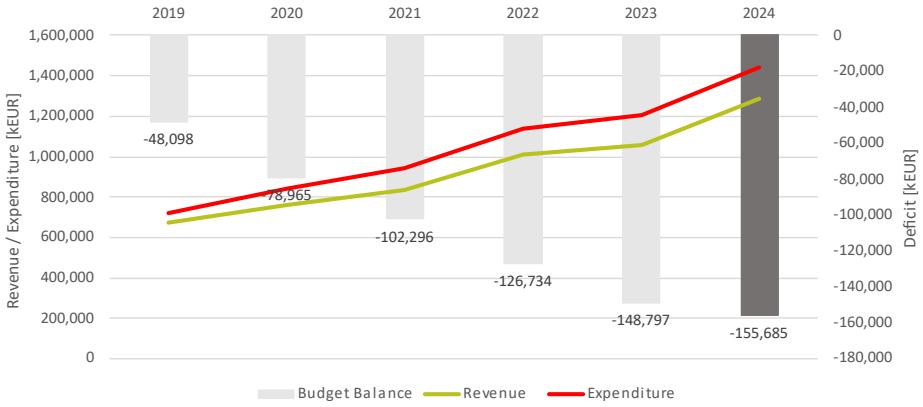


Figure 8 Vilnius city breakdown of revenues and expenditures, 2019-2024

In 2022, Lithuania experienced a significant demographic shift with an 89% increase in foreign residents, mostly due to the flow of Ukrainian refugees, who now form the largest group of non-EU citizens in the country. This rapid wave of migration poses many challenges, affecting economic and social life.

Access to caregiving facilities in Vilnius is limited, affecting gender equality, with financial barriers and insufficient capacity in preschools and elderly care services. Vilnius city's healthcare system includes 12 different types of hospitals and has been assessed as sufficient to serve its residents' needs.

Lithuania shows high levels of gender equality in education and employment, with Vilnius leading in gender equality among municipalities. Women slightly outnumber men in the workforce. Furthermore, the city has a high proportion of tertiary graduates, with a higher proportion of female graduates.

Vilnius hosts several gender equality bodies, such as the Lygių galimybių ir vyrų bei moterų lygybės grupė (eng. Equal Opportunities and Equality between Women and Men Group) within the Lygių galimybių ir vyrų bei moterų lygybės grupė (eng. Ministry of Social Security and Labour), which supervise gender equality initiatives and EU collaborations. The Moterų ir vyrų lygių galimybių komisija (eng. Commission on Equal Opportunities for Women and Men) coordinates the National Programme on Equal Opportunities and proposes policies to the Ministry.

Based on the performed analysis, the following gender-based gaps and risks were identified in the city:

- gender imbalance in early childhood education,
- gender pay gap and employment disparities,
- limited capacity in municipal preschools,
- inadequate elderly care services,
- accessibility and mobility limitations,
- lack of systematic data collection.

3.4 Economic baseline

Vilnius is the largest contributor to national Gross Domestic Product (GDP) in the country, accounting for more than 35% of Lithuania's total GDP. Additionally, Vilnius earned an international recognition as a suitable location for foreign direct investment (FDI), attracting 72% of Lithuania's total FDI. In 2021, primary FDI sectors included finance and insurance, export/import, vehicle repair as well as information and communications.

Overall unemployment in Vilnius is relatively low – being 6.9% in 2023 – but recent data on job vacancy rates and economic activity indicate a rising trend. Nevertheless, near term projections for a return to growth suggest that unemployment will return to historic levels over the next 2-3 years.

The city's budget position is of greater concern. Like most municipal governments in Lithuania, Vilnius has seen its operational budget deficit increase from around 5% to around 10% of revenues over the past five years (Figure 8), in spite of rising revenues over that time period. Rising expenditure has been driven by the response to and aftermath of the coronavirus pandemic, the direct impact of mass arrival of refugees following the Russian invasion of Ukraine and the indirect impact of the invasion and energy crisis on inflation across the region.

In Vilnius, the education sector accounted for around half the city's expenditure (€710m) in 2024. Other major spending categories included environmental and urban development (13%,

€184m) and mobility (12%, €166m), reflecting city's focus on sustainable growth and infrastructure improvement.

3.5 Vilnius' GHG emissions

In 2021, Vilnius emitted 2,492,967 tCO_2. The transport sector accounted for the largest share with 38% (948,088 tCO_2). The electricity sector also contributed - 25.4% (633,631 tCO_2), and the buildings sector (central and individual heating) - 25.3% (631,016 tCO_2). The waste sector contributed 2.9% (71,878 tCO_2) and other sectors 8.4% (208,354 tCO_2).

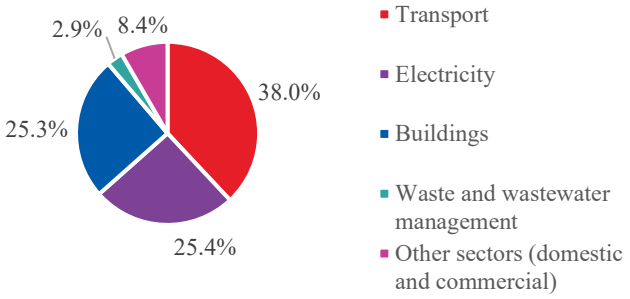


Figure 9 Distribution of Vilnius City GHG emissions (by sector, 2021)

3.6 Renewable energy potential in the city

The estimated technical potential of renewable energy sources (RES) in Vilnius is approx. 8,152,505.56 MWh. On the other hand, the estimated economic potential of RES in the municipality is approx. 5,588,583.67 MWh (excluding air source heat pump energy), which is approx. 63% of the total energy demand of the municipality (excluding Combined Heat and Power energy).

3.7 Risk and Vulnerability Assessment

An assessment of Vilnius' likely future challenges was carried out to complement the baseline assessment of existing challenges. This risk and vulnerability assessment (RVA) drew upon prior studies, expert assessment and stakeholder input to identify the sectors most vulnerable to potential hazards in the city. The hazard assessment included consideration of both current and a future changing climate.

Among environmental and climatic hazards, the RVA highlighted air pollution, extreme storm events (high rainfall and strong winds), extreme heat and rising urban heat island (UHI) conditions, and insect-borne diseases.

Among the most likely technological and infrastructure hazards, the RVA identified infrastructure system failure (especially in district heating), fires, road accidents and a potential accident at the Astravets nuclear power plant (Belarus). Key socio-economic hazards include housing availability, labour conflict/strikes, economic crisis, cyber security, and migration.

Based on the assessment, the most vulnerable systems in the city include public health, safety and sanitation, social welfare, transport and mobility, buildings, finance, biodiversity, and land use. The level of vulnerability varies depending on the hazard affecting each sector. Below are the measures and recommendations that should be considered in future actions to strengthen each sector's response to hazards:

- **Public health, safety, and sanitation**: Increase support for health services in response to the increase in disease and decrease in family doctors, and ensure access to primary health care. Conduct information campaigns to raise residents' awareness of the risks associated with natural disasters and diseases such as tick-borne encephalitis and Lyme disease. Continue to upgrade and expand the city's surface and stormwater management infrastructure to cope with increased rainfall and prevent flooding, thereby enhancing residents' safety. Extreme weather events, system failures, fires, road accidents and a nuclear accident all require effective emergency preparedness, response and recovery capabilities: this applies both to institutions (first responders, utilities etc.) and to citizens across the city.
- **Social welfare**: Increase the resources and efficiency of social services to better serve the growing number of people receiving assistance. Enhance the city's capacity to receive foreigners by providing temporary accommodation, food, and health care for migrants.
- **Transport and mobility**: Implement road safety measures to reduce accidents and continue to enforce these measures. Introduce stricter emission standards for vehicles and promote electric vehicles to combat air pollution. Encourage public transportation, cycling and walking.
- **Buildings**: Reinforce adaptive capacities in the energy sector through infrastructure modernisation and financial support for upgrading heating points (substations) in buildings and building insulation. Promote green roofs and walls, solar panels, and the use of reflective materials in buildings to reduce the Urban Heat Island effect. Implement dust control measures at

construction sites to address air pollution, particularly during the summer. Emphasise sector coupling, particularly in the areas of electricity-heat and electricity-transport, to increase the resilience of the energy system (a challenge mainly for the transport and mobility and buildings sectors).

- **Finance**: Although generally not exposed to direct physical hazards, finance plays an essential role in the city's capacity to respond to and recover from shocks and stresses. It is important to ensure that the budget is properly balanced. During crisis situations, prioritising funding for essential services and risk mitigation is crucial, guided by thorough cost-benefit analysis and long-term planning. Maintaining budget flexibility and engaging stakeholders can ensure the city's resilience and an effective response to unexpected events.
- **Biodiversity**: Protect the city's green spaces through regulatory and investment measures. Research and monitor biodiversity and take action to support it to improve environmental protection and quality of life for residents. Continue the development of nature-based solutions (NBS), such as meadows, forests, parks, and singular plants, to sequester carbon.
- **Land use:** Carefully consider the land use policies needed to improve the resilience of the city. Continue to limit extensive development. Implement solutions to cope with increased rainfall.

Other recommendations encompass areas such as disaster preparedness, environmental management, infrastructure resilience and adaptation, waste management and energy sector.

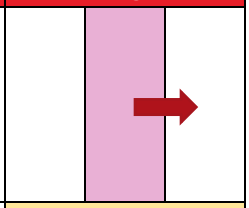
3.8 Smart Maturity Assessment

Cities are increasingly using the digitalisation of municipal services to improve the efficiency and accuracy of their operations, maintenance and planning. The Smart Maturity Assessment (SMA) for the GCAP assessed the extent to which Vilnius has adopted and integrated smart measures into its operations to date.

Smart technologies and digital transformation can influence the ability to improve the quality and efficiency of public services. When properly implemented, they also help effectively to manage resources to meet the needs and demands of the city. There is still room for improvement despite the advanced level of smart solutions implemented in Vilnius. One of the main identified obstacles is the lack of a coherent smart city strategy. However, new regulations introduced in 2024 clarified that the Vilnius City Strategy and the Coalition Agreement include specific technological directions as strategic points. In addition, the Open Vilnius strategy is currently being developed with a specific focus on technological directions. While the city has just implemented a new strategy to address these challenges, the solution will be a gradual process. The SMA found that there are currently a number of smart city initiatives – from Intelligent Transportation Systems (ITS) to digital public services and social media engagement – but that they tend to operate in isolation, lacking the synergies and effective communication needed to maximise their impact. In addition, the potential of these initiatives is often not fully realised, often due to limited access and lack of capture and use of potentially available data. As a result, the city cannot fully reap the benefits of smart city initiatives, including data-driven decision making and improved public services.

The city also faces challenges in ensuring seamless data sharing between different city departments and divisions, as well as with external partners. Looking ahead, Vilnius needs detailed planning, clear reporting, and the development of data-related skills. This approach will not only help fill existing gaps but also enable Vilnius to fully reap the benefits of smart city solutions. In this way, Vilnius will enhance city governance and services, while taking another crucial step toward becoming a smart and open city.

Table 2 Smart Maturity Assessment of Vilnius - Summary

			Ad-hoc / Opportunistic / Strategic
Smart city leadership & governance	**Area**	**Summary assessment**	**Stage**
	Current approach	Current approach to smart development is strategic, coherent and consistent. It would benefit from additional political support and backing for greater integration along all the cities entities. Greater political support also comes with risks, as incorporating the SI/DT topic into the political agenda makes it vulnerable to shifts in political priorities.	
	Governance	A city CTO has been appointed to make decisions in this area.	Enabling
	Policy foundation	The current policy documents are in place but needs to be reviewed and reconfirmed or updated by the new mayor/administration.	Integrating
Stakeholders' engagement	**Summary assessment**		**Stage**
	The city engages its stakeholders in SI/DT but there is no coherent, centralised approach.		Enabling
Integrated ICT	**Area**	**Summary assessment**	**Stage**
	Connectivity	Connectivity of the city is good, covering all the urban area with 4G and 5G, usage of the internet is widespread.	Optimising
	Integrated ICT infrastructures	City uses all necessary infrastructure, is well connected to the internet and is constantly looking for ways to optimise its technology.	Optimising
	Data-based capacities	City has plenty of data resources, they are well digitised and are often used.	Optimising

The SMA concluded that the city should aim to streamline and improve various aspects of city management through the integration of smart integration and digital transformation (SI/DT) initiatives.

These includes:

- Standardising project management principles.
- Further upgrading outdated systems such as traffic management.
- Integrating services across city departments to improve the citizen experience.
- There is also a need to strengthen the human resources (HR) and public relations teams so that they can devote more attention and resources to developing new educational initiatives.
- It also proposes the establishment of a dedicated governance body and the allocation of sufficient resources to ensure effective implementation and oversight of SI/DT projects.
- In addition, there should be a focus on using the new city's strategic plan to deepen integration efforts and prioritise solutions that address multiple city agencies or units by fostering collaboration.

Each GCAP action includes a "Smart City Potential" section to draw attention to the issues and opportunities identified in the SMA.

3.9 Public survey findings

The survey aimed to capture Vilnius citizens' views on the urban environment and key city challenges. Despite a relatively small, non-diverse sample, it offers valuable insights which have been used to inform the selection and development of actions in the GCAP.

The online survey was conducted in April 2024 (in the Lithuanian language). It featured 29 questions on climate change, urban sectors, and demographics. A total of 514 responses were received. Based on data provided to the survey, the respondents were about evenly divided between men and women, but there was a higher representation of individuals aged 26-39 and

those who were employed compared to the general population.

The state and challenges of the urban environment

A large majority (85%) of respondents are concerned about the impact of climate change on their city. The top three areas of concern include:

- Rising temperatures (identified by 57% of respondents),
- Local ecosystems and biodiversity (54% of respondents),
- Future living conditions (49% of respondents).

Summarising the survey results regarding environmental assets, the following conclusions can be drawn:

- A strong majority (80%) of respondents rate drinking water quality as good or excellent, with 54% suggesting only minor improvements.
- Green spaces' quality is generally rated from good to average, 25% of respondents consider them poor or very poor. A significant 61% call for major enhancements in both quality and quantity.
- Air quality is seen as average to good, yet over half believe it needs substantial improvement.
- Opinions are split on water bodies' quality, with roughly a quarter each saying they need improvement, significant improvement, or substantial improvement.
- 27% of respondents are unsure about the state of soil quality, indicating a need for greater public awareness.

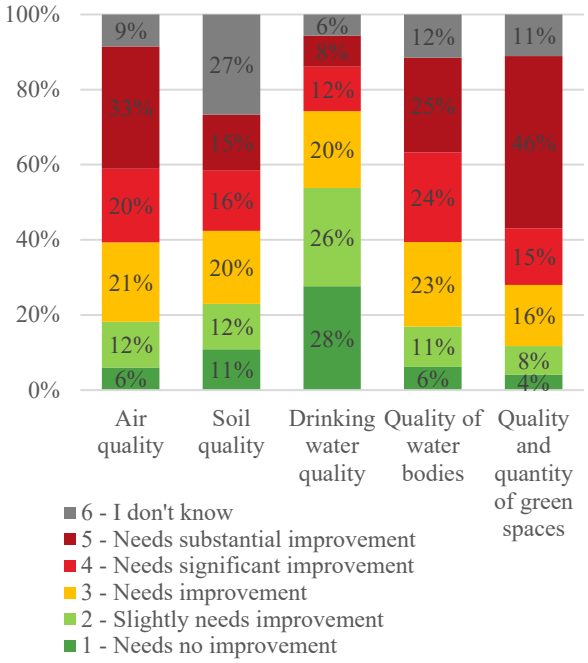


Figure 10 Improvement needs in environmental aspects

The current state and challenges of certain urban sectors

Based on the feedback received, the sectors that require significant improvement or even fundamental changes are: transport and mobility (76%), urban planning (72%), green spaces and biodiversity (64%). The least improvement needed, according to respondents, is in the Water and Wastewater sector in relation to drinking water.

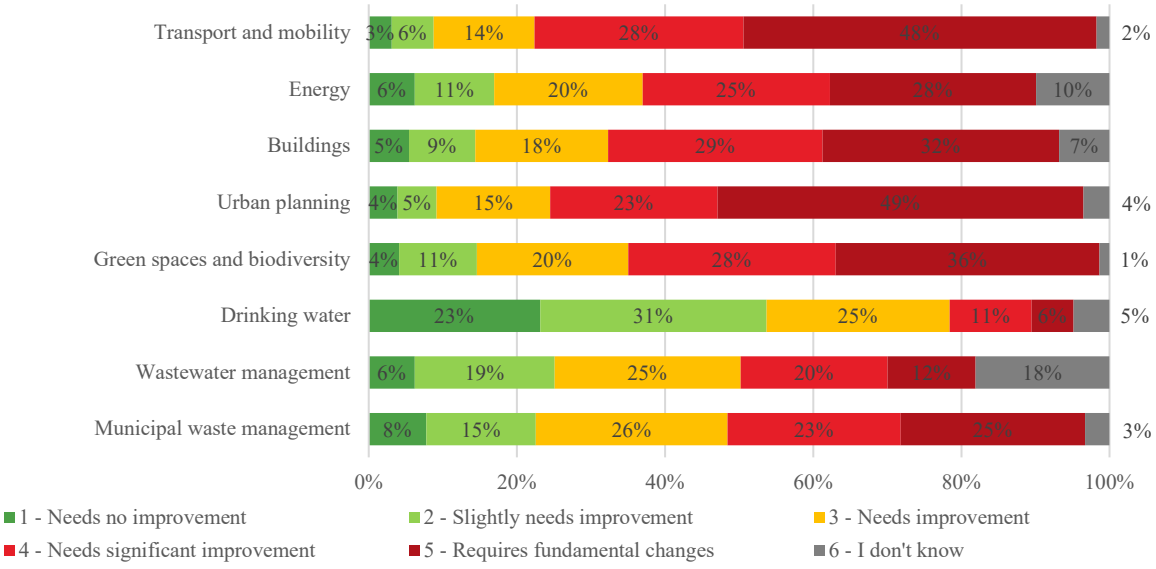


Figure 11 Improvement needs in sectors

Based on the responses, there are various aspects in each sector that could be improved. The areas that received the highest number of responses are listed in the Table 3.

Additional comments

The survey also gathered valuable insights through additional comments:

- Nearly half of the comments focused on existing infrastructure, emphasising the need for improvements and maintenance.
- The second largest group of comments highlighted the need for enhancing green areas and implementing sustainable solutions. Many respondents expressed strong disapproval of tree cutting.
- 7% of additional comments called for better waste collection systems.
- Additional feedback included suggestions on revitalisation, strategic planning, safety measures, and urban agriculture.

Table 3 Areas of improvement in sectors with the majority of responses

Sector	Area of potential improvement with the majority of responses
Transport and mobility	Organisation of public transport (e.g., bus lanes, real-time monitoring and planning of bus and trolleybus locations, route optimisation, integration of smart technologies, more routes during peak hours, etc.).
Energy	Increase in the use of RES.
Buildings	Support for investments in the modernisation of residential buildings to increase energy efficiency.
Urban planning	Ensuring multifunctional and integrated development.
Green spaces and biodiversity	Improvement of green space maintenance.
Water and wastewater	Improvement of surface water drainage system efficiency.
Municipal waste management	Promotion of waste prevention, recycling, and reuse initiatives.

ENVIRONMENTAL KEY FINDINGS

4. Environmental Key Findings

The environmental challenges in Vilnius were identified combining insights from the baseline assessment, indicator data, database analysis, technical assessment, expert knowledge, and stakeholder discussions. A traffic light system of green, yellow, and red was used to prioritise they main challenges. Environmental priority areas were selected by identifying the main challenges in each sector, and addressing these priority areas will help improve environmental conditions, enhance the quality of life for residents, and increase the quality and efficiency of the city's infrastructure.

MITIGATION OF GHG EMISSIONS

The city needs to address challenges arising from urban sprawl, aging vehicles, and diesel dependence. Energy inefficiency in residential buildings from the 1960s–1990s lead to increased carbon emissions, yet the transition to renewable energy and energy efficiency is hindered by a lack of energy storage and challenges in balancing supply and demand.

GREEN SPACES, BIODIVERSITY AND ECOSYSTEMS

Uncoordinated city planning coupled with rapid urbanisation threaten green spaces and biodiversity. The city requires additional measures to ensure preservation and restoration of its biodiversity and natural assets.

RESILIENCE AND ADAPTATION

To ensure the city's resilience and adaptability, action is needed in the following areas: improving the stormwater drainage system, managing industrial wastewater, and preparing for potential emergencies at the nearby Astravets nuclear power plant.
The city should monitor the economic impact of natural disasters and enhance the readiness of public infrastructure and private households to respond to such events.

WATER BODIES

Urban development and industrial activity contribute to water pollution, particularly through stormwater runoff.

SOIL

Increasing urban development places pressure on soil quality in the city. The presence of pollutants in the soil, including mercury and petroleum products, is often linked to activities such as metal storage and car repairs. There is a need for vigilant monitoring and preventive measures to avoid future contamination.

DRINKING WATER / WATER USE

The primary factors affecting drinking water and water usage in Vilnius are the water infrastructure and the water treatment processes. The city is actively working on modernising the water supply network and maintaining high water quality compliance. However, there are challenges connecting new users in sparsely populated areas to the existing infrastructure network.

AIR QUALITY

The city's air quality is primarily influenced by the household heating and vehicle traffic, which are the largest sources of PM_{10}, $PM_{2.5}$, and NO_2 emissions respectively. The city is actively managing ambient air pollution through infrastructure renovation, public fleet renewal with less polluting vehicles, and green infrastructure development.

The following sections provide additional information and detail on the baseline assessments which have been completed.

4.1 State of the environment in Vilnius city

The technical assessment identified the following key environmental challenges for Vilnius:

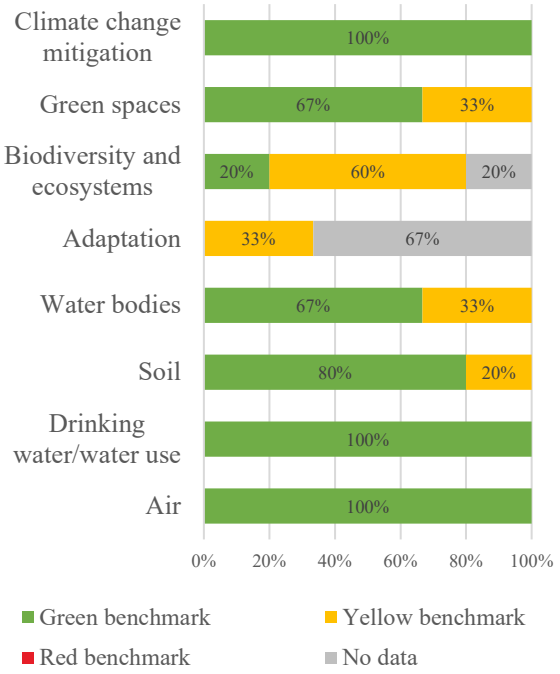


Figure 12 Results of Data Analysis for Vilnius Based on EBRD Reference State Indicators[1]

Climate change mitigation (GHG emissions): The transport sector contributes the largest share of GHG emissions in the city of Vilnius accounting for 38% of total emissions in 2021. Diesel (48%), gasoline (30%), gasoline/electric (6.5%), gasoline/gas (3.3%) and electric (1.4%) dominated the transport sector (2023). Heating and power was primarily generated by biomass (56%) and natural gas in 2017. Since then, the percentage of overall alternative energy sources has been increasing (27.09% in 2022). Vilnius has joined the EU Mission Cities Net Zero Cities programme, which aims to achieve climate neutrality targets by 2030. Vilnius actively promotes renewable energy sources (RES) by increasing energy efficiency in buildings, retrofitting buildings, constructing solar power plants and purchasing electric public vehicles, which are critical steps toward reducing GHG emissions. The challenge for the city is to improve local data collection to accurately monitor and report the city's progress in reducing emissions.

Related local policies:

- Vilnius Sustainable Energy and Climate Change Action Plan 2030
- Vilnius Strategic Development Plan 2021–2030
- Vilnius City Air Quality Management Programme and Action Plan 2020–2025

Open/Green spaces: Vilnius is one of the greenest cities in Europe with abundant forests and green spaces. Green areas occupy over 63% of the territory of Vilnius. The city demonstrates ongoing efforts to preserve, enhance and expand them. Vilnius was recognised as the European Green Capital 2025. The city's motto for its title year is: "Vilnius – the greenest city in the making." The Green Index tool has been introduced and digitalised to regulate new investments related to open and green spaces. The city has a huge potential to integrate NBS into urban environment. However, Vilnius lacks the document that holistically addresses the management and planning of greenery in the city. This absence, coupled with urban development pressures threatening existing areas poses a risk of loss or degradation of green spaces. Financial constraints present challenges to maintaining and ensuring the quality of green spaces. To address these challenges, the goals outlined in policy documents must be transformed into concrete actions.

Related local policies:

- Vilnius Comprehensive Plan of Vilnius 2021–2036
- Vilnius Strategic Development Plan 2021–2030
- 10 principles for quality of architecture in Vilnius 2022
- Sustainable Urban Mobility Plan 2017
- Vilnius City Municipality's Environmental Monitoring Programme for 2023–2028
- Green Index

Biodiversity: Vilnius has significant natural value and a high potential for biodiversity. This requires careful preservation, particularly in the face of the city's urban development, increasing

[1] This summary solely presents the results from the data collected for the indicator database. Each environmental component description chapter provides an in-depth commentary and highlights the challenges encountered in each area. The results displayed do not serve as a conclusive assessment of the city's performance but are strictly in relation to the benchmarks established by the EBRD.

pressure from tourism, and the introduction of invasive species. A significant part of Vilnius' green areas is protected within two Regional Parks: Pavilniai and Verkiai. There is one strict nature reserve (Kalnai Strict Reserve), 29 protected nature reserves, and 15 Natura 2000 sites within the city limits, and an additional three Natura 2000 sites near Vilnius. However, there is a noticeable gap in the mapping of rare/protected species and areas of biodiversity value, including Natura 2000 sites and animal migration routes. The city does not have a unified and systematic monitoring system (there are several different monitoring processes in place), or a complete natural inventory of the Vilnius area. Preserving its natural heritage while adapting to modern demands is key to the city's commitment to sustainable urban development.

Related local policies:

- Vilnius City Greenery Policy
- 10 principles for quality of architecture in Vilnius 2022
- Vilnius City Municipality's Environmental Monitoring Programme for 2023–2028
- Green Index

Adaptation: The city is becoming increasingly vulnerable to the impacts of climate change. Temperatures are now higher in Vilnius year-round, with an average annual air temperature 0.7–0.9°C higher compared to the end of the last century, and projections estimate an increase of 2.3°C to 4.7°C by 2100 compared to 1992–2020. This would result in higher energy consumption, and the appearance of invasive species of flora and fauna that can pose harm to local biodiversity and potentially increase health risks, such as tick-borne encephalitis. Heat waves and prolonged drought periods increase excess deaths, especially among vulnerable populations. The stormwater collection and treatment system in Vilnius is one of the least developed areas of urban infrastructure and so managing flash floods and ensuring public safety is a priority concern. It is crucial for the city to continue developing its water management strategies to mitigate local surface flooding risks. The city also needs to be prepared for possible emergencies in Belarusian nuclear power plant, as there is a risk of contamination of water bodies, food products, buildings, and other areas with radionuclides. The city is in the process of drafting the Vilnius City Adaptation to Climate Change Plan, which includes measures for adapting to climate change.

Related local policies:

- Vilnius Sustainable Energy and Climate Change Action Plan 2030
- Vilnius Strategic Development Plan 2021-2030

Water bodies: Vilnius is located in the confluence of the Neris and Vilnia rivers. In addition, there are several lakes within the city limits. The rivers are regulated and controlled by concrete or preserved stone banks (between Žirmūnai and Žverynas districts). As many as 28 species of fish have been found in the river (including 10 protected species). There is an area of concern is the section of the river near Žemieji Paneriai, where oil pollution, other chemical compounds and large accumulations of waste have been identified. Furthermore, there are six rivers (Neries, Vokės, Kairos, Varžuvos, Cedrono, Verkės) identified under the Water Framework Directive (WFD) in Vilnius in 2023. The ecological condition of the surface waters of four of them was classified as good, while the other two were classified as moderate. The water quality in Vilnius is considered satisfactory overall, but there have been fluctuations in biochemical oxygen demand (BOD) levels in the rivers, indicating occasional periods of stress. Bathing water quality is good, demonstrating effective management of recreational areas. Despite good water quality results in Vilnius, more efforts should be made to treat stormwater runoff.

Related local policies:

- Comprehensive Plan of Vilnius 2021–2036
- Vilnius Strategic Development Plan 2021-2030
- Vilnius City Municipality's Environmental Monitoring Programme for 2023–2028

Soil: Vilnius has an extensive permanent soil monitoring system. The overall environmental impact of pollution from the industrial and energy sectors is difficult to assess due to limited data. However, the city should investigate and assess former industrial sites more thoroughly, as these were excluded from previous monitoring activities. Maintaining low levels of heavy metals in the soil is manageable, but vigilance is necessary to prevent future contamination from any industrial activities or urban development in Vilnius.

Related local policy:

- Comprehensive Plan of Vilnius SEA 2017
- Vilnius City Municipality's Environmental Monitoring Programme for 2023–2028

Drinking water/water use: All drinking water supplied in Vilnius comes from deep underground wells, which are protected from environmental hazards and pollution. Vilnius has a consistently high Water Quality Compliance, with over 98% of all samples meeting the requirements. This demonstrates sustained efforts to maintain high water quality, and the number of water quality tests conducted each year has been rising consistently from 2018 onwards, from 8,000 to over 22,000 in 2020.

The main quality issues in Vilnius are the presence of iron, manganese, and ammonium in the groundwater. Most water quality problems are associated with water supply lines, resulting in poorer quality water reaching the customer at the end of the supply line. Modernisation of the water supply network and difficulties in connecting new users to urban infrastructure in sparsely populated areas are challenges for the city. Vilnius does not experience water stress.

Related local policies:

- Comprehensive Plan of Vilnius 2021–2036
- Vilnius Strategic Development Plan 2021–2030

Air: The geographical configuration of Vilnius in the Neris River valley affects the accumulation of pollutants, exposing the central districts (Žvėrynas, Šnipiškės and Old Town) to higher levels of air pollution. Despite this, according to the European City Air Quality Viewer platform, $PM_{2.5}$ levels in the city are well within limits, with Vilnius being among top 12% of European cities with the best air quality. Over the past decade, the city has undertaken many actions to improve air quality; including the renovation of roads, updating engineering networks; introducing more efficient vehicles to the public transport fleet; establishing new green areas and continuing green infrastructure development throughout the city.

Related local policies:

- Vilnius Strategic Development Plan 2021–2030
- Vilnius City Municipality Ambient of Air Quality Programme and Management Plan 2020–2025

SECTORAL KEY FINDINGS

5. Sectoral Key Findings

The priority sectoral challenges in Vilnius were identified through a comprehensive assessment of technical data, expert reviews and stakeholder discussions. Below is a summary of these priority sectoral challenges and related system-wide issues.

TRANSPORT

Contributes to environmental stress through GHG emissions, increased air and noise pollution, & biodiversity loss – driven by urban sprawl, ageing vehicles, and the popularity of diesel fuels.

High levels of car ownership and urban sprawl lead to increased pressure on green spaces and the need to optimise land use. The ageing and predominantly diesel vehicle fleet, and the popularity of private cars contribute to air and noise pollution. Public transport does not fully meet the needs of residents, especially in the suburbs, and there are issues with congestion, lack of accessibility, and inadequate services due to insufficient public transport infrastructure. The city's cycling infrastructure requires further investment to meet user needs. Furthermore, the city is facing a challenge due to the lack of adequate charging infrastructure for public transport electric vehicles.

BUILDINGS

From the 1960s–1990s buildings are particularly energy inefficient, contributing significantly to GHG emissions and reducing their capacity for resilience and adaptation to climate change.

A large informal rental market, aging building stock and ownership issues hinder efforts to improve living conditions, contributing to social inequality and housing instability. Despite attractive national and local subsidies for home retrofit, these have not been widely adopted. Residential buildings constructed between 1960 and 1990 are particularly energy inefficient, contributing to increased carbon emissions. Furthermore, the lack of a comprehensive framework for the use of Building Information Modelling (BIM) in the maintenance phase of construction projects and the lack of data on building condition and efficiency highlight the need for improved building standards and assessments.

LAND USE

Increases environmental pressures and impacts quality of life due to inefficient urban development, lack of brown-field redevelopment, and low urban density development.

Inconsistent planning and fragmented housing policies lead to inefficient land use and uncoordinated urban development. Complex urban renewal projects, fragmented property rights, and lack of resources in the city, contribute to urban sprawl and challenge regeneration efforts. Rapid urbanisation in the city also poses a threat to biodiversity and to the preservation of open green space. Additionally, increased population density in some areas and underutilisation in others place increased demands on public services and infrastructure. Former Soviet areas in particular lack public spaces, services, and social integration facilities, and there are no established plans to convert Soviet-era multi-family buildings into mixed-use areas, which would improve the quality of life for residents.

ENERGY

Increases GHG emissions and reduces air quality, primarily due to remaining share of fossil fuels in the energy mix, inadequate energy storage infrastructure, and supply-demand imbalances.

Insufficient energy storage and the challenges of balancing energy supply and demand hinder the transition to renewable energy and energy efficiency. Ageing infrastructure in Soviet-era buildings exacerbates energy inefficiencies, leading to increased fossil fuel consumption and emissions.

There is a lack of sufficient data for buildings outside the district heating networks, while the northern part of Vilnius faces significant limitations in developing district heating systems due to high costs caused by large distances from existing heat generation sources. The slow progress in industrial energy efficiency and green manufacturing contribute to continued fossil fuel dependency. Ambitious climate neutrality targets necessitate a rapid expansion of renewable energy, but limited space for the required infrastructure, building owners' reluctance due to high initial cost and lack of grid connectivity or capacity in some areas prolongs reliance on fossil fuels.

In addition, inadequate funding for modernisation in the private sector and among residents further limits progress towards a sustainable energy system.

SOLID WASTE

Pressures the environment due to the lack of waste separation at the source, negatively impacting soil quality, green spaces, air quality, and limiting the mitigation of GHG emissions.

As the city's economy expands, it faces increased waste issues. Despite the introduction of a new food waste collection system, public awareness and adoption remains low. There are high amounts of waste from packaging, yet the city's waste management system has limited capacity to sort waste, limiting the opportunities for recycling. High incineration rates and expensive treatment technologies reduce air quality while escalating incurred costs.

WATER

Creates environmental pressure through an inadequate stormwater drainage system, which is vulnerable to climate change impacts, impacting the quality of water bodies and biodiversity.

The stormwater drainage system is inadequate and vulnerable to climate hazards due to insufficient capacity and poor distribution of the system. While a new strategy to address this challenge is under development, it requires substantial funding to ensure coordinated improvement across the city and the implementation of numerous blue-green infrastructure solutions. The lack of industrial wastewater pre-treatment increases soil, surface water, and groundwater pollution. Ageing and service interruptions that affect residents, while partial digitalisation of water networks and low energy independence limit efficient management. Groundwater infiltration into sewer pipes and an underdeveloped stormwater treatment system exacerbate pollution and pose health risks. In addition, low water consumption and poor control of industrial wastewater discharges further challenge the city's water management efforts.

INDUSTRIES

Contribute to environmental pressure due to the need for stronger regulatory frame-works to ensure compliance and promote responsible practices.

The city's industrial growth must balance economic progress with environmental and social responsibility. Attracting new talent, providing a skilled workforce, attracting co-investment and support, and adhering to strict environmental standards are crucial. Energy efficiency in the industrial sector needs to be improved, and successfully managing post-industrial waste is critical to ensure it does not contaminate the water system.

The following sections provide additional information and detail on the baseline assessments which have been completed.

5.1 City of Vilnius sectoral summary

The technical assessment identified the following key challenges for Vilnius sectors:

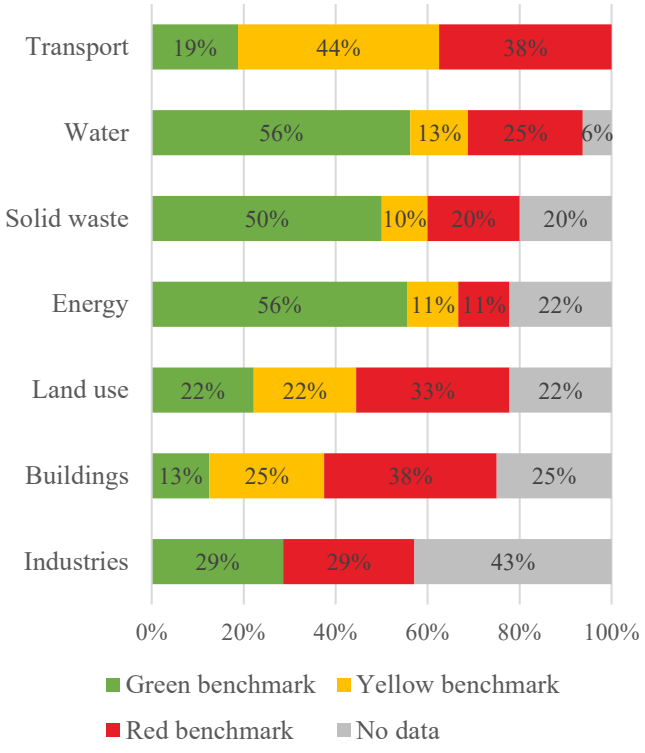


Figure 13 Results of Data Analysis for Vilnius Based on EBRD Reference Pressure Indicators [2]

[2] This summary solely presents the results from the data collected for the indicator database. Each sector description chapter provides an in-depth commentary and highlights the challenges encountered in each area. The results displayed do not serve as a conclusive assessment of the city's performance but are strictly in relation to the benchmarks established by the EBRD.

5.2 State of the Vilnius' sectors

The following section provides a summary of the main assessments, conclusions and stakeholder comments included in the Technical Assessment Report.

Transport

Most related local policies:

- Vilnius Sustainable Urban Mobility Plan (SUMP)

High levels of private car ownership and dependency characterise the current mobility system and encourages urban sprawl. In turn, urban sprawl encourages higher car ownership and use, reinforcing the cycle. Public transport planning needs to be improved to address service provision and accessibility for users. Efforts to improve the frequency of bus services are constrained by a lack of vehicles and drivers. In addition, inadequate charging infrastructure for electric vehicles and potential electricity shortages contribute to continued reliance on fossil fuel sources. Finally, 95% of the population exposed to road traffic noise is in the noise exposure zone. Noise management methods and policies are inadequate.

Sectoral context:

The largest share of GHG emissions in the city of Vilnius comes from the transport sector, accounting for 38% of total emissions in 2021. Currently, 51% of commuters travel by private car, 26% by public transport, and 16% by foot. Vilnius has the highest rates of traffic congestion in Lithuania, impacting air quality and the comfort and safety of road users. An ageing vehicle fleet leads to increased maintenance costs, higher emissions, and reduced fuel efficiency, however this is a challenge for the city to address, given the high rates of private vehicle ownership. While the share of diesel vehicles in the total fleet remains significant, it is on a downward trend, decreasing from 59.03% in 2017 to 47.97% in 2023. Nevertheless, the presence of diesel vehicles continues to contribute to emissions in the city. While the proportion of electric, hybrid, fuel cell, and liquefied natural gas (LNG) vehicles in the total passenger car fleet is increasing, it still represents a small proportion of the total fleet (1.411% in 2023). Increasing the share of vehicles powered by cleaner and alternative energy sources is crucial in order to meet the city's environmental targets and to reduce dependence on fossil fuels.

Main challenges and barriers identified:

- An aging vehicle fleet leading to higher emissions and lower fuel efficiency.
- The public transport system faces challenges in terms of poor efficiency, punctuality in peak hours, and coverage (especially in suburbs).
- Lack of integration between public transport and walking paths (especially in suburbs).
- Approximately 48% of the vehicle fleet is diesel-powered, emitting pollutants that can reduce air quality.
- Land use and infrastructure investments are not aligned with car-curbing measures to encourage the modal shift.
- Difficulties in applying Transport Oriented Development principles (which also apply to land use etc).
- Poor modal shift away from private cars to other public and active modes.
- Traffic congestion is significantly worsened by parents driving their children to school. This situation is primarily due to the lack of accessibility to high-quality social services.
- Lack of safe pedestrian infrastructure, especially in the suburbs.
- While there has been progress with alternative fuel vehicles, adoption is still at a low level. Further development is limited by insufficient charging infrastructure for electric vehicles (for public and private transport).
- The recent increase in service density is posing a challenge for public transport, leading to overcrowding and congestion at some stations.
- The stormwater collection and purification system is one of the least developed areas of urban infrastructure, which affects the state of the city's transport infrastructure.
- High levels of congestion cause noise and air pollution in the city centre.
- Insufficient dedicated bus lanes in the most congested areas and other prioritisation infrastructure for public transport

Buildings

Most related local policies:

- Lithuania's Long-term Renovation Strategy
- Comprehensive Plan of Vilnius
- Strategic Action Plan 2023-2025 of the VšĮ "Atnaujinkime miestą"
- Apartment Building Renovation (modernisation) Programme
- Sustainable Energy and Climate Change Action Plan 2030

Current legislation allows buildings with major problems in terms of technical systems, energy efficiency, fire safety and other hazards to be occupied, but not those with structural integrity defects. The subsidy system for building renovations, especially in heating systems is complex. Involving stakeholders, especially residents, in renovation projects is challenging due to the lack of organised community structures and legal entities for all buildings, as well as low activity and awareness among residents. 20% of the Lithuanian population are directly affected by energy poverty at the national level, while a further 40% are at risk. National programmes to support building retrofit are irregular, making planning and financing difficult for private entities and residents. The city lacks the financial and human capacity to undertake large-scale building retrofits and is limited to upgrading a maximum of 100 buildings per year.

Sectoral context:

The real estate market in Vilnius is the most active in the country. The capital's highly developed service and business sectors have led to increased real estate investment activity and significantly higher real estate prices than the national average. In total, there are more than 76,000 buildings in the city with a total area of 37.74 million m^2. The municipality and the state own 3% of the total buildings or 9% (3.5 million m^2) of the total floor area. In the territory of the city of Vilnius, there are about 5,300 multi-apartment buildings identified as having potential for retrofit, yet only 380 buildings have been renovated so far (about 7%) and another 270 buildings are in the process of renovation (project financing has been approved).

According to the data of the VĮ "Registrų centras" (state enterprise Centre of Registers) and the VĮ "Statybos produkcijos sertifikavimo centras" (state enterprise Building Product Certification Centre), the buildings of Vilnius City Municipality with energy performance class (EPC) B and higher (low-energy buildings with consumption <139 kWh/m^2) account for 17.13% of the total floor area of the buildings assessed. Approximately 58% of the assessed buildings have and EPC rating of E-G.

19.07% of other buildings in the municipality (residential, business, manufacturing, medical, etc.) have an EPC rating of B or higher, while 69.55% have and EPC rating of E-G.

High energy consumption for heating and cooling is caused by inefficiencies in building envelope performance, heating/cooling systems, or occupant behaviour. The remaining share of fossil fuels in the city's energy mix contributes to an increased carbon footprint.

Main challenges and barriers identified:

- Large informal rental market and lack of regulatory control.
- Complex ownership issues, including difficulties with establishing legal ownership and lack of direct influence over private property limits effectiveness of managing land and improving living conditions for people.
- Lack of a comprehensive framework and a systematic approach for BIM utilisation in the maintenance phase of the life cycle of construction and retrofit projects.
- Passive residents that are not willing to renovate houses despite an attractive national and local subsidy mechanisms.
- High energy consumption in residential buildings.
- Lack of available data on building energy efficiency, energy use, or building conditions.
- Outdated and energy inefficient 1960s-1990s architecture.
- Lack of building material passport assessment in the city.

Land use

Most related local policies:

- Comprehensive plan of the Republic of Lithuania
- Comprehensive Plan of Vilnius
- Vilnius City Strategic Development Plan 2021-2030
- Vilnius District Municipality Strategic Development Plan 2024-2032

The city is actively trying to optimise the use of space, yet challenges persist due to high demand for land and poor quality growth within the inner city, resulting in urban sprawl and its associated issues. Unsustainable urban sprawl results in the loss of green space, increased infrastructure costs, and increased social inequality. To address these challenges, it is essential to prioritise infill development. Low population density often contributes to urban sprawl, where infrastructure and services are spread over a larger area, which can strain municipal resources and limit the efficiency of public transport systems. As the urban area of the city is expected to continue to grow, it is vital to ensure that commuting time, commuting distances, and access to everyday services are not negatively impacted.

Alongside urban sprawl, there is a lack of integrated planning in new housing developments, especially in non-priority peripheral areas, which leads to insufficient infrastructure provision. Transforming ground floor spaces in Soviet-era residential buildings into mixed-use areas would enhance liveability. While there is a high potential for better planning of new development in the current Comprehensive Plan of Vilnius, there are limited tools to control where this development occurs. There are insufficient personnel in the Architecture Division in the Municipality which poses challenges to permitting processes.

Sectoral context:

Effective land use and building management are of major challenges in Vilnius region. The infrastructure systems in the city are exposed to stress due to the increasing numbers of users.

In Vilnius, a standard for the development of streets has been developed, alongside the 10 rules of urban planning and architecture:

- Respect the urban context and adapt to it when planning new buildings or public spaces.
- Open spaces are defined by their boundaries and maintained by the community that uses them.
- Design streets with the needs of society and nature in mind.
- Employ innovative infrastructure design principles.
- Use natural and local building materials.
- Prioritise refurbishment over new construction.
- Protect and preserve heritage sites.
- Try to maintain and develop green space.
- Organise architectural competitions to find the best architectural ideas, the most rational functional solutions, and the most aesthetic architectural expression.
- Prioritise projects that will be socially useful.

The real estate market in Vilnius is responsive to economic conditions and consumer preferences. The recent increase in office vacancy rates is a result of the post-pandemic shift towards remote working.

Main challenges and barriers identified:

- Inconsistent planning of residential areas results in uncoordinated urban development.
- Difficulty implementing complex urban renewal projects.
- Fragmented ownership results in complexity implementing regeneration projects.
- Overambitious spatial planning documents.
- Increased demand on public services and infrastructure due to rising population density in some areas and underutilisation in others.
- Lack of municipal staff to manage regeneration projects.
- Fragmented land ownership poses challenges to city planning and development.
- Threat of loss or degradation of green space.
- Lack of development of pedestrian and public transport infrastructure.
- Very high vacancy rates of office buildings.

Energy

Most related local policies:

- National Energy Independence Strategy
- Law on Renewable Energy of the Republic of Lithuania
- National Energy and Climate Action Plan of the Republic of Lithuania for 2021-2030
- Long-term strategy for Vilnius district heating networks 2021-2040
- Vilnius City Municipality Renewable Energy Action Plan 2030
- Sustainable Energy and Climate Change Action Plan 2030

The bureaucracy and high number of stakeholders involved in decision making processes lead to complexity in the energy sector. There is insufficient funding for modernisation of energy systems, and the municipality has no direct influence on the electricity distribution system operator.

There is a lack of data on fuel use in buildings which are not connected to the centralised heating network. The increasing volatility and uncertainty of electricity prices have accelerated investment in solar photovoltaic technology, by both private and government entities.

Sectoral context:

The city has universal access to energy with the electricity system providing most of the energy requirements for both power and heating (in 2019 electricity consumption for heating accounts for 5.43% of total electricity consumption). AB "Energijos skirstymo operatorius, ESO" provides electricity distribution services for electricity and gas to customers who are connected to ESO's distribution network. AB "Litgrid" is an electricity transmission operator and AB "Ambergrid" is a gas transmission operator. In 2023 the total electricity production in the city was 266,300 MWh, of which 36% was generated from RES. 94% of this electricity is produced by the CHP plant (VE-2) of the AB "Vilniaus šilumos tinklai, VŠT", which also produces heat energy by combustion of solid biomass. A second CHP plant, the Vilnius Cogeneration Plant (Vilniaus kogeneracinė jėgainė, VKJ) produces energy from municipal waste, around 50% of which is biodegradable.
Besides the heat generation facilities owned by the network operator VŠT, the heat network of Vilnius city comprises eight independent heat producers operating 11 individual heat generation sources.
The maximum heat consumption load is 1,080 MW. The total heat energy capacity within Vilnius is 1,400 MW, of which 500 MW is from RES (36% of the share of the installed capacity). VŠT supplies heat energy to ~7,300 buildings, with a total heat energy consumption of about 2,400 GWh/year. Almost three-quarters of the heat energy consumed is used for space heating.

Main challenges and barriers identified:

- Lack of sufficient renewable energy storage systems pose challenges in scaling-up renewable energy solutions and achieving energy-efficiency.
- Difficulties in balancing energy supply and demand.
- Lack of data on buildings not connected to the district heating network.
- Ageing infrastructure and low energy efficiency in the Soviet-era buildings.
- Topographical conditions and terrain in the northern part of Vilnius significantly limit the development of district heating systems within the city.
- Slow transformation of energy efficiency in industry, with limited development of green manufacturing and clean production.
- Ambitious climate neutrality targets necessitate rapid and substantial action on RES development in the city.
- Lack of space to expand large-scale efficient photovoltaic installations. However, there is significant potential for rooftop PV installations in the city.

Solid waste

Most related local policies:

- Republic of Lithuania's Law on Waste Management
- National Waste Prevention and Management Plan (2021 – 2027)
- Vilnius Region Waste Prevention and Management Plan for 2021–2027
- Vilnius City Municipality Waste Prevention and Management Plan 2021 – 2027

There is poor awareness among citizens about household waste management resulting in inadequate separation of waste at the source, coupled with excessive packaging producing high levels of waste. The quality of collected and sorted waste, especially paper waste, is low, often making them unsuitable for recycling or reuse. There is no effective tracking of illegal municipal waste dumping.

Sectoral context:

The Municipality organises the municipal waste management system in line with legislation, and appoints waste managers to provide municipal waste management services. The municipal company SĮ "Vilniaus atliekų sistemos administratorius, VASA" manages the municipal waste system, controlling municipal waste carriers, waste holders, managing and collecting the local tax, and other tasks as defined in the Resolution of the Vilnius City Council of 11 May 2016 no. 1–445 "On Approval of the Vilnius City Municipality Waste Management Regulations".

VAATC handles regional waste management, including various treatment facilities and public information. In the decade to 2022 per capita waste generation decreased from 665 to 340 kg, however it is important to note that the methodology calculating waste generation also changed during this period.

Vilnius has established several DGASA sites in the city and has implemented various initiatives to encourage separation at source of dry recyclables to minimise mixed waste. Food waste in the city has been collected separately since the start of 2024. The majority of municipal solid waste collected each year consists of packaging waste and secondary raw materials, bio-based degradable waste, textiles, and other non-hazardous waste.

In 2021:

- 40% of municipal waste was recycled,
- 44% of municipal waste was incinerated,
- 16% of municipal waste was landfilled.

The Mechanical Biological Treatment Plant (MBT) sorts waste and separates materials for reuse from biodegradable waste (which is bio-dried and composted). On average, around 230,000 tonnes of municipal solid waste are treated at the Vilnius MBT facility annually, and around 12,000 tonnes of secondary raw materials are placed on the market each year.

The Vilnius Regional Landfill was opened in 2007 with the plan to operate for 20 years, but with the subsequent construction of the MBT plant, the landfill is expected to operate for 50 years. The landfill can hold almost six million tonnes of waste and is designed to hold 339,900 tonnes per year. Waste generated in Vilnius City Municipality accounts for the largest share of waste managed at the landfill (88%).

Main challenges and barriers identified:

- As the city's economy continues to develop, waste generation is expected to continue rising.
- Poor separation of waste at source.
- Poor citizen awareness about their waste management obligations.
- Poor recycling rates as a result of waste separation difficulties.
- The effectiveness of the new food waste collection system is currently being evaluated.
- Producers and importers do not sufficiently apply eco-design principles (EPR practice), which results in a large amount of packaging waste.
- Insufficient capacity to separate packaging waste from other non-packaging secondary raw materials.
- Lack of demand for sorted packaging waste and secondary raw materials.
- High contamination of paper-based waste
- High incineration rates due to poor quality of packaging waste and secondary raw materials and poor separation.
- High costs of the treatment technology, leading to high waste management costs.

Water

Most related local policies:

- Law on Drinking Water Supply and Wastewater Management of the Republic of Lithuania
- Water Development Programme 2017–2023
- Comprehensive Plan of Vilnius
- Vilnius Strategic Development Plan 2030
- The Adoption of a Methodology for Setting Prices for the Management of Sewage Sludge in Technological Chains
- Government Decision on the Adoption of the Water Development Programme 2017–2023
- Regulation on Surface Wastewater Management

Accidents and breakdowns in sewerage networks are primarily caused by ageing pipes and blockages caused by pollutants irresponsibly discharged by residents, industry, services and especially construction companies. While the promotion of wastewater treatment is regulated at the national level, there is a lack of regulation and fiscal incentives at the local level. The rate of annual upgrade to the network should be 1%, but it is currently around 0.1% due to insufficient funds and the issue not being regarded as a priority.

Sectoral context:

All drinking water supplied in Vilnius comes from underground wells (40 to 245 meter-deep). There are 20 water supply areas in Vilnius with 272 deep wells used to supply water to Vilnius districts. UAB “Grinda” manages about 2,050 km of surface wastewater networks, and collects and cleans stormwater (rain and snowmelt water) in Vilnius. Thirteen surface wastewater cleaning stations are in operation, with an efficiency of 16,170 l/s. Another 884 ha are cleaned by UAB “Vilniaus vandenys”, collecting both domestic and surface wastewater. The stormwater collection and purification system is one of the least developed areas of urban infrastructure.

The volume of water consumption per capita has fluctuated between 62 and 70 l/day/person between 2016 and 2022. 60% of the network of water pipes are 30 years old and are deteriorating, posing a challenge for the city. The energy used for water production has almost halved (from 0.736 kWh/m³ in 2012 to 0.488 kWh/m³ in 2022), there remains some room for further optimisation in the system’s efficiency.

During the 11-year period to 2022, the water supply network length increased by 101.4 km, while the wastewater collection system length increased by 111.4 km. Despite this, there are 3,260 households in Vilnius agglomeration (includes Vilnius city and its suburbs) that are still not connected to the central wastewater collection system.

Vilniaus vandenys operates 1,530 km of sewer networks and 258 wastewater pumping stations to collect and transport wastewater to the treatment plants.

Main challenges and barriers identified:

- Inadequate condition of the stormwater drainage system.
- Vulnerability of existing system to climate change.
- No separate and appropriate treatment of industrial and municipal wastewater.
- Insufficient leak identification and repair.
- Deterioration of the water supply network pipelines.
- Low level of digitalisation of the water and sewerage network leading to inefficiencies.
- Low energy independence in water supply and water treatment infrastructures.
- Issues with groundwater infiltration into sewage pipes.
- Underdeveloped stormwater collection and treatment system contributes to localised flooding and water logging.
- Inadequately treated sewage causing pollution.
- Low water consumption.
- Lack of control of industrial wastewater discharge.
- Need to reduce the area of impermeable surfaces.

Industries

Most related local policies:

- National Energy Independence Strategy
- Climate Change Management Law of the Republic of Lithuania
- Medium-term Policy for Industrial Development and its Implementation Strategy
- Towards Advanced Manufacturing. Lithuania's Industrial Transformation to 2030
- Sustainable Energy and Climate Change Action Plan 2030
- Regulation on Surface Wastewater Management
- Wastewater Management Regulation
- Vilnius Strategic Development Plan 2030

Energy-intensive industries located in the city of Vilnius include metal, plastics, electronics and electrical engineering, laser, automotive and other manufacturing companies. However, the main activities are concentrated around ICT, biotechnology and financial activities. The city's industrial policies focus on attracting investors and creating favourable business conditions. The policy framework is insufficiently credible and stable and a lack of indicators and targets are limiting progress. Inadequate regulation and governance issues, including a lack of ownership, poor public coordination, and weak institutions, are limiting a green transformation in the city, while prominent business cultures often miss opportunities due to conflicts of interest. There is a lack of a competitive market for secondary raw materials, partly due to low prices for primary materials, and efforts to move industry towards a sustainable future are hampered by the lack of national targets for the European single market.

Sectoral context:

While the main economic activities in Vilnius are concentrated around Information and Communications Technology (ICT), biotechnology, and financial activities, the city also hosts energy-intensive industries, including manufacturing companies in metal, plastic, electronics, electrical engineering, lasers, and the automotive sector. Sources of air pollution from industry include emissions from construction sites and industrial activities; wind lifting particulate matter and dust from dry surfaces. Industrial and energy companies in the city have reduced pollution and adapted to new environmental standards by phasing out old, inefficient devices and installing new, more efficient technologies that use fewer resources and emit less pollution.

According to the AB "Energijos skirstymo operatorius, ESO", approximately 350,000 MWh of natural gas, 123,000 MWh of biomass, 21,200 MWh of biogas and 120,000 MWh of other fuels was consumed by enterprises in the industrial sector of Vilnius city in 2019. The industrial sector is the main contributor to electricity consumption in the municipality. Many manufacturing and industrial buildings receive the lowest EPC ratings of F and G.

Main challenges and barriers identified:

- Difficulty attracting co-investment and support to the zone and the city with a sustainability-focussed business profile.
- Lack of an appropriately skilled workforce for modern industry.
- Need for further financial support to attract investment and create business synergies while ensuring appropriate environmental and municipal management standards.
- Insufficient energy efficiency initiatives in the industrial sector.
- Need to develop approached to management of post-industrial waste on private land.

GREEN CITY VISION AND STRATEGIC GOALS

6. Green City Vision and Strategic Goals

6.1 Structure

Figure 14 outlines the steps in developing the GCAP. To develop ambitious actions, it is essential to establish a clear vision, straightforward strategic goals, and specific mid-term targets.

Figure 14 Steps to develop the GCAP

Vilnius Green City Vision and Strategic Goals were developed and agreed during the Green City Vision and Strategic Goals workshop on 3rd July 2024.

6.2 Green City Vision

Ahead of the workshop, we reviewed the strategic documents of Vilnius and Lithuania to identify existing visions for sustainable development. Based on this analysis, a word cloud highlighting the most frequently used terms was created and presented to the workshop participants.

Figure 15 Word cloud - most frequently used terms in existing visions for Vilnius

The activities, exercises, and discussions in the workshop resulted in a final GCAP vision that will guide the implementation of GCAP actions and urban improvements that will be achieved over the next 15 years.

> ***We are creating a more comfortable and open Vilnius - the greenest capital of Europe - providing a healthy and happy life for everyone.***

6.3 Green City Strategic Goals

During a stakeholder engagement workshop hosted on 3rd July 2024, participants selected the most important environmental and sectoral goals. The foundation for the Goals and related Targets was based on the challenges identified during the baseline analysis. These strategic goals should be priorities for the next 10 years of development in Vilnius.

The city should focus on achieving climate neutrality by 2030, preserving biodiversity and green spaces, raising environmental awareness among residents and businesses, enhancing the city's resilience to the effects of climate change, improving traffic safety, and increasing the energy efficiency of buildings.

Figure 16 Green City Strategic Goals

Specific targets have been selected to support and measure the achievement of the identified strategic goals. These targets are based on the city's baseline and EBRD benchmarks showing how each sector's performance is expected to improve over 10 years (2025-2035), driven by the implementation of the GCAP actions.

The key prioritised targets were identified by internal stakeholders (representatives from the city and municipal companies) during the workshop. These targets are presented in the Table 4.

Table 4 Key prioritised targets

ENVIRONMENT	
Current state	**10-years target according to EBRD green benchmark**
ID 2. Biochemical Oxygen Demand BOD in rivers and lakes (2023)	
3.548 mg/L →	<2 mg/L
ID 9. Estimated economic damage from natural disasters floods droughts earthquakes etc. as a share of GDP (2022)	
1 % →	<0.5 % of GDP
ID 7.4 Connectivity of natural area (2020)	
30 % →	>60 % of natural area
ID 6.2 Share of population living within 400m of open green space of at least 0.5ha (2021)	
60 % →	>70 % of population
TRANSPORT	
Current state	**10-years target according to EBRD green benchmark**
ID 11.2. Motorisation rate (2023)	
0.514 vehicles per capita →	<0.3 vehicles per capita
ID 11.4. Kilometres of road dedicated exclusively to public transit per 100000 population (2023)	
7.532 km →	>40 km
ID 11. Transport modal share in commuting (2022)	
43,6 % →	<30 %
ENERGY	
Current state	**10-years target according to EBRD green benchmark**
ID 22.2. Share of district heating from carbon intensive sources (2023)	
31.94 % →	0 %* **in accordance with The Ten-Year Investment Plan for the Development Of The Heat Sector Of "Vilniaus Šilumos Tinklų" Company*
ID 21.2. Percentage of network line losses (2023)	
5.07 % →	<5 %
ID 23 Proportion of total energy derived from RES as a share of total city energy consumption in TJ (2022)	
27.09 % →	>27 % (target according to NZC Action Plan)
BUILDINGS	
Current state	**10-years target according to EBRD green benchmark**
ID 14. Electricity consumption in buildings (2019)	
78.45 kWh/m^2 →	<47 kWh/m^2
ID 15.1. Heating (fossil fuels) and cooling consumption in residential buildings (2019)	
158.73 kWh/m^2 →	<96 kWh/m^2
ID. 15. Heating (fossil fuels) and cooling consumption in residential buildings (2020)	
146.95 kWh/m^2 →	<104 kWh/m^2
LAND USE	
Current state	**10-years target according to EBRD green benchmark**
ID 33. Population density on urban land (2023)	
1450.06 res./km^2 →	7,000–20,000 residents/km^2
ID 34.1. Percentage of urban development that occurs on existing urban land rather than on greenfield land (2015)	
2.21 % →	>40 %
ID 33.1. Average commuting distance (2023)	
7.81 km →	>5 km
SOLID WASTE	
Current state	**10-years target according to EBRD green benchmark**
ID 30.2. Proportion of organic waste (2021)	
0.0004 % →	>20 %
ID 29. Total solid waste generation per capita (2022)	
340 kg/year/capita →	<300 kg/year/capita
WATER	
Current state	**10-years target according to EBRD green benchmark**
ID 27. Percentage of residential and commercial wastewater that is treated according to applicable national standards (2022)	
4.78 % →	>60 %
ID 27.1. Percentage of non-industrial buildings equipped to reuse grey water (2022)	
0 % →	>80 %

GREEN CITY ACTION PLAN

7. Green City Action Plan

7.1 General overview

After a thorough baseline analysis of the city of Vilnius and the definition of the vision and strategic goals, stakeholders reviewed and discussed the preliminary list of actions. As a result of these workshops, discussions and the active involvement of a wide range of stakeholders throughout the process, a comprehensive list of 28 GCAP actions has been jointly developed.

The actions present a plan for improving the city's environmental performance over a period of 1–5 years. GCAP actions are grouped into different categories such as policies, pre-investments, investments and other initiatives.

Each action is supported by a detailed description outlining its scope, justification and importance to the city's environment. In addition, the benefits and cost estimates associated with each action are presented. The analysis covers both positive environmental impacts and impacts on community wellbeing and sustainable development. The cost estimates provide insight into the financial implications, ensuring a realistic and balanced approach to implementation. Each action is described in detail on the following pages.

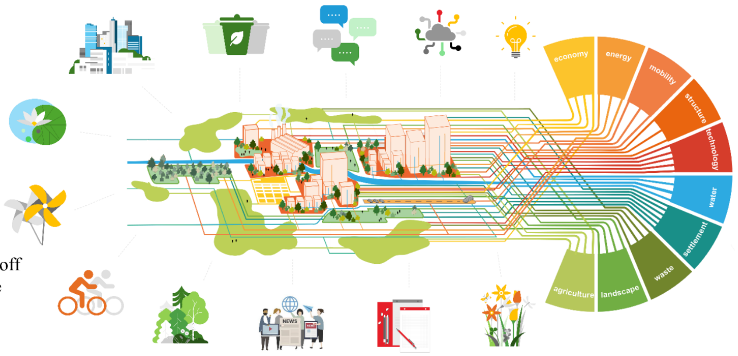
Figure 17 Workshop – Action Development Engagement

Figure 18 Workshop – Action Development Engagement

Solid waste – 5 actions
SW1 – Preventing waste generation through raising awareness and education
SW2 – Expanding the network of DĖK'UI stations
SW3 – Further introduction of DGASA (lt. Didelių gabaritų atliekų surinkimo aikštelės) – bulky waste collection sites
SW4 – Upgrade of the local MBT facility
SW5 – Developing a smart municipal waste management system

Energy – 5 actions
E1 – Enhancing the use of renewable energy sources (RES) in district heating
E2 – Enhancing the use of renewable energy sources (RES) in non-centralised heating systems
E3 – Reconstruction of heating networks
E4 – Building Renewable Energy Community
E5 – Developing a flexible energy storage system

Buildings – 5 actions
B1 – Upgrading municipal buildings and their systems
B2 – Promoting the modernisation of multi-apartment buildings
B3 – Integrate and enhance building condition and energy efficiency data
B4 – Promoting quarterly modernisation of residential buildings
B5 – Promoting panel modernisation of multi-apartment buildings



Water – 3 actions
W1 – Strengthen the city's resilience to surface water run-off
W2 – Power generation installations for water and sewage infrastructure facilities
W3 – Resilience of water supply system

Transport – 5 actions
T1 – Renewal and modernisation of public transport fleet and related infrastructure
T2 – Enhancing public transport routes efficiency
T3 – Expanding and integrating cycling infrastructure and pedestrian pathways
T4 – Development of infrastructure for multimodal points
T5 – Expansion of the network of public charging stations and charging points for electric cars

Land use – 5 actions
LU1 – Green streets and heat island – investment programme for decreasing perceptible temperature in summer
LU2 – Protection and restoration of valuable green areas
LU3 – Development of local plans and land use standards
LU4 – Redeveloping existing urban land to increase liveability
LU5 – Strengthening of the Public Participation in urban planning

Figure 19 Summary of GCAP actions

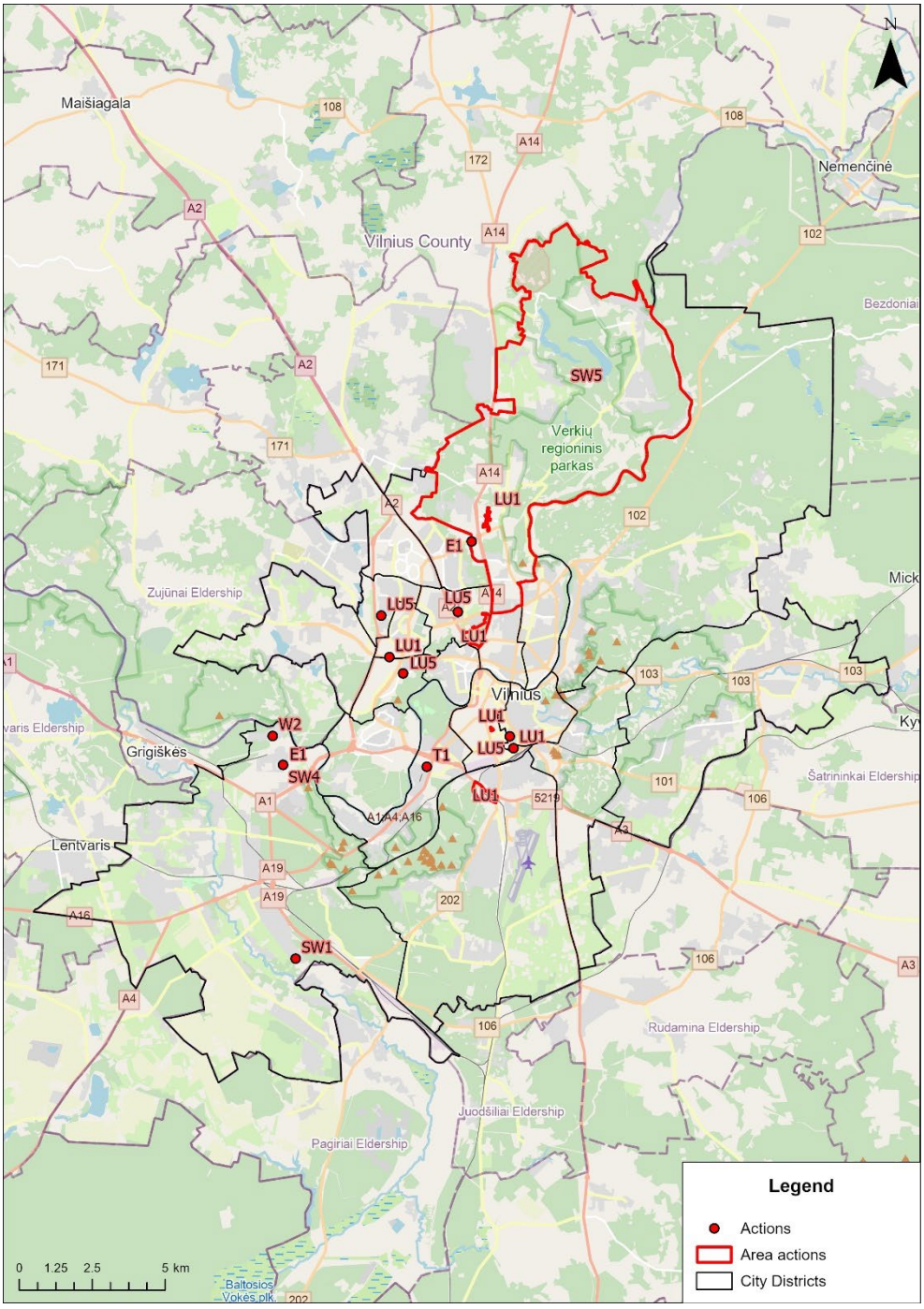


Figure 20 Indicative locations of proposed actions

7.2 Actions interconnections

To create a more sustainable and liveable city, it is crucial to understand the interdependent relationships between the actions. Some actions across sectors are interconnected and must collaborate effectively to create a cohesive urban space. The success of one action may rely on the effective implementation of others. A detailed overview of these connections is provided in the Table 4, highlighting the need for a holistic approach to urban sustainability in the city.

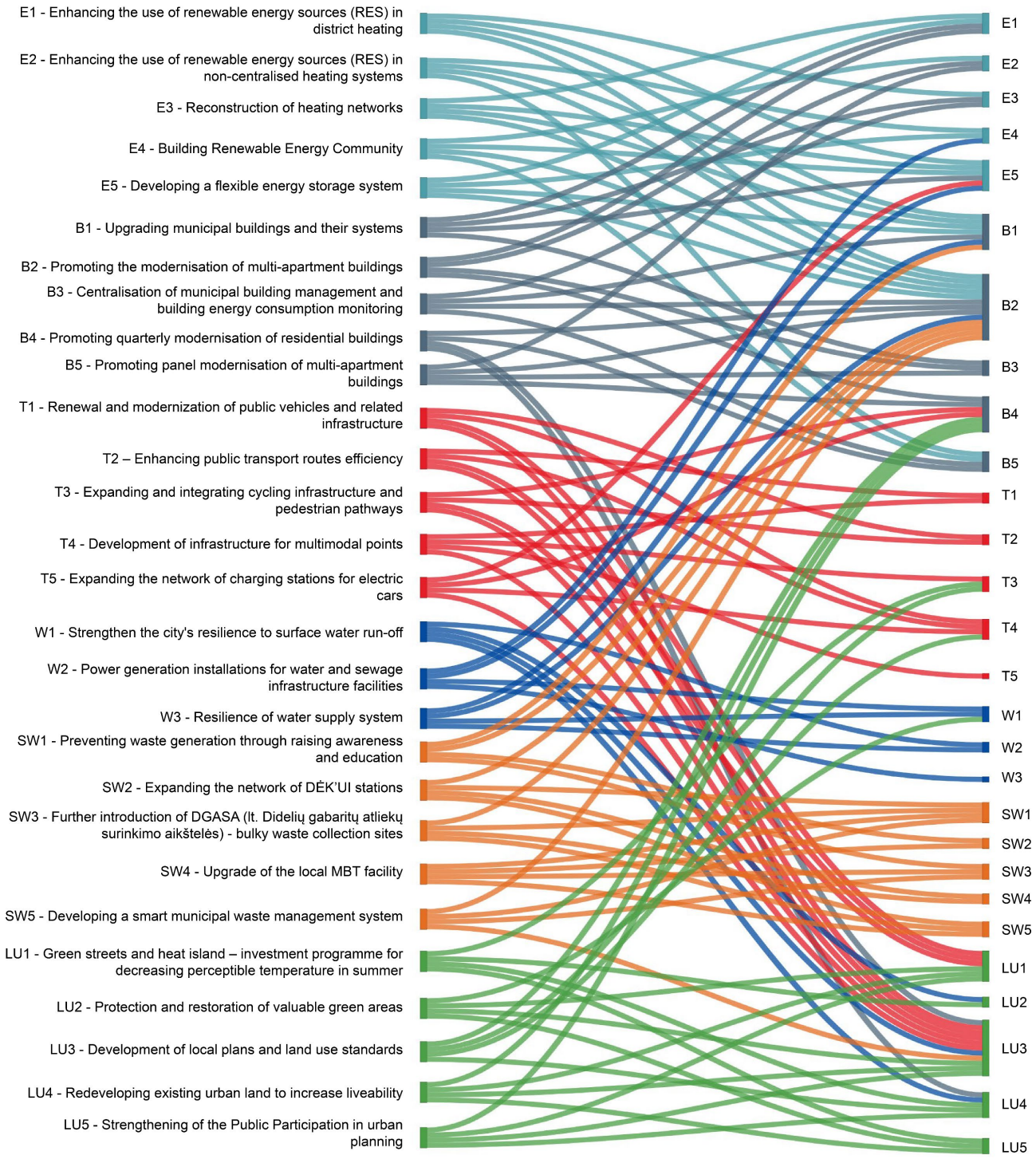


Figure 21 Actions interconnections

ENERGY

Summary of Action Plan – Energy

Five investment plans have been formulated with the aim of improving energy efficiency, facilitating the transition to clean energy, strengthening energy independence and increasing the city's resilience and sustainability.

Below is a summary of the planned actions for the energy sector.

Table 5 Summary of actions in the energy sector

E1 Enhancing the use of renewable energy sources (RES) in district heating
• Construction of the RK-8 boiler plant. • Construction of the RK-2 CHP plant. • Modernisation of 349 heat points (heat substations).
E2 Enhancing the use of renewable energy sources (RES) in non-centralised heating systems
• Funds for household/services/industry consumers – municipal expenditures on non-centralised heating to use more RES for heat generation. • Replacement of inefficient and polluting boilers. • Installation of 130 kW heat pump + 80 kWp solar plant in multi-apartment buildings.
E3 Reconstruction of heating networks
• Reconstruction of the district heating network (70km in total). • Implementation of digital twin in district heating system. • Installation of 64,320 smart hot water meters.
E4 Building Renewable Energy Community
• Development of RES in the Vilnius area (grants, loans, coverage of ineligible VAT values). • Marketing and promotion activities for the existing national grants programme. • Publicity and education campaigns.
E5 Developing a flexible energy storage system
• Conduct a feasibility study and select the appropriate technology for storing electricity generated from RES. • The implementation of a 10 MW energy storage pilot project with a capacity of 40 MWh.

Energy sector financing route

CapEx:

- €489,473,000

OpEx (annual):

- €4,599,000

Estimated cost savings (annual):

- €17,476,500

Potential sources of financing:

- Municipal budget
- State budget
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc.
- InvestEU
- REPowerEU
- Horizon Europe (Pillar II)
- The Innovation Fund
- Modernisation Fund
- NER 300 programme
- New Generation Lithuania: Component Green Transformation of Lithuania
- Programme for the European Union funds' investments in 2021–2027 (Policy objective 2. A greener Europe, Action 2.1 Promote energy efficiency and reduce greenhouse gas emissions
- Climate Change Program
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)
- LIFE Programme Clean Energy Transition sub-programme
- Private investors

Reduction of tCO_{2e} (annual):

- 386,041.80 tCO_{2e}

7.3 Actions in energy sector

Key Conditions

E1 Enhancing the use of renewable energy sources (RES) in district heating

The heat network of the city of Vilnius consists of 758 km of pipelines. Heat generation sources are operated by the network operator (heat supplier) VŠT and eight independent producers, which operate 11 individual heat generation sources and participate in heat auctions. The biggest supplier of district heating (DH) in Vilnius city is VŠT, which supplied 99.45% of the total heat energy to the DH in 2021. VŠT also manages smaller heat networks. In addition to the DH network, there are 10 district boiler houses, 23 individual boiler houses, three container boiler houses and two mobile boiler houses (used only in the case of network reconstructions).

The total thermal energy capacity (including peak and reserve units) of the energy plants in Vilnius is 1,417.6 MW, of which 507.6 MW is from RES (36% of the share of installed capacity). The DH system mainly uses biomass, municipal waste and natural gas. In 2022 the gas accounted for 25.6%.

In 2019, the share of energy from renewable sources in the DH system was 54.16% and increased to 68% (60.9% of RES and 7.2% of non-biodegradable municipal waste) in 2023 (due to the use of biofuel and waste-to-energy plants).

In addition, both the Vilniaus miesto savivaldybės administracija, VMSA, and the national government provide subsidies for individuals and businesses to connect to DH. In Vilnius, 349 heat points (heat substations) are connected to the DH network and require modernisation. The total capacity of the heat points is 115,255 kW.

E2 Enhancing the use of renewable energy sources (RES) in non-centralised heating systems

According to 2019 data from the Statistical Office, dwellings in urban areas were heated by DH systems (79.5%), DH from a local boiler house (0.8%) and individual heating (19.7%), with an average heated area of 62 m^2 and an average thermal energy consumption of 60.5 kWh per m^2. Thermal energy consumption is not measured in buildings not connected to a DH system.

In households, solid biomass is the main fuel used for heating (around 65%). In addition, according to the Building Product Certification Centre (SPSC, 2019), there are 850 buildings in the municipality that use heat pumps to produce heat (either as the main source of heat production or as an alternative source of heat production). The total heated area of these buildings is 653,972.17 m^2, with the greatest use of heat pumps in residential buildings.

According to the State Data Agency, about 20% of the population in Vilnius is not connected to DH. According to the Law on Renewable Energy of the Republic of Lithuania, by 2030 the share of heat produced from RES in the fuel balance of non-centralised household heating must be at least 80%. The Municipality of Vilnius would use various public/financial measures to encourage users of decentralised heating to switch to RES and would aim for a 90% share of RES in the fuel balance of decentralised heating. Several projects are planned to contribute to RES production and market balance, such as waste heat recovery, heat pumps and thermal energy storage. Subsidies for connection to DH systems are available both in the city of Vilnius and at the national level. A subsidy scheme is currently being implemented at the national level. Residents can receive financial support to replace inefficient biomass or fossil fuel boilers with more efficient renewable heat technologies in individual households not connected to a DH system.

E3 Reconstruction of heating networks

DH is supplied to the inhabitants of the city of Vilnius through 758 km of pipelines. The average age of a pipeline is 34 years, but in some places, it can be more than 70 years old, while the majority of heating pipelines were laid around 1985 (2023). The pipelines are being renovated to maximise the efficiency of the network (heat losses were 11.8% or 337 GWh in 2023). It is also important to note that, on average, the oldest networks are located in Žirmūnai near Laisvės Avenue, in the north-eastern part of the city near the Neris embankment (Žirmūnai and Antakalnio streets) and in the micro-district between Tukstantmečio and Dariaus ir Girėno streets.

The city estimates that VŠT will connect an average of 464,000 m^2 of new usable heated area per year. The density of DH consumption in the city is uneven, with the highest heat consumption concentrated in the central and residential areas, where the highest concentration of apartment buildings are located. It is also noticeable that in the southern zone of the city, where most of the heat production sources are concentrated,

consumption is low, while in districts such as Naujamiestis and Senamiestis, as well as in the area where Justiniškės, Fabijoniškės and Pašilaičiai sub-districts meet, the concentration of DH consumption is significantly higher.

E4 Building a Renewable Energy Community

In Vilnius, electricity from RES is produced in solar power plants, hydropower plants and a biogas plant. In terms of electricity generation, the municipality produced 96,373 MWh of electricity from RES in 2023. Vilnius Municipality operates three hydropower plants – Grigiškių, Rokantiškių and Vokės. Biomass power plants account for the largest share of electricity production – 92%, solar power plants – 3% and hydroelectric power plants – 4%. There are no producers using wind energy for electricity generation in the municipality.

Looking at the development of RES, the most influential development is that of solar power plants. Aerothermal, waste, solar, geothermal and solar energy have the highest potential. It is estimated that the economic potential (excluding centralised energy supply) is about 63% of the total energy demand of the municipality. Informing the public about the possibility of installing solar power plants within a community (as a producing consumer) or within a country (as a remote producer), and the benefits they can bring to energy efficiency in buildings, climate change mitigation and air pollution reduction, would be a prerequisite for accelerating the deployment of air source heat pumps (AHPs).

Fossil fuel heating systems (natural gas, diesel, coal, peat briquettes, etc.) can be replaced by a new biofuel boiler or heat pump with support from various funding programmes, depending on the current calls for support (e.g. Climate Change Programme). In addition, if the person receives public funding, 15% of the grant will be reimbursed by the municipality. This is important as the use of solid fossil fuels such as coal, lignite and peat will be banned in the municipality. This ban would apply to entities not connected to the DH network (households, service sector companies, etc.).

Residents have the opportunity to apply for a subsidy to purchase solar energy systems for their homes or from a remote power plant, with a maximum capacity of 10 kW. Additionally, the government provides various compensation measures for individuals transitioning to less polluting heating methods. One such measure includes a reimbursement of up to 85% of the costs for those who choose to replace fossil fuel boilers with renewable energy installations.

E5 Developing a flexible energy storage system

The total electricity production in the city in 2023 was 266,330 MWh, of which 96,373 MWh was generated from RES (36%). The total amount of electricity produced in Vilnius is only 13% of the total energy demand. The total energy consumption in the city in 2023 was 2,083 GWh.

Most of this electricity (94%) is produced by the CHP plant (VE-2) of VŠT, which also produces thermal energy by burning solid biomass. Electricity from RES is produced in solar power plants (installed capacity 6.3 MW and production 3,220 MWh – 3% of the total RES production), hydropower plants (installed capacity 830 kW and production 3,756 MWh – 4% of the total RES production) and a biomass plant (installed capacity 29 MW and production 89,098 MWh – 92% of the total RES production).

The city wants to expand its renewable energy generation but faces challenges such as, the energy storage needs to balance supply and demand (especially for renewables). These issues require investment in infrastructure, technology and regulation to ensure a reliable and sustainable electricity supply. Smart grid solutions can also help improve grid efficiency and security of supply. The city is also currently exploring the possibility of waste heat recovery from supermarkets, data centres, industrial plants and combined heat and power.

E1 Enhancing the use of renewable energy sources (RES) in district heating

Timescale
2025–2030

CapEx € 61,505,000
OpEx € 3,570,000

Action type
Investment – upgrade/retrofit

Part of the Climate City Contract Action Plan

Action description

AB “Vilniaus šilumos tinklai, VŠT” supplies heat energy to ~7,300 buildings, with a total heat energy consumption of about 2,408 GWh/year. Most of the consumed heat energy – 72.5% – is used for space heating. By 2026, around 80% of district heating will be produced from renewable energy sources (RES). By 2030, climate neutrality of district heating from RES is expected to be achieved. Combined Heat and Power (CHP) systems using RES are already replacing the use of environmentally polluting fuels for thermal energy production.

Two new biomass-fired boiler plants are planned to be in operation by 2030: the RK-8 boiler plant (planned capacity 25 to 60 MW) and the RK-2 CHP plant (planned capacity: 10 to 15 MW heat, and 2.6 to 3.0 MW electricity). These projects are also intended to contribute to renewable heat production and market balancing, such as the use of waste heat, the installation of heat pumps and thermal energy storage.

VŠT has invested €8 million in the most powerful absorption heat pump in the Baltic States – with an output of almost 9 MW. The system was put into operation in the 2024 heating season. The heat pump will increase the efficiency of the boiler plant and use waste heat, producing more than 17,000 MWh of additional energy annually and saving about €1,360,000. In addition, the heat pump will reduce the amount of CO_{2e} by almost 4,000 tons per year. The city is currently discussing a project, with the EBRD, related to the new air source heat pumps.

The Municipality of Vilnius intends to implement a programme for the modernisation of heating points (heating sub-stations), which supports the modernisation of these in multi-family houses and single-family houses (one and two-family houses) with a dependent system and the installation of balancing valves on heating and hot water risers. The intensity of the financial support can be up to 50%. To further support the district heating system, 349 heat points in the city will be upgraded.

A crucial aspect of implementing heat source modernisation projects is coordinating these efforts with building upgrades. This integrated approach is essential for maximising the effectiveness of the investments made.

Targeted results of the action and costs (CapEx)

Construction of the RK-8 boiler plant	€40,000,000
Construction of the RK-2 CHP plant	€18,500,000
Modernisation of 349 heat points (heat substations)	€3,005,000

Operational Costs (OpEx)

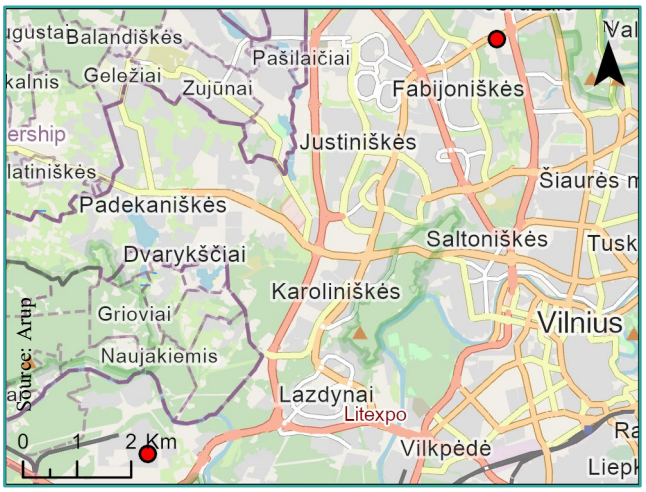
- Maintenance of the RK-8 boiler plant – €2,400,000
- Maintenance of the RK-2 CHP plant – €1,110,000
- Operating and maintenance cost of heat points – €60,000

City’s strategy / policy / plans

- Sustainable Energy and Climate Change Action Plan 2030
- Long-term strategy for Vilnius district heating networks 2021–2040
- Vilnius City Municipality Renewable Energy Action Plan 2030

Potential action location

RK-8 - Ateities st. 12 and RK-2 – Jočionių st. 13, Vilnius



Implementing body

AB “Vilniaus šilumos tinklai, VŠT”

Key supporting actors

Vilniaus miesto savivaldybės administracija, VMSA as the Approval authority

Supporting & relevant actions

- E3 Reconstruction of heating networks
- E5 Developing a flexible energy storage system
- B1 Upgrading municipal buildings and their systems
- B2 Promoting the modernisation of multi-apartment buildings

Potential sources of financing

- Municipal budget,
- Private sources through partnership with the city in the form of BOO, BOT, DBO, etc,
- InvestEU,
- Horizon Europe (Pillar II),
- The Innovation Fund,
- Modernisation Fund,
- NER 300 programme,
- New Generation Lithuania: Component Green Transformation of Lithuania,
- Climate Change Program,
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)
- LIFE Programme Clean Energy Transition sub-programme.

E1 Enhancing the use of renewable energy sources (RES) in district heating

Related Challenges

1. Difficulties in balancing energy supply and demand.
2. Ambitious climate neutrality targets necessitate rapid and substantial action on RES development in the city.

Directly addressed Strategic Goals

1. SGE1 Achieving the city's climate neutrality by 2030.
2. SGEN1 Scaling up renewable energy solutions and achieving energy efficiency and independence.

Supported Targets

1. ID 22.2. Share of district heating from carbon intensive sources – less than 10%
2. ID 23. Proportion of total energy derived from RES as a share of total city energy consumption in TJ – more than 27%

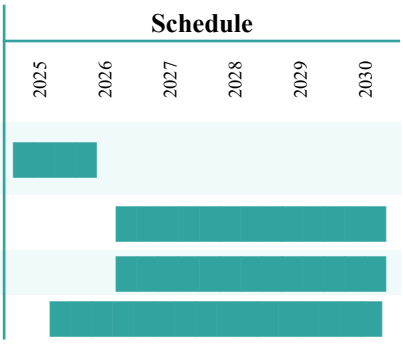
Projected benefits

✓ **Reduction of 312,184.39 tCO_2**
Climate City Contract Action Plan Estimations

✓ **Job creation potential: 200–300**

- ✓ Decreased reliance on imports
- ✓ Enhanced local energy security
- ✓ Stable and cost-effective energy solutions
- ✓ Fostered community engagement and sustainable practices
- ✓ Enhanced efficiency, reduced energy waste and expenses
- ✓ Improved system reliability and performance
- ✓ Affordable and stable heating solutions
- ✓ Resilience against heating disruptions
- ✓ Reduced waste and landfill use

Milestones



1	Obtaining the appropriate documentation and permits to commence construction of the new energy plants (RK-8 boiler plant and RK-2 CHP plant)
2	Construction of the RK-8 boiler plant
3	Construction of the RK-2 CHP plant
4	Modernisation of heat points

Smart City Potential

- The use of Geographical Information System (GIS) technology will enable the mapping and analysis of the city's infrastructure and energy sources. Coupled with data on renewable energy potential (wind, solar, geothermal), GIS can help identify suitable places for investment.
- Substations are a key component in the development of the city's smart grid system. This system could optimise energy use, improve grid resilience and facilitate the integration of RES.
- Further investments can involve a digital thermal management system, which would facilitate the integration of diverse renewable energy resources.

Gender Equality and Social Inclusion

- Ensure that employment opportunities during construction and operation are inclusive, especially for underrepresented groups. This approach can also help alleviate energy poverty among vulnerable groups by providing them with stable income that can improve access to a reliable energy services.
- Targeted recruitment campaigns for women are a key strategy. Partnerships with local educational institutions and technical schools can create a pipeline of female talent for the renewable energy sector. In addition, working with organisations that support women in STEM can provide mentorship and resources, further empowering women to succeed in the field.

E2 Enhancing the use of renewable energy sources (RES) in non-centralised heating systems

Timescale
2025–2030

CapEx € 43,345,000
OpEx € –

Action type
Investment – upgrade/retrofit

Part of the Climate City Contract Action Plan

Action description

While efficiency measures will reduce pollution and deliver economic benefits for the city, a transition away from fossil fuels is still necessary to deliver clean air in Vilnius and to reduce the city's contribution to rising global GHG emissions. According to the Lietuvos energetikos agentūra, €118,200,000 is to be allocated for the replacement of inefficient and polluting boilers over a six years period (ending in Q3 2029). The municipality provides additional subsidies for the replacement of polluting boilers in households or for connection to district heating (DH). The supportive policy environment for shifting away from fossil fuel heating, both at the local and state level, has a significant impact on the transition.

As part of the GCAP actions, it is important to implement dedicated activities aimed at counteracting energy poverty through fees, subsidies, and discounts. Actions should not create solutions that exclude any user groups but rather create equal opportunities (climate justice) and increase inhabitants' awareness of energy consumption (monitoring and targeting).

The total budget allocated by the state to the project includes expenditures for non-centralised heating to use more RES for heat generation and production across different sectors:

- Household consumers: €163,771,500 (32,430 buildings not connected to district heating).
- Service sector: €158,937,000 (1,709 buildings not connected to district heating).
- Industry sector: €75,348,000 (1,932 buildings not connected to district heating.)

The city's budget also represents significant value in the implementation of the overall project.

There is also a state programme that will support the replacement of inefficient biomass or fossil fuel boilers in single-family houses with class 5 biofuel boilers or ground-water, water-water and air-water heat pumps. Vilnius is participating in this programme and has received funds to distribute.

A crucial aspect of implementing heat source modernisation projects is coordinating these efforts with building upgrades. This integrated approach is essential for maximising the effectiveness of the investments made

Targeted results of the action and costs (CapEx)

Funds for household consumers – municipal expenditures on non-centralised heating to use more RES for heat generation	€16,377,000
Funds for service sector – municipal expenditures on consumers in the non-centralised heating to use more RES for heat generation	€15,894,000
Funds for industry sector – municipal expenditures on consumers in the non-centralised heating to use more RES for heat production	€7,535,000
Replacement of inefficient and polluting boilers	€3,539,000
Installation of 130 kW heat pump + 80 kWp solar plant in multi-apartment buildings (selection of appropriate capacities depending on the individual building)	€117,400 per 1 building

Potential action location

To be identified

Source: unsplash.com

Implementing body

Vilniaus miesto savivaldybės administracija, VMSA

Key supporting actors

AB "Vilniaus šilumos tinklai, VŠT" as the Approval authority

Supporting & relevant actions

E4 Building Renewable Energy Community

B1 Upgrading municipal buildings and their systems

B2 Promoting the modernisation of multi-apartment buildings

B5 Promoting panel modernisation of multi-apartment buildings

Potential sources of financing

- InvestEU,
- Horizon Europe (Pillar II),
- The Innovation Fund,
- Modernisation Fund,
- NER 300 programme,
- New Generation Lithuania: Component Green Transformation of Lithuania,
- Climate Change Program,
- Programme for the European Union funds' investments in 2021–2027 (Policy objective 2. A greener Europe, Action 2.1 Promote energy efficiency and reduce greenhouse gas emissions.
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)

City's strategy / policy / plans

- Sustainable Energy and Climate Change Action Plan 2030
- Long-term strategy for Vilnius district heating networks 2021–2040

E2 Enhancing the use of renewable energy sources (RES) in non-centralised heating systems

Related Challenges

1. Difficulties in balancing energy supply and demand.
2. Lack of data on buildings not connected to the district heating network.

Directly addressed Strategic Goals

1. SGE1 Achieving the city's climate neutrality by 2030.
2. SGEN1 Scaling up renewable energy solutions and achieving energy efficiency and independence.

Supported Targets

1. ID 23. Proportion of total energy derived from RES as a share of total city energy consumption in TJ – more than 27%
2. ID 15. Heating (fossil fuels) and cooling consumption in buildings – less than 104 kWh/m^2

Projected benefits

✓ **Reduction of 70,180.41 tCO_2**
Climate City Contract Action Plan Estimations

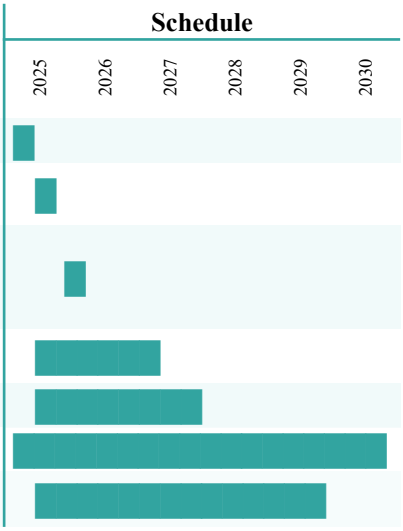
✓ **Job creation potential: 5–10**

- ✓ Energy transition
- ✓ Decreased reliance on imports and enhanced local energy security
- ✓ Stable and cost-effective energy solutions
- ✓ Fostered community engagement and sustainable practices

Estimated cost savings (EUR per year)

- ✓ Socio-economic savings due to reduction of negative impact on Vilnius (mainly due to pollution from inefficient biofuel boilers and fossil fuel boilers) – €9,078,000

Milestones



1	Conduct a needs assessment of the current heating system in non-centralised areas.
2	Secure funding and allocate a budget for the subsidy program.
3	Launch a campaign and promote awareness-raising information on the possibility of obtaining additional funding for investment in the replacement of a heat source in a building not connected to a district heating network.
4	Open the application period and provide support for applicants.
5	Review applications and approve eligible candidates.
6	Installation of 130 kW heat pump + 80 kWp solar plant in multi-apartment buildings
7	Facilitate the installation of RES by coordinating with approved installers.

Smart City Potential

- Creation of a virtual "one-stop shop" for all fund information. Digital platforms (including adaptation of existing ones) to facilitate customer access to funds and subsidies information and the virtual submission of applications.
- Investments in this fund should support:
  - Efficient heat pumps with smart controls which can adapt to external temperatures and demand to heat homes with renewable energy.
  - Furthermore, advanced thermal storage systems store excess renewable heat for use during peak demand (Action E5 – Developing a flexible energy storage system).
  - IoT integrated CHP systems generate heat and electricity efficiently, increasing the use of RES in decentralised heating systems.
- In addition, the city could invest in smart grids and VPPs, which integrate decentralised renewable energy installations to balance energy supply and demand, increasing system efficiency and stability.

Gender Equality and Social Inclusion

- Ensure that clean energy projects are truly inclusive and to promote equality and diversity in decision-making. This means actively involving a wide range of voices in shaping these projects.
- One effective approach is to target subsidies and financial support to single-parent and low-income households, making clean energy more accessible to those who need it most. This can include offering targeted tariff reductions and subsidies specifically for single-parent households.
- Public awareness campaigns are also crucial. By focusing on female-headed households, the elderly, and other underserved groups, we can ensure their access to the necessary information, technology, and subsidies.
- In addition, developing financial literacy workshops for women, especially those in low-income households or informal employment, can empower them to make informed decisions about clean energy.
- Involving women in the consultation process is an important step. This initiative helps address the specific time and care burdens often faced by women and ensures that their needs and perspectives are considered in the planning and implementation of clean energy projects.

E3 Reconstruction of heating networks

Timescale
2025–2030

CapEx € 156,500,000
OpEx € 396,300

Action type
Investment – upgrade/retrofit

Part of the Climate City Contract Action Plan

Action description

The reconstruction of the heat network is projected to reduce its loss rate to 11.2% by 2025 and further to 9.5% by 2030. Each year, the VŠT undertakes the reconstruction of approximately 10 km of heat networks. For these works, VŠT annually allocates around €20,000,000. These investments are necessary to facilitate the operation of the network at lower temperatures, which increases the ability of the system to use renewable and waste heat-based sources.

It is also recommended to conduct thermal aerial scanning to identify the main sources of heat loss and prioritise their upgrading. Thermal imaging of a district heating network is the most reliable and proven method of detecting and locating heat losses. The source of key issues can relate to various defects or failures in the thermal insulation, as well as leaks.

The modernisation of the operation of the heating networks will be implemented through the following measures:

1. Deployment of smart meters;
2. Applying the principles of the digital twin.

Smart meters are already being used in the district heating system. Currently, about 189,200 remotely readable smart meters for hot water of VŠT have been installed in the city of Vilnius. There is a risk that parts of the network may not be fully compatible with digital solutions, which can cause inconsistencies in monitoring and optimising energy efficiency across the city. For this reason, a periodical upgrade of all networks needs to be maintained. This tool, integrated with the digital twin, will help improve the efficiency of the whole network; the aim is to have a digitalised management system for the whole integrated network. By 2025, it is planned to reach 40% of hot water meters read via the VŠT IoT platform (% of total). In 2028, 100% of smart water meters should be installed (the exact number is not yet known).

Extensive use of digital twin technology in the Vilnius city district heating system is planned, with its application anticipated to increase energy efficiency by about 20%.

Targeted results of the action and costs (CapEx)

Reconstruction of the district heating network (70km in total)	€140,000,000
Implementation of digital twin in district heating system	€1,200,000
Installation of 64,320 smart hot water meters	€15,300,000

Operational Costs (OpEx)

- Maintenance of a new 70km district heating network – €249,800
- Maintenance of a digital twin – €12,000
- Maintenance costs of the new smart hot water meters – €134,500

City's strategy / policy / plans

- Sustainable Energy and Climate Change Action Plan 2030
- Long-term strategy for Vilnius district heating networks 2021–2040
- Vilnius City Municipality Renewable Energy Action Plan 2030

Potential action location

To be identified

Source: unsplash.com

Implementing body

AB "Vilniaus šilumos tinklai, VŠT"

Key supporting actors

Vilniaus miesto savivaldybės administracija, VMSA as the Approval authority

Supporting & relevant actions

- E1 Enhancing the use of renewable energy sources (RES) in district heating
- E5 Developing a flexible energy storage system
- B1 Upgrading municipal buildings and their systems
- B2 Promoting the modernisation of multi-apartment buildings

Potential sources of financing

- InvestEU,
- Modernisation Fund,
- Programme for the European Union funds' investments in 2021–2027 (Policy objective 2. A greener Europe, Action 2.1 Promote energy efficiency and reduce greenhouse gas emissions,
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc,
- LIFE Programme Clean Energy Transition sub-programme,
- Modernisation Fund,
- New Generation Lithuania: Component Green Transformation of Lithuania.

E3 Reconstruction of heating networks

Related Challenges

1. Lack of data on buildings not connected to the district heating network.
2. Topographical conditions and terrain in the northern part of Vilnius significantly limit the development of district heating systems within the city.

Directly addressed Strategic Goals

1. SGE1 Achieving the city's climate neutrality by 2030.
2. SGEN1 Scaling up renewable energy solutions and achieving energy efficiency and independence.

Supported Targets

1. ID 15.1. Heating (fossil fuels) and cooling consumption in residential buildings – less than 96 kWh/m^2
2. ID 15. Heating (fossil fuels) and cooling consumption in buildings – less than 104 kWh/m^2

Projected benefits

✓ **Reduction of 2,620 tCO_2**
Climate City Contract Action Plan Estimations

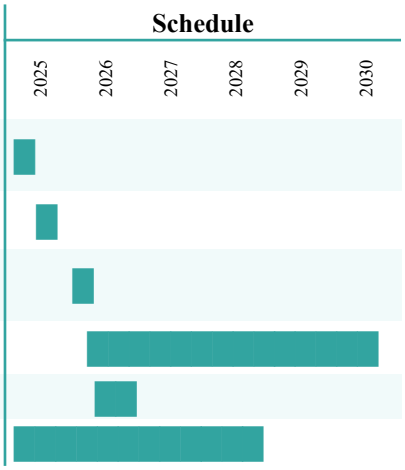
✓ **Job creation potential: 10–15**

- ✓ Energy security
- ✓ Enhanced network efficiency, reduced energy waste and costs
- ✓ More affordable and stable heating solutions
- ✓ Bolstered community resilience against disruptions and climate impacts
- ✓ Improved network reliability and responsiveness
- ✓ Increased resilience against disruptions with digital systems

Estimated cost savings (EUR per year)

- ✓ Savings related to district heat loss – €5,572,000
- ✓ A combination of factors contribute to losses of up to – €1,000,000. The causes of this includes; leaks, accounting errors, accidents and possibly fraud.
- ✓ Digitising meter readings in wells and buildings – €400,000

Milestones



1	Conduct a detailed assessment of the current district heating network to identify weaknesses and areas needing reconstruction.
2	Develop detailed engineering designs and specifications for the new district heating network.
3	Conduct environmental and social impact assessments to understand the potential effects of the reconstruction.
4	Carry out the reconstruction of the district heating network according to the detailed design.
5	Installation of digital twin in district heating systems.
6	Installation of smart hot water metres.

Smart City Potential

- The installation of smart hot water meters with remote readability across Vilnius will enable the real-time monitoring of consumption, thereby enhancing data-driven decision-making.
- The refurbishment of the network will include the installation of SCADA (Supervisory Control And Data Acquisition), flow, temperature and pressure sensors at the pumping stations and a complete GIS mapping of the network. Combined with a thermal management system, this will allow VŠT to create a digital twin of the network.
- The VŠT IoT platform will be expanded to enable real-time data collection and management of smart meters.
- The creation of a thermal energy management system will enable the best design and integration of various renewable energy resources. The district heating system with intelligent control system allows continuous monitoring, control and management of the entire heat supply and demand, ensuring high efficiency and reliability.

Gender Equality and Social Inclusion

- To foster a more inclusive approach in the reconstruction and modernisation of the heating network, it is essential to ensure equality and diversity in decision-making roles. This involves actively promoting diverse representation in key positions. Encouraging female leadership in project management, construction oversight and implementation is a crucial step. Providing mentorship programs for women in technical and management roles can help achieve this goal, empowering more women to take on leadership positions.
- Offer equal opportunities for all workers to participate in technical training. This ensures that everyone has the chance to develop the necessary skills for these advanced technologies. Additionally, ensuring equal representation in educational programs about digital twin technology and its impact on energy efficiency can further promote inclusivity.
- Targeted outreach to single-parent households can highlight the benefits and usage of smart meters, supporting the improvement of energy management.

E4 Building Renewable Energy Community

Timescale
2025–2030

CapEx € 211,530,000
OpEx € 222,700

Action type
Investment – new

Action description

The creation of a Renewable Energy Community, a legal entity that brings together public, business and civic initiatives in the field of renewable energy. It advocates for the transition from fossil fuels to cleaner, locally-produced renewable energy, prioritising people, their needs and increasing public acceptance of renewable energy projects. This action should leverage the reduction of energy poverty in communities. The Community could encourage people to use energy from RES by establishing an information and advice centre. This centre will provide information on project applications and funding opportunities for replacing solid fuel boilers with heat pumps, installing solar power plants, and more.

The Renewable Energy Community operation assumes a connection with the National Energy and Climate Action Plan, which includes the introduction of a system of subsidies for residents and businesses to support the installation of new renewable energy systems. The planned operating grants system amounts to €78.5 million. An estimated loan of €95.9 million, excluding VAT, is needed from REPowerEU to develop 155 MW of RES for electricity generation. Additionally, the state budget will cover the VAT ineligible from REPowerEU funds, which totals €36.6 million. The financing scheme includes a grant of up to 45% and a loan of up to 55% of the investment value. It is important to create a transparent and clear regulatory framework for the operation of funds and subsidies.

In order to support this initiative, it is recommended to create a city-managed Sustainable Energy Investment Fund for Vilnius that can attract donors to support a targeted programme in the city. The main objective of this fund is to mobilise capital from the private/business sector to implement climate-related actions. This will make it possible to financially support small-scale climate change initiatives. Ideas for these projects will be open to urban communities, businesses and other stakeholders. The fund foreseen by the initiative would cover the costs of projects meeting certain criteria (potential to reduce GHG emissions, energy, etc.), including investments related to the development and modernisation of energy infrastructure. The Sustainable Energy Investment Fund would have the possibility to raise funds from external sources: crowdfunding and external investors. In addition, the City could use private capital to create a component of the fund focused on innovation by small and medium-sized enterprises, based on the experience of the Paris Green Fund.

Public involvement and education are vital for renewable energy adoption. The city should actively engage the community and raise awareness to ensure social preparedness and support for renewable energy initiatives.

Targeted results of the action and costs (CapEx)

Development of RES in the Vilnius area (grants, loans, coverage of ineligible VAT values)	€211,000,000
Marketing and promotion activities for the existing national grants programme	€10,000
Publicity and education campaigns	€520,000

Operational Costs (OpEx)

- 5 FTEs to serve applicants – €120,000

Sustainable Energy Investment Fund:

- Costs of personnel – €38,160
- Costs of subcontracting – €55,000
- Indirect costs – €9,540

City's strategy / policy / plans

- Sustainable Energy and Climate Change Action Plan 2030
- Long-term strategy for Vilnius district heating networks 2021–2040
- Vilnius City Municipality Renewable Energy Action Plan 2030

Potential action location

To be identified

Implementing body

Vilniaus miesto savivaldybės administracija, VMSA

Key supporting actors

- Lietuvos energetikos agentūra as the Regulator
- AB "Vilniaus šilumos tinklai, VŠT" as the Implementing partner
- UAB "Vilniaus kogeneracinė jėgainė" as the Consultant
- UAB "Vilniaus vandenys" as the Consultant

Supporting & relevant actions

- E2 Enhancing the use of renewable energy sources (RES) in non-centralised heating systems
- E5 Developing a flexible energy storage system
- B2 Promoting the modernisation of multi-apartment buildings
- B5 Promoting panel modernisation of multi-apartment buildings

Potential sources of financing

- Municipal Budget,
- Horizon Europe (Pillar II),
- Modernisation Fund,
- New Generation Lithuania: Component Green Transformation of Lithuania,
- REPowerEU,
- Climate Change Program,
- The National Energy and Climate Action Plan,
- a loan from REPowerEU,
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc,
- State Budget,
- Private and institutional investors.

E4 Building Renewable Energy Community

Related Challenges

1. Ambitious climate neutrality targets necessitate rapid and substantial action on RES development in the city.
2. Difficulties in balancing energy supply and demand.

Directly addressed Strategic Goals

1. SGE1 Achieving the city's climate neutrality by 2030.
2. SGEN1 Scaling up renewable energy solutions and achieving energy efficiency and independence.

Supported Targets

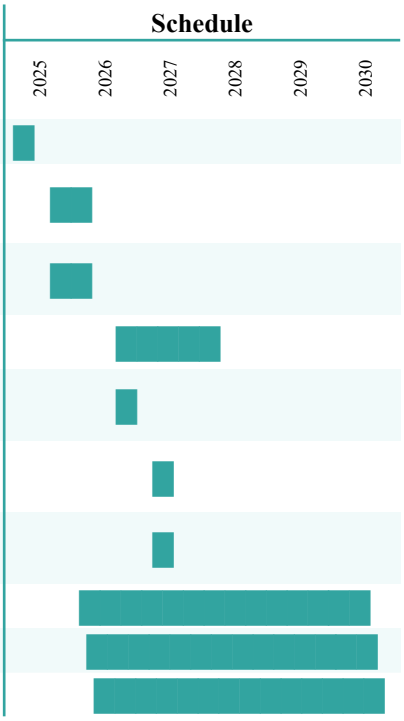
1. ID 14. Electricity consumption in buildings – less than 47 kWh/m^2
2. ID 23. Proportion of total energy derived from RES as a share of total city energy consumption in TJ – more than 27%

Projected benefits

✓ **Job creation potential: 5–10**

- ✓ Promoted sustainable energy practices
- ✓ Reduced dependence on fossil fuels
- ✓ Achieved long-term cost savings through reduced energy expenses
- ✓ Driven innovation in renewable energy and sustainable infrastructure
- ✓ Empowered residents to shape their energy future and strengthen local resilience
- ✓ Mobilised private capital for climate action initiatives
- ✓ Supported small-scale projects and fostered local climate action
- ✓ Established framework for evaluating and implementing climate projects

Milestones



1. Analyse the legal and regulatory requirements for establishing and operating the fund.
2. Identify and secure initial funding sources, including government grants, private investments, and institutional investors.
3. Publicity and education campaigns - engage with stakeholders, including potential investors, project developers, and community organisations, to gather input and build support for the fund.
4. Launch a marketing and outreach campaign to attract investors and promote the fund.
5. Conduct a comprehensive assessment to understand the community's renewable energy needs and potential.
6. Engage with stakeholders, including residents, businesses, and community organisations, to gather input and address concerns.
7. Launch a campaign and promote awareness-raising information on the possibility of obtaining additional funding for investment in the RES.
8. Open the application period and provide support for applicants.
9. Review applications and approve eligible candidates.
10. Facilitate the installation of RES by coordinating with approved installers.

Smart City Potential

- A dedicated digital platform should be developed to manage net billing and net metering of energy production and consumption. This platform would provide a comprehensive, user-friendly interface for tracking energy production, consumption and transactions within the community. It should be hosted on a secure, scalable cloud infrastructure and provide key features such as real-time energy monitoring, data analysis and user account management. The platform could also integrate peer-to-peer (P2P) energy trading solutions, allowing community members to buy and sell excess energy directly, without the need for intermediaries, increasing both transparency and cost-effectiveness.
- In addition, an Action E5 – Developing a flexible energy storage system could support the overall energy balance by storing excess energy and optimising its use across multiple households. Intelligent balancing technologies would be integrated to manage energy flows at building, district or city level, ensuring low-cost charging and sustainable energy use. This approach would reduce dependence on external suppliers and improve energy resilience across the community.

Gender Equality and Social Inclusion

- Ensure equal participation and leadership in governance and decision-making processes. This means not only encouraging women to participate but also supporting them in taking on leadership roles within the community.
- Creating targeted financial mechanisms for women entrepreneurs or companies led by women is a key strategy. These mechanisms can encourage more investment in renewable energy projects, fostering a diverse and dynamic energy sector.
- Raising awareness about the importance of women's participation. Media campaigns that highlight successful stories of women-led energy projects can inspire and motivate others, showcasing the significant impact women can have in this field.

E5 Developing a flexible energy storage system

Timescale
2025–2029

CapEx € 16,593,000
OpEx € 410,000

Action type
Investment – pilot

Action description

Electricity system flexibility and balancing services are important factors in ensuring the reliability and efficiency of electricity supply. They are particularly important in the Baltic countries – Lithuania, Latvia and Estonia – as they seek to integrate into the European single electricity market and ensure the smooth flow of electricity between countries. Vilnius is experiencing a rapid increase in demand for electricity, as well as an increase in the supply of energy production facilities. Without energy storage and the challenges of balancing supply and demand, the transition to renewable energy and energy efficiency is hindered, perpetuating dependence on fossil fuels and contributing to environmental degradation.

Currently, the UAB "Energy Cells" is installing and integrating into the Lithuanian energy system a system of four energy storages (batteries), the total cumulative power and capacity of which will reach 200 MW and 200 MWh. UAB "Energy Cells" will install four energy storage devices with a power of 50 MW and a capacity of 50 MWh in the substations of Vilnius, Šiauliai, Alytus and Utena. It is the largest in the Baltic States and one of the largest projects of its kind in Europe.

An interdisciplinary feasibility study should be developed for a hybrid surplus energy storage system for a pumped storage power plant and other storage technologies (both for electricity and heat energy). Pumped storage technology involves converting electricity into potential gravity energy by pumping water from the lower to the upper reservoir during periods of excess production and reversing the process during peak hours allowing the stored water to generate electricity. It is also important to ensure that electricity can be stored on-site (energy storage – lithium-ion batteries) or used immediately. Installing photovoltaic panels on buildings located in the city's oldest districts would help to provide an alternative source of power for residents and would be the most effective solution in terms of reducing CO_2 emissions (combined with the replacement of low-efficiency heat sources in residential buildings). Solar energy from the photovoltaic panels could also be secured in energy storages and then used to power the electric vehicle charging hubs.

In parallel, the city's district energy infrastructure offers significant potential for further optimisation through the use of large-scale thermal energy storage systems. By incorporating power-to-heat technologies, excess electricity generated during periods of low demand can be converted into thermal energy via electric boilers or heat pumps and stored in thermal energy storage units.

A potential and disruptive technology that could be implemented in the future through the development of solar power generation sources within the city, could be the use of electrolysers to produce green hydrogen. The high-pressure technology for hydrogen production operates at low voltage, allowing integration with photovoltaic installations.

Targeted results of the action and costs (CapEx)

Conduct a feasibility study and select the appropriate technology for storing electricity generated from RES	€200,000
The implementation of a 10 MW energy storage pilot project with a capacity of 40 MWh	€16,393,000

Operational Costs (OpEx)

- Operating and maintenance costs of energy storage – €410,000

City's strategy / policy / plans

- Sustainable Energy and Climate Change Action Plan 2030
- Vilnius City Municipality Renewable Energy Action Plan 2030

Potential action location

To be identified


Source: unsplash.com

Implementing body

Vilniaus miesto savivaldybės administracija, VMSA

Key supporting actors

- AB "Energijos skirstymo operatorius, ESO" as the Operator
- AB "Litgrid" as the Operator
- AB "Ambergrid" as the Operator

Supporting & relevant actions

- E1 Enhancing the use of renewable energy sources (RES) in district heating
- E4 Building Renewable Energy Community
- B1 Upgrading municipal buildings and their systems
- B2 Promoting the modernisation of multi-apartment buildings

Potential sources of financing

- InvestEU,
- Horizon Europe (Pillar II),
- The Innovation Fund,
- Modernisation Fund,
- NER 300 programme,
- New Generation Lithuania: Component Green Transformation of Lithuania,
- Climate Change Program,
- Programme for the European Union funds' investments in 2021–2027 (Policy objective 2. A greener Europe, Action 2.1 Promote energy efficiency and reduce greenhouse gas emissions,
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.).
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc.

E5 Developing a flexible energy storage system

Related Challenges

1. Difficulties in balancing energy supply and demand.
2. Lack of sufficient renewable energy storage systems pose challenges in scaling-up renewable energy solutions and achieving energy-efficiency.

Directly addressed Strategic Goals

1. SGE1 Achieving the city's climate neutrality by 2030.
2. SGEN1 Scaling up renewable energy solutions and achieving energy efficiency and independence.

Supported Targets

1. ID 21.2. Percentage of network line losses – less than 5%
2. ID 23. Proportion of total energy derived from RES as a share of total city energy consumption in TJ – more than 27%

Projected benefits

✓ **Reduction of 1,057.00 tCO_2**
Green City Action Plan Estimations

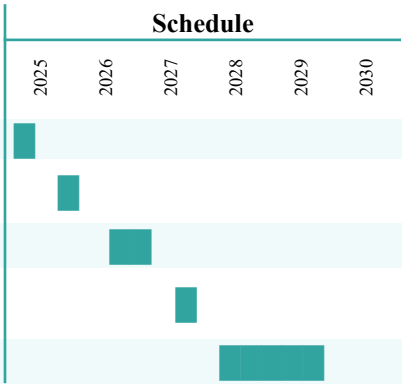
✓ **Job creation potential: 25–50**

- ✓ Balanced supply and demand
- ✓ Improved reliability
- ✓ Excess renewable energy stored for use during low generation
- ✓ Reduced costs by avoiding expensive peak power plants
- ✓ Minimised energy wastage
- ✓ Reliable backup power during outages
- ✓ Reduced dependency on external energy with locally stored energy

Estimated cost savings (EUR per year)

- ✓ Electric producers can avoid the cost of maintaining sufficient generation capacity to meet peak demand (plus a reserve margin) by discharging batteries during periods of high demand, and charging them during periods of low demand – €1,426,500

Milestones



1	Conduct a comprehensive assessment of the current energy infrastructure and demand patterns.
2	Evaluate different energy storage technologies to determine the most suitable option.
3	Develop detailed engineering designs and specifications for the energy storage system.
4	Conduct environmental and social impact assessments to understand the potential effects of the energy storage system.
5	Carry out the construction of the energy storage system according to the detailed design.

Smart City Potential

- Energy management systems (EMS), can be used to control stored electricity and manage generated electricity from renewable sources.
- To optimise the efficiency of new RES sources (PV systems), a sensor architecture can be equipped with voltage, current, irradiance, temperature, and inertia sensors for monitoring of a RES system. These sensors can utilise a wireless communication system. The sensors can also detect critical faults, such as temporary and permanent shadowing, contamination and anomalous ageing, which can then be addressed to shorten the return on investment.
- Operation and maintenance (O&M) technologies for battery storage systems include real-time monitoring and diagnostics tools to track battery performance, state of charge (SoC), state of health (SoH), and temperature management. Advanced sensor networks, often utilising LoRaWAN (Long Range Wide Area Network) technology, can enhance wireless communication and data transmission over long distances with low power consumption. It can detect issues such as overcharging, overheating, or capacity degradation. By integrating these sensors with a wireless communication system and analytics platform, critical faults like cell imbalances, thermal runaways, and degradation due to aging can be identified early.

Gender Equality and Social Inclusion

- Provide equal opportunities for employees in technical roles related to the development and management of these technologies.
- Energy storage systems present new job opportunities in emerging technologies. To ensure women benefit from these opportunities and to create scholarship programs specifically aimed at women pursuing engineering degrees or certifications in energy storage technologies.
- Developing a career advancement programme for women working in the energy sector is another key strategy. This programme can offer on-the-job training, mentorship, and leadership development opportunities, in partnership with universities and technical institutes.
- Promoting work-life balance policies is also important. Providing on-site childcare services for parents working in energy storage facilities, along with flexible working hours and telecommuting opportunities, can help retain more women in technical roles.

BUILDINGS

Summary of Action Plan – Buildings

The five investments have been designed to enhance the quality of life for residents, improve the energy efficiency of buildings and mitigate energy poverty. Collectively, these investments will bolster the resilience of the city's building infrastructure and reduce energy consumption in both heating and electricity.

Below is a summary of the planned actions for the buildings sector.

Table 6 Summary of actions in the buildings sector

B1 Upgrading municipal buildings and their systems
• Upgrading of all existing municipal buildings that are currently below energy efficiency class B owned by the Vilnius Municipality by 2030 (972,731 m²).
B2 Promoting the modernisation of multi-apartment buildings
• Renovation 2.4k multi-apartment buildings. • Publicity and education campaign, marketing and promotion activities to help implement the existing multi-apartment modernisation program.
B3 Integrate and enhance building condition and energy efficiency data
• Installation of a centralised automatic system for reading and analysing building meters and readings. • Establish framework and systematic approach for the use of Building Information Modelling (BIM) in the maintenance phase of construction and upgrading projects.
B4 Promoting quarterly modernisation of residential buildings
• Realisation of the Neighbourhood Programme.
B5 Promoting panel modernisation of multi-apartment buildings
• Implementation of the panel (modular) modernisation project (modernisation of about 45 apartment buildings).

Buildings sector financing route

CapEx:

- €1,170,464,000

OpEx (annual):

- €2,698,000

Estimated cost savings (annual):

- €68,528,000

Potential sources of financing:

- Municipal budget
- ESCO
- PPP
- AB "Šiaulių bankas"
- UAB, "ILTE"
- InvestEU
- Modernisation Fund
- New Generation Lithuania: Component Green Transformation of Lithuania
- Climate Change Program
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)

Reduction of tCO_{2e} (annual):

- 73,113.85 tCO_{2e}

7.4 Actions in buildings sector

Key Conditions

B1 Upgrading municipal buildings and their systems

The energy consumption in buildings, both residential and non-residential, is a critical factor in the environmental footprint of a city. For Vilnius, understanding and managing this consumption is essential in the context of climate change and energy efficiency. Energy efficiency is achieved when buildings are energy efficiency class B or higher. According to the data of the VĮ "Registrų centras" (state enterprise Centre of Registers) and the VĮ "Statybos produkcijos sertifikavimo centras" (state enterprise Building Product Certification Centre), the buildings of Vilnius City Municipality with energy performance class B and higher (low-energy buildings with consumption <139 kWh/m^2) account for 17.13% of the total floor area of the buildings assessed. The lowest energy performance classes E–G account for about 58% of the total assessed building area. Other buildings in the municipality (business, manufacturing, medical, etc.) with energy performance class B and above account for 19.07% of the total assessed building area. The lowest energy performance classes E–G account for about 69.55% of the total building area assessed.

The city's efforts to upgrade municipal buildings are in line with the Fit for 55 initiatives, which aim to achieve zero emissions in all buildings by 2050. Member States have set progressive energy reduction targets for existing non-residential buildings:

- by 2030, energy consumption should be lower than that of the worst-performing 16% of buildings;
- by 2033, this target extends to the worst-performing 26%.

The revised Energy Performance of Buildings Directive promotes the integration of solar technologies during significant renovations of public buildings. According to the directive, existing public buildings should be prepared for the installation of solar systems, which should be gradually implemented where it is technically, economically, and functionally possible.

B2 Promoting the modernisation of multi-apartment buildings

In the territory of Vilnius, there are about 5,328 multi-apartment buildings assessed as having potential for renovation, of which only 380 (about 7%) buildings have been renovated so far and another 270 buildings are in the process of renovation (project financing has been approved). Heating and cooling consumption in residential buildings from fossil fuels is recorded at 158.73 kWh/m^2 in 2019. According to EBRD – GCAP benchmarks the extent of reliance on fossil fuels for heating and cooling needs to be significantly reduced. The available data for 2018 shows that electricity consumption in residential buildings in Vilnius is 32.90 kWh/m^2, which also puts it in the red in terms of the benchmarks.

The city of Vilnius has also set up a public institution – "Atnaujinkime miestą", to support and promote the energy-efficient renovation of multi-apartment buildings in Vilnius. Serving as a one-stop-shop, VšĮ "Atnaujinkime miestą" plays a crucial role in promoting the modernisation of buildings by providing homeowners with centralised advice and guidance. This streamlined approach helps simplify the process, enabling homeowners to easily prepare and implement comprehensive refurbishment measures for their buildings, while also ensuring access to the necessary information, resources, and support for energy-efficient upgrades. Vilnius is investing in energy-efficient buildings, closely monitoring air quality and ensuring that this information is readily available to residents. By 2030, 2,400 blocks of flats should be renovated (at least 300 per year). The Vilnius Coalition Programme foresees the creation of a special fund for the renovation of apartment buildings and the additional financing of renovation projects on top of the state support. This would encourage more residents to renovate their homes.

These efforts align with the Fit for 55 initiatives, which aim to decrease the average primary energy use of all residential buildings by at least 16% by 2030 and 20–22% by 2035. 55% of the energy reduction target is expected to be achieved through the renovation of the worst-performing buildings. Appropriate measures should be introduced to tackle the risks of so-called "renovictions" (eviction related to a significant increase in rent following renovation works).

B3 Integrate and enhance building condition and energy efficiency data

As a result of winning the Interreg Europe "RenoWave" project, the VšĮ "Atnaujinkime miestą" has received European funding to digitise information on the technical condition of Vilnius' buildings and make it accessible to experts and citizens. Currently, buildings are classified by their year of construction or heat consumption, which helps identify priority areas for renovation programs. However, until now, it has not been possible to classify buildings according to their technical condition. The information is not digitised, and the assessment methodology is inconsistent. The new digital tool will provide a standardised system for assessing the technical condition of buildings and offer a more comprehensive overview of the city.

The creation of a universal hub (online platform) with open access for residents, which provides information about their buildings (condition, energy efficiency, future plans), allows them to exchange ideas, and vote on proposed measures. Data on building energy efficiency (especially buildings that are not connected to municipal networks) can be collected through various methods:

- Mandatory energy certificates: These are stored in a central registry and evaluate the energy efficiency of buildings according to set standards.
- Databases and management systems: These involve the creation of databases where information on energy consumption, obtained from energy distributors or end-users, are stored, monitored and analysed.
- Installation of smart energy meters for users: These smart meters transmit data remotely. The meters should be installed progressively, starting with the highest energy consumers, before being available to other customers.

B4 Promoting quarterly modernisation of residential buildings

Vilnius faces a significant challenge due to outdated and energetically inefficient architecture planned and built in the 1960s–1990s, particularly in multi-apartment building blocks and brownfields. Collaborative efforts with locals for the renovation of these structures have been promoted through diverse public financial tools and incentives, aiming to expedite the renovation process.

In 2015, only 2.21% of development took place on existing urban land, suggesting that most development took place on greenfield sites. This low level of urban growth on existing urban land leads to unsustainable urban sprawl, resulting in the loss of green space, increased infrastructure costs and social inequality.

The Comprehensive Plan of Vilnius identifies the need to modernise and renovate Soviet-era mass housing estates and to create local centres and sub-centres. In 2004, the city adopted the "Programme for the renovation (modernisation) of apartment buildings" and entrusted its implementation to the VšĮ "Atnaujinkime miestą". The company is a public institution that supports and promotes the energy-efficient refurbishment of multi-apartment buildings in Vilnius. VšĮ "Atnaujinkime miestą", as a one-stop-shop, offers advice and outreach counselling to homeowners and supports them in preparing and implementing comprehensive refurbishment measures for their buildings. The latest update on the programme was approved by the city in 2023 under the name "Programme for increasing the energy efficiency of selected quarters of Vilnius city until 2025".

The programme is composed of two schemes: "Neighbourhood Renewal Programme" and "Energy Efficiency Improvement Programme for Selected Neighbourhoods". The "Neighbourhood Renewal Programme" where all residents located in apartment buildings built no later than 2002 can renew their yard, both cosmetically (the existing infrastructure is repaired) and fundamentally (the renovation work is carried out according to the project). The municipality allocates up to €70 per sqm of undeveloped territory. In 2022, 16 territories of neighbourhoods, within 87,000 sq. m of land, were renovated. The "Energy Efficiency Improvement Programme for Selected Neighbourhoods" covers neighbourhoods where more than 50% of the dwellings have been renovated/modernised and where the construction of the dwellings was completed before the end of 1993. Municipal funding: €10 per sqm of undeveloped neighbourhood area.

Completed projects under the Neighbourhoods Programme include the following districts S. Konarskio st. 10, 10A, 12, 14, 16, 18, 18A, 20, 22; V. Pietario st. 5, 7; Saulėtekio al. 53, 55, 57; Rudens st. 30; Filaretų st. 85; Lvovo st. 91; Vytauto st. 6; Antakalnio st. 83;

Savanorių pr. 11; MK Čiurlionio st. 35; K. Donelaičio st. 14, 16, 18, 20.

This could transform community spaces into co-working spaces, local markets and leisure facilities, encouraging mixed-use development and ensuring that residents have easy access to a range of services in close proximity. The implementation of such modernisation projects should serve as a model for future renovations and provide the basis for a "lessons learned" methodology. This approach should aim not only to improve the quality of the buildings, but also to foster a supportive community. This should be achieved through clear communication, the organisation of educational activities and site visits to demonstrate the progress and impact of the refurbishment. All these elements should improve the social mix within neighbourhoods by providing affordable housing options.

B5 Promoting panel modernisation of multi-apartment buildings

The high energy consumption for heating and cooling (2019 – 158,73 kWh/m^2) indicates possible inefficiencies in the performance of the building envelope, heating/cooling systems or occupant behaviour. The EBRD GCAP reference level should be <96 kWh/m^2. In addition, the electricity consumption of residential buildings in Vilnius (2018 – 32,90 kWh/m^2) is outside the acceptable range according to the EBRD GCAP benchmarks (<21 kWh/m^2).

This indicates relatively inefficient use of electricity, which may be due to inefficient electrical appliances, inadequate lighting, older electrical installation infrastructure or lack of energy awareness among residents. The consumption rate of fossil fuel heating and cooling in residential buildings is mainly related to heat consumption. This is because cooling systems are not as common in residential buildings; they are usually individual air conditioners. However, it is important to note that the higher heating consumption rates can be attributed to the moderately cold climate of Vilnius. Aplinkos ministerija (Ministry of Environment) coordinates the calls for applications for state financial support for the renovation of panel buildings.

B1 Upgrading municipal buildings and their systems

Timescale
2025–2030

CapEx € 583,639,000
OpEx € –

Action type
Investment – upgrade/retrofit

Part of the Climate City Contract Action Plan

Action description

Renovating all municipal buildings below energy efficiency class B and achieving energy efficiency class B or higher would result in at least 40% less energy demand. Renovation of municipal buildings is already underway, including schools, kindergartens, and hospitals, however, around 83% of the area of municipally-owned buildings still requires renovation (the total area of municipally-owned buildings is 1,173,804 m²). The regulations should also emphasise the preservation of architectural value, ensuring that renovations do not compromise the integrity of the building's design. A programme for the modernisation of public buildings that are currently below energy efficiency class B (972,731 m²) including thermal modernisation of buildings, electrification, installation of proper control systems and RES, renewal of ventilation systems, implementation of intelligent LED lighting systems and other energy efficiency related aspects. Energy modernisation of buildings is aimed at reducing the consumption of heat, electricity and water, as well as to decrease the reliance on fossil fuels. Priority should be given to reducing heat losses in a building, i.e., activities covering;

- insulation of building partitions,
- fabric / thermal upgrade (replacement of doors and windows, roof and façade elements),
- installation of energy-efficient HVAC systems

The Circular Economy Principles related to the re-use of construction materials should also be implemented wherever possible and in accordance with building regulations. The upgrading of urban buildings should also ensure equality, inclusivity and easy access to these buildings for all vulnerable groups.

In addition, in the context of the EPBD directive regarding sustainable mobility, it is important to ensure an adequate number of charging points for electric vehicles, allowing for intelligent charging. Furthermore, additional parking space should be provided for bicycles.

Efforts should then focus on increasing the share of renewable energy. In order to ensure the smooth and systematic implementation of the renovation of municipal buildings, it is proposed to develop an internal standard for the renovation of municipal buildings. Developing strategies and policies to guide the city's renovation of existing buildings is crucial. These policies should be aligned with Energy Performance of Buildings Directive (EPBD), Energy Efficiency Directive and the European Taxonomy, which provides a framework to encourage sustainable investments. They should incorporate solutions that promote electrification and the use of RES (for example, solar panels on the roofs of buildings).

Targeted results of the action and costs (CapEx)

Upgrading of all existing municipal buildings that are currently below energy efficiency class B owned by the Vilnius Municipality by 2030 (972,731 m²)	€583,639,000

City's strategy / policy / plans

- Comprehensive Plan of Vilnius
- Sustainable Energy and Climate Change Action Plan 2030

Potential action location

To be identified

Implementing body

Vilniaus miesto savivaldybės administracija, VMSA

Key supporting actors

VšĮ "Atnaujinkime miestą" as the Technical advisor

Supporting & relevant actions

- E1 Enhancing the use of renewable energy sources (RES) in district heating
- E3 Reconstruction of heating networks
- E5 Developing a flexible energy storage system
- B3 Integrate and enhance building condition and energy efficiency data

Potential sources of financing

- Municipal budget
- ESCO,
- AB "Šiaulių bankas" ,
- UAB "ILTE",
- InvestEU,
- Modernisation Fund,
- New Generation Lithuania: Component Green Transformation of Lithuania,
- Climate Change Program,
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.).
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc.

B1 Upgrading municipal buildings and their systems

Related Challenges

1. Ageing infrastructure and low energy efficiency in the Soviet-era buildings.
2. Outdated and energy inefficient 1960s-1990s architecture.

Directly addressed Strategic Goals

1. SGE1 Achieving the city's climate neutrality by 2030.
2. SGB2 Enhancing the energy efficiency of existing buildings through structural upgrades and digital management solutions.

Supported Targets

1. ID 14. Electricity consumption in buildings – less than 47 kWh/m^2
2. ID 15. Heating (fossil fuels) and cooling consumption in buildings – less than 104 kWh/m^2

Projected benefits

✓ **Reduction of 4,719.03 tCO_2**
Climate City Contract Action Plan Estimations

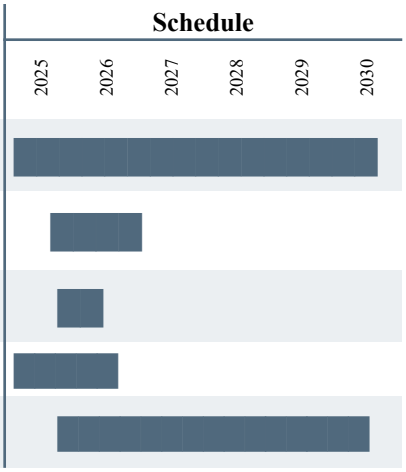
✓ **Job creation potential: 200–500**

- ✓ Improved energy efficiency through upgraded insulation, HVAC systems and lighting reduces energy consumption
- ✓ Cost savings and reduced energy, water and waste bills
- ✓ Enhanced comfort and better indoor environment

Estimated cost savings (EUR per year)

- ✓ Savings related to the renovation of buildings managed by the municipality – €3,670,000

Milestones



1	Conduct a comprehensive assessment of the current condition and performance of municipal buildings and their systems.
2	Identify key areas for upgrades, such as energy efficiency, structural integrity, and modernizing systems.
3	Evaluate different technologies and solutions for building upgrades (e.g., HVAC systems, insulation, lighting, renewable energy systems).
4	Develop detailed engineering designs and specifications for the building upgrades.
5	Carry out the construction and installation of the upgraded systems according to the detailed design.

Smart City Potential

- Potential solutions to be implemented in newly upgraded buildings could include temperature sensors, the automation of HVAC systems, and the centralised control and accounting of the building. It may also be beneficial to introduce and integrate smart heat, electricity, and water meters during the refurbishment of public buildings.
- Integrating these smart meters can enhance transparency and efficiency, allowing building administrators to monitor usage closely. This data could be shared and promoted on an existing or new digital platform/applications, further supporting energy management and optimisation efforts.
- Displaying annual-seasonal heat gains on building facades as "exemplary zero carbon buildings", with a dashboard showing commissioning time and energy saved for the project, could also be a valuable addition.

Gender Equality and Social Inclusion

- Ensure diverse representation in decision-making processes by providing equal opportunities for all individuals. This includes actively creating an inclusive environment where leadership roles are accessible to everyone with the necessary competence. Implementing inclusive leadership targets can help create more balanced leadership structures without discrimination.
- Providing equal opportunities for employees to participate in technical training and employment related to building renovations is essential. This includes training in energy-efficient technologies and systems, ensuring that all employees have the skills needed for these advanced projects.
- Targeting low-income households and start-up businesses for subsidies related to energy-efficient building renovations can make these improvements more accessible. This approach helps support those who might otherwise be unable to afford such upgrades.
- Specialised training programs targeting women, particularly in technical fields like energy-efficient technologies, HVAC systems, and digital management solutions. Pairing these programs with mentorship opportunities and career advancement support can help women thrive in technical roles, ensuring they have the resources and guidance needed to succeed.

B2 Promoting the modernisation of multi-apartment buildings

Timescale
2025–2030

CapEx € 392,350,000
OpEx € 480,000

Action type
Investment – upgrade/retrofit

Part of the Climate City Contract Action Plan

Action description

In Vilnius, as in the rest of Lithuania, the majority of residential buildings consist of apartment blocks constructed before 1990. A comprehensive modernisation programme has been launched, targeting around 2,400 multi-apartment buildings. It is also essential to ensure that heritage buildings are being upgraded appropriately. The aim is to improve the energy efficiency of these buildings through a range of measures, such as thermal insulation, installation of solar panels, upgrading ventilation systems (where mechanical ventilation is present), and incorporating intelligent LED lighting systems.

The EBRD is lending €25 million to SB modernizavimo fondas 2, a specialised fund managed by Šiaulių Bank to finance energy efficiency investments in residential multi-apartment buildings in Lithuania, alongside Swedbank and the European Investment Bank.

According to Lithuania's National Energy and Climate Action Plan for 2021–2030, upgrading a multi-apartment building to achieve at least energy efficiency Class C could reduce energy consumption by approximately 40%, resulting in annual energy savings of about 100 GWh if all eligible buildings are upgraded. The overarching goal of energy modernisation is to decrease the consumption of heat, electricity, and water.

To support these efforts, residents can apply for state funding for building modernisation. However, in order to qualify for this financial assistance, the renovated buildings must meet a minimum energy efficiency standard of Class B.

A key priority of these upgrades is to minimise heat loss, focusing on measures such as:

- Insulating building partitions (walls, roofs, and floors),
- Undertaking thermal upgrades, which include replacing old doors, windows, roofs, and façade elements,
- Modernising heating systems by replacing outdated boilers with energy-efficient alternatives like condensing gas boilers or heat pumps,
- Installing mechanical ventilation systems with heat recovery, particularly where mechanical ventilation systems are already in place.

Another important aspect of thermal upgrade is the increased use of RES, primarily through the installation of photovoltaic panels to harness solar energy. Furthermore, integrated wastewater collection and reuse systems (e.g. for flushing toilets) should be implemented in parallel to reduce water consumption. These upgrades will not only reduce energy consumption but also contribute to the city's broader environmental goals by promoting sustainability and reducing greenhouse gas emissions. Regulatory and financial incentives should also be introduced for building administrators to increase their involvement in the upgrading process.

Targeted results of the action and costs (CapEx)

Renovation of 2,400 multi-apartment buildings	€392,000,000
Publicity and education campaign to help implement the existing multi-apartment modernisation program	€350,000

Operational Costs (OpEx)

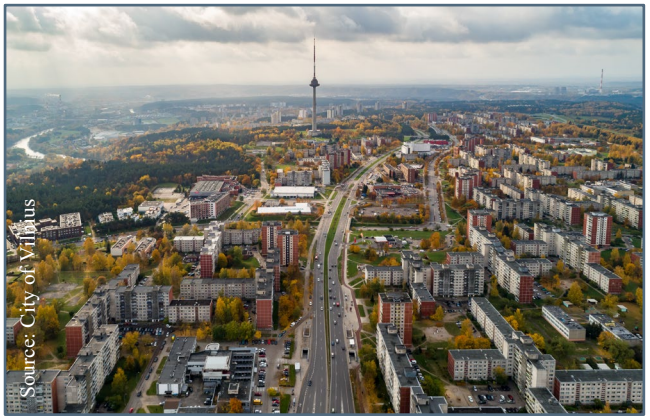
- 20 FTEs to run VšĮ "Atnaujinkime miestą" which is administrating the process of multiapartment buildings' refurbishment – €480,000

City's strategy / policy / plans

- Comprehensive Plan of Vilnius
- Strategic Action Plan 2023–2025 of the VšĮ "Atnaujinkime miestą"
- Sustainable Energy and Climate Change Action Plan 2030
- The Vilnius Coalition Programme

Potential action location

To be identified



Implementing body

VšĮ "Atnaujinkime miestą"

Key supporting actors

Vilniaus miesto savivaldybės administracija, VMSA as the Approval authority

Supporting & relevant actions

E1 Enhancing the use of renewable energy sources (RES) in district heating

E2 Enhancing the use of renewable energy sources (RES) in non-centralised heating systems

B3 Integrate and enhance building condition and energy efficiency data

B4 Promoting quarterly modernisation of residential buildings

Potential sources of financing

- Municipal budget
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc.,
- ESCO,
- AB "Šiaulių bankas",
- UAB "ILTE",
- InvestEU,
- Modernisation Fund,
- New Generation Lithuania: Component Green Transformation of Lithuania,
- Climate Change Program,
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)

B2 Promoting the modernisation of multi-apartment buildings

Related Challenges

1. Passive residents that are not willing to renovate houses despite an attractive national and local subsidy mechanisms.
2. Ageing infrastructure and low energy efficiency in the Soviet-era buildings.

Directly addressed Strategic Goals

1. SGE1 Achieving the city's climate neutrality by 2030.
2. SGB2 Enhancing the energy efficiency of existing buildings through structural upgrades and digital management solutions.

Supported Targets

1. ID 14. Electricity consumption in buildings – less than 47 kWh/m^2
2. ID 15.1. Heating (fossil fuels) and cooling consumption in residential buildings – less than 96 kWh/m^2

Projected benefits

✓ **Reduction of 68,394.82 tCO_2**
Climate City Contract Action Plan Estimations

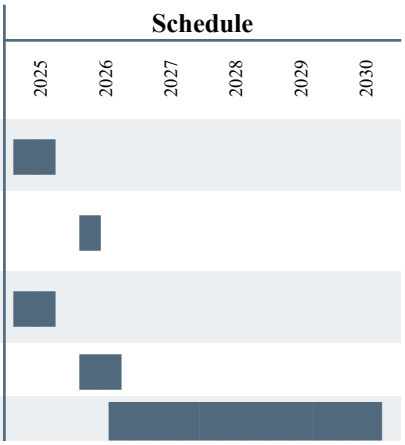
✓ **Job creation potential: 200–500**

- ✓ Maintained affordable housing
- ✓ Ensured accessibility for diverse socioeconomic groups
- ✓ Revitalised neighborhoods and enhanced livability through urban renewal
- ✓ Reduced energy costs
- ✓ Employment opportunities and benefits to local economies

Estimated cost savings (EUR per year)

- ✓ Savings related to the renovation of residential buildings – €64,858,000

Milestones



1	Conduct a comprehensive assessment of the current condition and energy performance of the multi-apartment buildings.
2	Evaluate different technologies and solutions for building upgrades (e.g., HVAC systems, insulation, lighting, renewable energy systems).
3	Launch a public awareness campaign to inform residents about the modernisation project and its projected benefits.
4	Develop detailed engineering designs and specifications for the building upgrades.
5	Carry out the renovation and installation of upgraded systems according to the detailed design.

Smart City Potential

- The implementation of smart metering, intelligent heating control systems and Building Management Systems (BMS), which enable real-time data collection. This data includes information on heating demands, energy and water consumption.
- It is recommended to conduct regular updates and create a GIS portal database for upgraded buildings.
- An existing or new digital platform/application could act as a one-stop-shop for managing and promoting these actions, potentially serving as a hub for awareness campaigns, sharing real-time data, and tracking the progress of energy-saving initiatives (combined with action B4 and T5).
- There is an opportunity to collaborate with the Social Services department and University to leverage different datasets to develop an "energy poverty" map of the city.

Gender Equality and Social Inclusion

- Involve a diverse range of voices. This includes offering training and employment opportunities for employees in construction and energy-efficient technology installation, such as solar panels and heat recovery systems.
- Developing outreach programs to inform low-income or single-parent households about state funding and the projected benefits of energy-efficient upgrades. Expanding these efforts to engage women-led households, elderly women, and underserved communities can be achieved by partnering with women's organisations and community networks. These partnerships can deliver energy-efficiency information tailored to their specific needs.
- Introducing targeted financial products, such as low-interest loans or grants, specifically for women-led households or businesses, ensures they have access to state funding for modernisation projects. This financial support can make a significant difference in enabling these groups to participate fully in the modernisation efforts.
- Encouraging the involvement of women-led construction firms or teams in modernisation projects is another key strategy. This can be facilitated through gender-responsive procurement policies that support diverse firms with a commitment to gender equality, or by providing capacity-building support for women entrepreneurs in the sector.

B3 Integrate and enhance building condition and energy efficiency data

Timescale
2025–2027

CapEx € 4,475,000
OpEx € 96,000

Action type
Digital tool / platform / data

Part of the Climate City Contract Action Plan

Action description

The action results in the need to enhance the energy efficiency of existing buildings and switch away from heat combustion stoves that utilise solid fuels. A significant challenge for cities is the lack of building data and energy usage monitoring, which are vital for assessing effective solutions, particularly in buildings not connected to municipal networks.

Furthermore, the anticipated surge in electricity and heat demand will exert additional pressure on resources, necessary to anticipate and implement suitable measures. The city is responsible for implementing suitable control systems for managing its district heating network (development of energy consumption management and monitoring system), aimed at optimising operational efficiency, reducing operational expenditures, and improving system reliability.

The first step should be the implementation of centralised professional management of municipal buildings in the public buildings that are currently below energy efficiency class B (972,731 m²). At a later stage, these solutions and the whole system can be extended to individual residents. Installation of a centralised automatic system for reading and analysing buildings by replacing old meters and sub-meters with new digitalised ones. It will enable the optimisation of building systems and energy consumption based on continuously collected and analysed data, calculate the CO_2 emissions of the buildings under management, with the aim of reducing the emissions of each building on an annual basis (thus committing both the manager and the users of the buildings to a common goal). A framework and systematic approach should be established for the use of Building Information Modelling (BIM) in the maintenance phase of construction and upgrading projects. In addition, it is recommended to implement building passport assessments and energy certification processes. Where feasible, BIM solutions should be applied to both new and refurbished buildings to improve the efficiency and transparency of project delivery.

In the next steps, a digital tool "building databank" will help to organise and digitise the information on the condition of the multi-apartment buildings in need of renovation, and to assign them to a certain category according to the need for renovation. This data will include information on electricity and heat consumption, water consumption, structural condition of buildings and similar. This tool will help to constantly inform and notify residents about the condition of their building, which will hopefully increase their awareness and concern about the need for renovation. The platform could also enable the energy classification of buildings, calculate the CO_2 emissions of buildings and inform about buildings upgrading standards. A platform will improve the work of the municipality in order to speed up the renovation processes and increase energy efficiency in multi-apartment buildings. Data can be stored on existing servers or in the cloud. This can also be integrated into an existing platform https://maps.vilnius.lt/, which ensures accessibility and user-friendliness.

The installation of the centralised automatic system, together with the upgrading of buildings, offers great potential for ESCO. Improved data and real-time performance would help to establish a robust market for this type of financing.

Targeted results of the action and costs (CapEx)

Installation of a centralised automatic system for reading and analysing building meters and readings	€4,475,000
Establish framework and systematic approach for the use of Building Information Modelling (BIM) in the maintenance phase of construction and upgrading projects.	-

Operational Costs (OpEx)

- 4 FTEs to manage and maintain the new system – €96,000

Potential action location

To be identified

Source: unsplash.com

Implementing body

Vilniaus miesto savivaldybės administracija, VMSA

Key supporting actors

- VšĮ "Atnaujinkime miestą" as the Operator
- UAB "ID Vilnius" as the Technical advisor
- Lietuvos Respublikos Aplinkos Ministerija as the Regulator

Supporting & relevant actions

- E3 Reconstruction of heating networks
- B1 Upgrading municipal buildings and their systems
- B2 Promoting the modernisation of multi-apartment buildings
- B5 Promoting panel modernisation of multi-apartment buildings

Potential sources of financing

- Municipal budget
- ESCO,
- AB "Šiaulių bankas",
- UAB "ILTE",
- InvestEU,
- Modernisation Fund,
- New Generation Lithuania: Component Green Transformation of Lithuania,
- Climate Change Program,
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)

City's strategy / policy / plans

- Comprehensive Plan of Vilnius
- Strategic Action Plan 2023–2025 of the VšĮ "Atnaujinkime miestą"
- Sustainable Energy and Climate Change Action Plan 2030

B3 Integrate and enhance building condition and energy efficiency data

Related Challenges

1. Lack of data on buildings not connected to the district heating network.
2. Difficulties in balancing energy supply and demand.

Directly addressed Strategic Goals

1. SGB1 Raising safety and accessibility of existing buildings by creating a solid regulatory framework and complex building refurbishment.
2. SGB2 Enhancing the energy efficiency of existing buildings through structural upgrades and digital management solutions.

Supported Targets

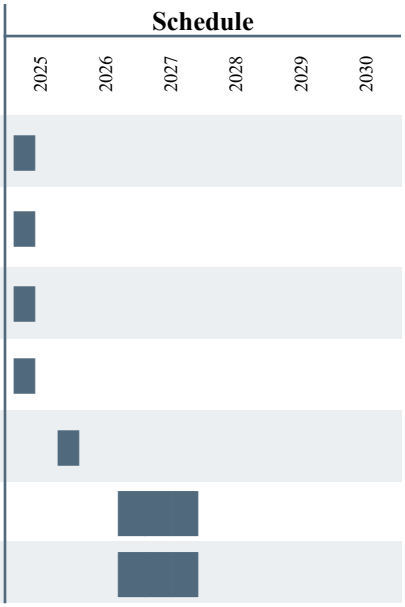
1. ID 14. Electricity consumption in buildings – less than 47 kWh/m^2
2. ID 15. Heating (fossil fuels) and cooling consumption in buildings – less than 104 kWh/m^2

Projected benefits

✓ **Job creation potential: 1–5**

- ✓ Streamlined operations and improved management efficiency
- ✓ Lowered operational and maintenance costs
- ✓ Reduced energy consumption
- ✓ Comprehensive and accurate data on energy use for better decision-making
- ✓ Predictive analytics for addressing maintenance issues and preventing costly problems

Milestones



1	Conduct an assessment of the current systems used to determine the condition of a building and for energy efficiency data collection and management.
2	Evaluate different technologies and solutions for data integration and enhancement (e.g., data management platforms, IoT sensors, energy monitoring systems).
3	Develop detailed designs and specifications for the integrated data system, including hardware, software, and data protocols.
4	Engage with stakeholders, including building managers, residents, and energy professionals, to gather input and address concerns.
5	Develop and implement standards for data collection, storage, and reporting to ensure consistency and accuracy across all buildings.
6	Develop the integrated data system according to the detailed design.
7	Install necessary hardware, such as sensors and monitoring devices, in the selected buildings.

Smart City Potential

- Creation of a monitoring platform that will facilitate the integration of IoT sensors measuring building parameters, including insulation, heating and resource consumption. This will establish a foundation for further data-driven decisions and maintenance of the buildings.
- In a more advanced stage, this will enable the development of smart systems supporting the growth of energy management maturity in the city, such as BEMS (Building and Energy Management System) and HEMS (Home Energy Management System).
- The use of images of thermal energy losses taken by drones for the benefit of public buildings.
- Building Information Modelling (BIM) can enhance the modernisation of buildings by integrating smart technologies such as 3D scanning, IoT sensors, and AI for predictive maintenance. Additionally, Virtual Reality / Augmented Reality and digital twin technologies improve planning and decision-making, leading to more efficient and transparent renovation processes.

Gender Equality and Social Inclusion

- Provide equal opportunities for training and support. This includes training employees in the installation and management of new digital meters and energy monitoring systems.
- Promoting equal involvement in the development and use of digital tools for building condition assessment and renovation planning. By ensuring that all employees have access to these tools, we can create a more inclusive and effective approach to building management.
- Collecting gender-disaggregated data on energy consumption and building conditions is another important step. This data helps understanding how men, women, and underserved groups are differently impacted by energy inefficiencies. Using this information, we can design gender-responsive energy policies that address these disparities.
- Offering specific technical training in digital tools, IoT systems, and energy monitoring technologies ensures that all individuals are equally involved in the operation and management of these systems. Promoting leadership roles for underrepresented groups in digital energy management further supports this goal, empowering women to take on key positions in this field.

B4 Promoting quarterly modernisation of residential buildings

Timescale
2025–2030

CapEx € 100,000,000
OpEx € 2,122,000

Action type
Investment – upgrade/retrofit

Part of the Climate City Contract Action Plan

Action description

The implementation of complex multi-apartment buildings refurbishment projects is one of the local government's priorities. The renovation of multi-apartment buildings and other public buildings, as well as the improvement of the living environment, access roads, street lighting and other infrastructure, leads to greater energy efficiency. Refurbishment of entire multi-apartment building includes upgrading above and below ground utilities and environmental rehabilitation.

Municipality provides financial support to encourage neighbourhood renovation through the Neighbourhood Programme. Neighbourhood renewal measures include: renewal and repair of existing pavements, repair of the stairscases in the common area, placing benches and rubbish bins (not waste containers), trimming (pruning) of existing vegetation, lighting (site) renovation, extension of car parks, installation of a lighting system, installation of stairscases for common use, fencing, retaining walls, entry barriers, sports or recreation ground with facilities, bicycle racks (garages), new planting (trees, shrubs, lawns), landscaping and other measures to regenerate the area. A structural assessment of the existing buildings should be carried out before modernisation work begins.

The first step is to improve the Soviet-era zones by making the neighbourhoods more attractive, liveable and in line with modern urban development principles such as the 15-minute city concept. This involves creating mixed-use developments that provide residents with easy access to essential services, public transport and social amenities within a short walk or bike ride of their homes. In addition, the possibility of retrofitting the roofs to create sports, leisure or community centres should be explored.

The Circular Economy Principles relating to the re-use of construction materials should also be implemented wherever possible and in accordance with building regulations. The upgrading of residential neighbourhoods should also ensure equality, inclusivity and easy access to these areas for all vulnerable groups.

Implementation of the action should be combined with transit-oriented development to increase population density in well-connected areas, optimise the use of existing urban land and reduce urban sprawl. The design of new neighbourhoods should include cycling infrastructure, parking with publicly accessible electric vehicle chargers, and easily accessible public transport stops.

To preserve the green areas of the neighbourhood, the programme stipulates that at least 30% of the green areas of the total area of the neighbourhood must be left undeveloped. This is an opportunity to enhance blue-green infrastructure and nature-based solutions (NBS) in the developing neighbourhoods. The Soviet-era buildings will benefit not only from improved building quality and efficiency, but also from the transformation of their surroundings into more liveable and service-oriented spaces, including community hubs that will serve as centres for essential services such as municipal offices, healthcare, libraries and cultural activities.

Targeted results of the action and costs (CapEx)

Realisation of Neighbourhood Programme	€100,000,000

Operational Costs (OpEx)

- Maintenance of newly upgraded neighborhoods – €2,122,000

City's strategy / policy / plans

- Comprehensive Plan of Vilnius
- Strategic Action Plan 2023–2025 of the VšĮ "Atnaujinkime miestą"

Potential action location

To be identified

Implementing body

VšĮ "Atnaujinkime miestą"

Key supporting actors

Vilniaus miesto savivaldybės administracija, VMSA as the Approval authority

Žemės tvarkymo ir administravimo skyrius as the Technical advisor

Miesto aplinkos skyrius as the Technical advisor

Supporting & relevant actions

B2 Promoting the modernisation of multi-apartment buildings

B5 Promoting panel modernisation of multi-apartment buildings

LU3 Development of local plans and land use standards

LU4 Redeveloping existing urban land to increase liveability

Potential sources of financing

- Municipal Budget,
- AB "Šiaulių bankas",
- UAB "ILTE",
- InvestEU,
- Modernisation Fund,
- New Generation Lithuania: Component Green Transformation of Lithuania,
- Climate Change Program,
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.).
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc.

B4 Promoting quarterly modernisation of residential buildings

Related Challenges

1. Outdated and energy inefficient 1960s–1990s architecture.
2. Difficulty implementing complex urban renewal projects.

Directly addressed Strategic Goals

1. SGE2 Ensuring high quality ecosystems and urban spaces by involving external stakeholders in the transparent process of strengthening and integrating urban and environmental policies.
2. SGE3 Establishing infrastructure resilience and implementing city adaptation measures to effectively respond to climate change impacts and urban sprawl pressure.

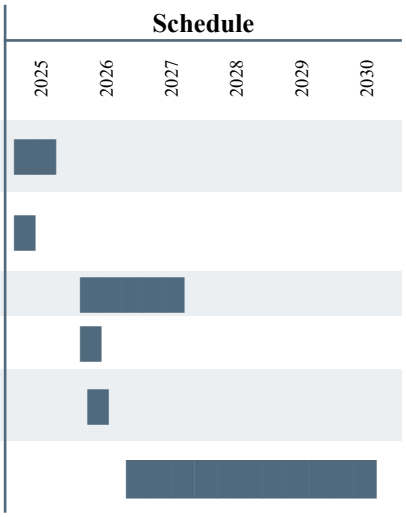
Supported Targets

1. ID 6.2. Share of population living within 400m of open green space of at least 0.5ha – over 70% of population
2. ID 7.4. Connectivity of natural area – over 60% of natural area

Projected benefits

- ✓ **Job creation potential: 200–500**
- ✓ Walkable neighbourhood
- ✓ Reduced energy costs and GHG emissions
- ✓ Increased social equity
- ✓ Employment opportunities and benefits to local economies

Milestones



1	Conduct a comprehensive assessment of the current state of the neighbourhood infrastructure and identify areas that need to be modernised.
2	Engage with stakeholders, including residents, local businesses, and community organisations, to gather input and address concerns.
3	Open the application period and provide support for applicants.
4	Review applications and approve eligible candidates.
5	Develop detailed engineering designs and specifications for each project component (e.g., pavements, lighting, sports grounds).
6	Carry out the construction and installation of the various project components as outlined in the detailed design.

Smart City Potential

- An existing or new digital platform/application could act as a one-stop-shop for managing and promoting these actions, potentially serving as a hub for awareness campaigns, supporting local initiatives and the development of RES (combined with action B2 and T5).
- The creation of an online library of materials from demolished buildings suitable re-used.
- To enhance the appeal of older neighbourhoods, particularly to younger demographics, the following strategies could be considered:
  1. Implementing smart energy management systems in buildings (smart metering and HVAC automated control systems), in collaboration with private building administrators.
  2. Enhancing security through the integration of smart lighting and surveillance cameras where applicable.
  3. Integrating RES and other energy generation and conservation solutions (wind, solar, battery).
  4. Developing public services and/or encouraging residents to establish services on the ground floor of buildings, thereby fostering interconnectivity within districts.

Gender Equality and Social Inclusion

- Provide equal training and support opportunities for employees. This includes managing and executing neighborhood renewal projects, such as green infrastructure and urban development.
- Encouraging equal participation in the design and implementation of community hubs. These hubs should address the needs of all residents, fostering a sense of community and inclusivity.
- Developing outreach programs to inform and engage residents about opportunities for involvement in neighbourhood improvements and community activities is another key step. These programs can help to ensure residents' awareness and encourage them to participate in these initiatives.
- Offering childcare during meetings and women-targeted consultation sessions can ensure that women's voices are included in modernisation planning. This support helps women balance their responsibilities and actively participate in decision-making processes.
- When planning building upgrades, it is important to incorporate universal design principles and measures to improve safety, such as better lighting and surveillance systems. These improvements are especially important in public spaces around multi-apartment buildings where women may feel more insecure.

B5 Promoting panel modernisation of multi-apartment buildings

Timescale
2025–2029

CapEx € 90,000,000
OpEx € –

Action type
Investment – upgrade/retrofit

Part of the Climate City Contract Action Plan

Action description

Panelised construction technology for renovation is the process of installing the ventilated façade – fabricating the frame, inserting the wool, installing the windows and applying the cladding – takes place in the factory. This means that the installation of a ventilated wall using panel technology eliminates the need for scaffolding, aluminium profiles, insulation and cladding on site. In terms of construction time alone, panel renovation can reduce the time needed to insulate the façade by several months, reduce noise on site and freight traffic movements in the city. It is crucial to ensure that the upgrades will not only improve the buildings, but also the surrounding areas and neighbourhoods.

However, it does not shorten the phases of preparation of the investment project, technical design and obtaining the building permit. On average, the renovation of a building takes about 26 months from concept to delivery. In the case of panel refurbishment, this period is expected to be around 22 months.

Pilot projects for the renovation of a panel for two multi-apartment buildings in Vilnius are approved. Furthermore, the city planned implementation of the panel (modular) modernisation projects of about 45 multi-apartment buildings. The Municipality could promote this initiative by raising awareness among citizens, educating them during various information events, assisting in the preparation of the necessary documentation, organising procurement etc.

The Vilnius Coalition Programme foresees the creation of a special fund for the renovation of apartment buildings and the additional financing of renovation projects on top of the state support. This could encourage more residents to renovate their homes. If residents increasingly opt for panel-based renovation, this would speed up the modernisation of buildings, achieve energy efficiency, and reduce GHG emissions.

The apartment buildings will be renovated and insulated using factory-made standardised structures – wall and roof panels. It is expected that a significant part of the mass of the panels will consist of organic materials.

The innovative modular technology will ensure not only a greener and more convenient renovation for the residents, but also a faster one. In the future, economies of scale will be critical to the successful implementation of modular construction/refurbishment, involving whole neighbourhoods.

Targeted results of the action and costs (CapEx)

Implementation of the panel (modular) modernisation project (modernisation of 45 multi-apartment buildings)	€90,000,000

City's strategy / policy / plans

- Comprehensive Plan of Vilnius
- Strategic Action Plan 2023–2025 of the VšĮ "Atnaujinkime miestą"
- Sustainable Energy and Climate Change Action Plan 2030

Potential action location

To be identified

Implementing body

VšĮ "Atnaujinkime miestą"

Key supporting actors

Aplinkos projektų valdymo agentūra as the Financer/investor

Vilniaus miesto savivaldybės administracija, VMSA as the Approval authority

Residents as the Referral

Building Administrators as the Operator

Supporting & relevant actions

E2 Enhancing the use of renewable energy sources (RES) in non-centralised heating systems

B2 Promoting the modernisation of multi-apartment buildings

B3 Integrate and enhance building condition and energy efficiency data

B4 Promoting quarterly modernisation of residential buildings

Potential sources of financing

- Municipal budget
- ESCO,
- AB "Šiaulių bankas",
- UAB "ILTE",
- InvestEU,
- Modernisation Fund,
- New Generation Lithuania: Component Green Transformation of Lithuania,
- Climate Change Program,
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.).
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc.

B5 Promoting panel modernisation of multi-apartment buildings

Related Challenges

1. Lack of available data on building energy efficiency, energy use, or building conditions.
2. Outdated and energy inefficient 1960s–1990s architecture.

Directly addressed Strategic Goals

1. SGB1 Raising safety and accessibility of existing buildings by creating a solid regulatory framework and complex building refurbishment.
2. SGB2 Enhancing the energy efficiency of existing buildings through structural upgrades and digital management solutions.

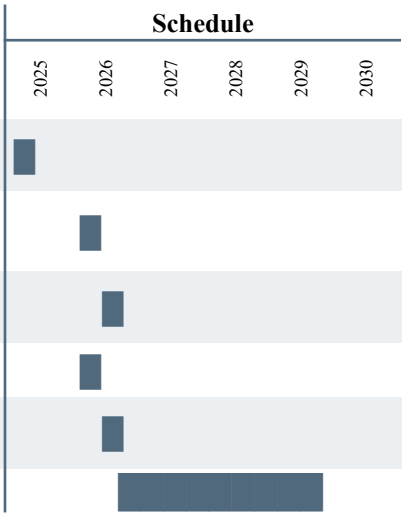
Supported Targets

1. ID 14. Electricity consumption in buildings – less than 47 kWh/m^2
2. ID 15. Heating (fossil fuels) and cooling consumption in buildings – less than 104 kWh/m^2

Projected benefits

- ✓ **Job creation potential: 50–100**
- ✓ Energy saving
- ✓ Reduced risk of energy poverty
- ✓ Increased social equity
- ✓ Employment opportunities and benefits to local economies

Milestones



1	Conduct a comprehensive assessment of the current condition and energy performance of buildings that can be upgraded with panel technology.
2	Evaluate different technologies and solutions for building upgrades (e.g., insulation, HVAC systems, lighting, renewable energy systems).
3	Launch a public awareness campaign to inform residents about the modernisation project and its projected benefits.
4	Develop detailed engineering designs and specifications for the building upgrades.
5	Engage with stakeholders, including residents, building managers, local businesses, and community organisations, to gather input and address concerns.
6	Carry out the renovation and installation of upgraded systems according to the detailed design.

Smart City Potential

- It is recommended that the project incorporates sensors to monitor efficiency gains and other key performance indicators (KPIs) throughout the project's lifespan (smart metres related to electricity and heat consumption, water consumption, temperature, humidity etc.).
- The platform developed in action B3, which is designed to integrate and enhance building condition and energy efficiency data, should be capable of tracking and visualising every aspect of the process.
- By integrating IoT sensors, AI-driven analytics, and automation systems, real-time monitoring and optimisation of energy usage, maintenance needs, and performance can be achieved. These technologies enable predictive maintenance, reduce operational costs, and extend the lifespan of the modular panels.
- Additionally, smart solutions support remote control and diagnostics, improving safety and minimising downtime, while also allowing for scalable upgrades that can adapt to future innovations or changes in operational requirements.

Gender Equality and Social Inclusion

- Provide equal opportunities for training and support. This includes training employees in the technical aspects of panelised construction and modular renovation technologies, ensuring everyone has the skills needed for these innovative projects.
- Developing support mechanisms for single-parent households or start-up businesses to access financing for panelised renovation projects. These mechanisms can help make these advanced renovation techniques more accessible to those who might otherwise struggle to afford them.
- Ensuring equal employment opportunities for women and other underrepresented groups in panel building modernisation projects is another key strategy. This includes promoting them in technical, supervisory, and management roles. Using procurement guidelines to favour contractors with strong gender balance in their teams can further support this goal, encouraging a more inclusive workforce.

TRANSPORT

Summary of Action Plan – Transport

The five indicated investments will support the transformation of the transport sector. It is a crucial element in Vilnius's mission to achieve climate neutrality. The actions are designed to reinforce the city's existing initiatives to change the behaviour of road users and to boost the share of cycling, walking and public transport in the city. They are also intended to facilitate the provision of clean, safe, efficient and low-carbon transport for all citizens.

Below is a summary of the planned actions for the transport sector.

Table 7 Summary of actions in the transport sector

T1 Renewal and modernisation of public transport fleet and related infrastructure
• Purchase of 164 Trolleybuses, 367 e-buses and 16 H_2 buses. • Purchase of 4 electric ships. • Installation of 50–100 kW charging points (250 pcs). • Modernisation of contact network and substations and optimisation of operations. • Installation of a 3 MW electrolyser on the site of the Vilnius thermal power network with a hydrogen storage facility.
T2 Enhancing public transport routes efficiency
• Increase of street lanes dedicated for public transport in Vilnius (47.9 km of dedicated lanes for public transport are expected to be in place and 71 intersections reconstructed, with priority given to public transport). • Installation of intelligent traffic light control infrastructure on the Vilnius Public Transport trunk line.
T3 Expanding and integrating cycling infrastructure and pedestrian pathways
• Construction/reconstruction of inter-district cycle routes (320km). • Installation of 60 bicycle storage facilities. • Installation of 9,000 bicycle racks in the city's public spaces, schools, other educational institutions, near public transport stops, recreational areas, places visited by tourists, etc. • Development of a "Bikeconomics" studies and counters. • Permeable pavement construction (300 km).
T4 Development of infrastructure for multimodal points
• Multi-variant concept or location study for a new multimodal transport hub. • Development of a technical study for the construction of a multimodal interchange. • Construction of a multimodal transport hub.
T5 Expansion of the network of public charging stations and charging points for electric cars
• Installation of 5,500 medium power (22 kW) charging points for electric vehicles. • Installation of 1,600 high power (50 kW) charging points for electric vehicles.

Transport sector financing route

CapEx:

» €682,941,600

OpEx (annual):

» €11,012,550

Estimated cost savings (annual):

» €14,126,300

Potential sources of financing:

» Municipal budget

» State budget

» InvestEU

» Horizon Europe (Pillar II)

» The Innovation Fund

» Private sources through partnership with the city in form of BOO, BOT, DBO, etc.

» Programme for the European Union funds' investments in 2021–2027 (Policy objective 8. Special priority. Sustainable urban mobility. Action 8.1 Promote sustainable multimodal urban mobility as part of the transition to a zero-carbon economy

» New Generation Lithuania: Component Green Transformation of Lithuania

» Climate Change Program

» National Energy and Climate Action Plan (3. Policies and measures, T11. Creation of a Sustainable Mobility Fund)

» Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)

» CEF Transport Alternative Fuels Infrastructure Facility (AFIF)

Reduction of tCO_{2e} (annual):

» 124,071.66 tCO_{2e}

7.5 Actions in transport sector

Key Conditions

T1 Renewal and modernisation of public transport fleet and related infrastructure

The city relies heavily on motorised private car usage for travel (0.514 vehicles per person in 2023). In 2023, the share of residents commuting by public transport was only 26%. The development of infrastructure, accessibility, efficiency, frequency and comfort will encourage residents to use public transport.

Currently, the city is making efforts to promote less polluting public transportation by planning to purchase electric buses and low-floor trolleybuses. There are currently 790 vehicles in the public transport fleet in Vilnius. These include 540 buses and 250 trolleybuses. 404 of these are diesels, 279 are electric and 107 CNG vehicles. The major pain point in the public transport system today lies in the old buses still in service. The average age of trolleybuses is 24.5 years, while the average age of buses is nine years. To address this, SĮ "Susisiekimo paslaugos, JUDU" launched a major tender in March 2024. The aim of this tender is to procure transport services from private companies and only environmentally friendly buses (hydrogen and electric). No diesel, CNG or LPG buses will be part of the future services.

By 2030, it is planned that electric, hydrogen and other alternative fuel vehicles will account for 100% of the total public transport fleet operated by UAB "Vilniaus viešasis transportas, VVT" (which currently provides 80% of the city's public transport services). The VVT is in the process of procuring new vehicles for its public transport fleet and in August 2024, Vilnius Public Transport Fleet put 20 new trolleybuses into service. Currently, VVT has installed five electric bus charging stations in Vilnius.

T2 Enhancing public transport routes efficiency

In Vilnius, like in many other cities the traffic load on the streets changes from month to month. This depends on various reasons. The main ones are school holidays, public and religious holidays, climatic conditions, and the time of year. Vilnius faces significant transport challenges due to the low number of dedicated roads for public transportation. In Vilnius, all vehicles travel about 11,000,000 km per day. The annual traffic volume is about 3,500,000,000 km. The high traffic demand on the city's arterial streets exceeds the capacity of these streets, causing congestion which spills back to the city's main intersections. The resulting congestion affects not only the flow of private vehicles and public transport, but also the overall quality of life in the city.

According to INRIX Global Traffic Data, in 2022 Vilnius ranks 102nd with 50 hours delay per driver of traffic congestion (annually), while London ranks first with 156 hours lost per driver (Riga – 41h, Tallin – 47h). In addition, Vilnius ranks 1st as the most congested city in Lithuania, affecting air quality, road user comfort and safety. There is a need to optimise public transport routes to make travelling around Vilnius more convenient and attractive for residents. A more user-friendly public transport system would encourage people to use public transport instead of their own cars.

T3 Expanding and integrating cycling infrastructure and pedestrian pathways

The condition of cycle paths network has improved significantly (it is now longer and more integrated with road traffic resulting in level of 4% in cycle traffic (2023). The implementation of cycling infrastructure has directly influenced the number of cyclists, demonstrating the substantial impact of well-designed paths.

However, the existing network of bicycle routes does not meet user's needs. The total length of cycle paths in 2022 was 150 km. Infrastructure improvements planned for 2030 should increase the share of cycling in the overall modal distribution of trips to 7.5%. This would contribute to reducing car traffic in the city, with a concomitant reduction in GHG emissions.

T4 Development of infrastructure for multimodal points

As car ownership increases, parking spaces in Vilnius are becoming increasingly overcrowded with cars. In Vilnius, there are both paid and free parking zones. Paid parking is available in the central part of the city as well as at individual attractions located outside the central part of the city. There are about 41,000 parking spaces in central part of the city.

Parking is free in the rest of the city, in apartment blocks and in peripheral zones. There are about 75,000 parking spaces in residential areas. According to data provided by Susisiekimo Paslaugos, the majority of paid parking lots are more than 85% full on average. The total number of paid parking lots in the city centre is 1,041 in which there are 8,768 paid parking spaces and 1,633 reserved parking spaces. The paid parking spaces are divided into five zones; 1. blue zone – 288 parking spaces; 2. red zone – 2,100 parking

spaces; 3. yellow zone – 3,259 parking spaces; 4. green zone – 4,530 parking spaces; 5. white zone (reserved spaces only) – 224 parking spaces.

This high occupancy rate reflects the saturation of the city centre with cars, which are increasingly demanding new parking spaces, and measures need to be taken to manage this development. It should be noted that each additional parking lot invites another car into the city centre. The extension of the paid zones and the increase in parking charges are expected to reduce the flow of cars into the city centre, bring order to the existing parking areas and reduce the number of vehicles driving around the city centre looking for a place to park, thus increasing the flow of vehicles in the city centre.

The current pricing policy encourages long term parking in the city centre as the prices charged are low and do not encourage the public to reconsider their mode of travel to the city centre. In residential areas, the problem of parking becomes more pronounced in the evening, as residential areas are congested with vehicles and residents park wherever they can find space (on average around 10% of all cars are parked in unauthorised places), i.e. on pavements, green areas, playgrounds, in front of pedestrian crossings where parking is prohibited, etc., with negative effects on the environment and the quality of life of the people.

The parking demand in the Soviet-era areas of the city is based on the principle of one parking space for 10 people. According to the current household size, four households share one parking space.

The majority of parking lots/spaces are accessible for people with disabilities (94%).

T5 Expansion of the network of public charging stations and charging points for electric cars

In Lithuania, including Vilnius, diesel is the most popular fuel used in the total vehicle fleet (almost 48%). For passenger vehicles, Lithuania is compliant with Europe wide emission standards – EURO6 standard. Fuel standards are set at the national level. EURO5 and EURO6 vehicles represent only 20% of total vehicles fleet in the city.

Vilnius is making progress with alternative fuel vehicles, but this is still at a low level. There is a diverse mix of electric, natural gas, LPG and hybrid vehicles, with 1,411% of the total passenger car fleet in 2023 powered by alternative energy sources. Most alternative fuel cars are electric. This figure is on a slow upward trend, reflecting the city's efforts to use alternatives of fossil fuels source of energy in transport. Freight transport registered in the city of Vilnius using alternative fuels accounts for 0.7% – mainly LPG, the rest being diesel.

Furthermore, the introduction of a low emission zone is slated for 2025, with the particulars − such as the transition to electric vehicles, payment systems, and regulatory measures − yet to be determined. A preliminary restriction has been in place in the old town since 2022. This initiative will unfold gradually, encompassing both the old town and city centre, potentially spanning an area of 540 hectares.

T1 Renewal and modernisation of public transport fleet and related infrastructure

Timescale
2025–2030

CapEx € 317,327,800
OpEx € 8,945,950

Action type
Investment – upgrade/retrofit

Part of the Climate City Contract Action Plan

Action description

By 2030, Vilnius is expected to have 531 public transport vehicles powered by alternative fuels: 367 electric buses and 164 new trolleybuses (belonging to the UAB "Vilniaus viešasis transportas, VVT"). There are also plans to buy 16 hydrogen buses. By 2030, VVT intends to maintain an average vehicle age of six years across its fleet, reflecting ongoing updates and modernisation efforts. By 2030, VVT expects to have around 250 electric bus charging stations (note: these plans are not yet confirmed by the city). The EBRD has provided a €38 million loan to VVT to help Vilnius become a Green City by purchasing 91 battery-electric trolleybuses. Additionally, VVT received €40 million from the Green Cities programme to buy 73 new trolleybuses and 71 battery/electric buses.

In addition, the city plans to purchase 4 electric ships to further support public transport on the Žirmūnai-Žvėrynas route. These ships will run every 30 minutes and will be able to carry up to 35 people. The charging infrastructure for these ships and the stops will be developed in the next 5 years.

Furthermore, the operation of electric buses requires a sufficient, strategically located network of charging stations that correlates with the number of electric buses in the city. The city will also ensure that the energy used to power the vehicles comes from renewable sources. In addition, modernisation and optimisation of the contact network and substations needed to operate the trolleybuses is expected to be completed by 2029.

One potential solution for electric buses equipped with Vehicle-to-Grid (V2G) technology is to store energy in their batteries and release it back to the grid when needed. This process involves the e-bus connecting to the grid, where it can either draw electricity to charge its batteries or release stored energy to help balance supply and demand.

Furthermore, the city approved an €8 million plan to develop green hydrogen production, specifically for transport sector, including the construction of a hydrogen storage facility and a public access energy charging station. It is planned that a 3 MW electrolyser installed on the Vilnius district heating networks would be sufficient to produce hydrogen for additional 40 buses.

Targeted results of the action and costs (CapEx)

Purchase of 164 Trolleybuses	€94,298,000
Purchase of 367 e-buses	€189,638,000
Purchase of 16 H_2 buses	€6,195,000
Purchase of 4 electric ships	€2,000,000
Installation of 50–100 kW charging points (250 pcs)	€5,625,000
Modernisation of contact network and substations and optimisation of operations	€17,155,000
Installation of a 3 MW electrolyser on the site of the Vilnius thermal power network with a hydrogen storage facility	€2,416,800*

*70% of the project implementation costs will be covered by the Ministry of Energy and the remaining 30% by the municipal budget.

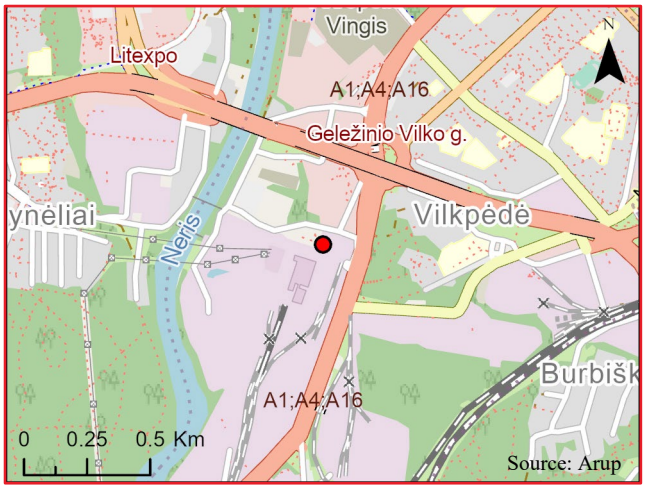
Operational Costs (OpEx)

Operating costs of new low-cost vehicles (power costs only):

- Trolleybuses – €1,622,000
- E-buses – €6,071,000
- H2 buses – €730,100
- Maintenance costs for electric vehicle charging stations – €281,250
- Electrolyser OPEX (include the costs of electricity and water) – €241,700

Potential action location

Elektrinės g. 2, Vilnius



Implementing body

UAB "Vilniaus viešasis transportas, VVT",
AB "Vilniaus šilumos tinklai, VŠT"

Key supporting actors

Vilniaus miesto savivaldybės administracija, VMSA as the Approval authority

Supporting & relevant actions

T2 Enhancing public transport routes efficiency

T4 Development of infrastructure for multimodal points

LU1 Green streets and heat island – investment programme for decreasing perceptible temperature in summer

LU3 Development of local plans and land use standards

Potential sources of financing

- Municipal budget,
- State budget,
- CEF Transport Alternative Fuels Infrastructure Facility,
- InvestEU,
- Horizon Europe (Pillar II),
- The Innovation Fund,
- New Generation Lithuania: Component Green Transformation of Lithuania,
- Climate Change Program,
- National Energy and Climate Action Plan (3. Policies and measures, T11. Creation of a Sustainable Mobility Fund),
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.).
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc.

City's strategy / policy / plans

- Vilnius Sustainable Urban Mobility Plan (SUMP)

T1 Renewal and modernisation of public transport fleet and related infrastructure

Related Challenges

1. Approximately 48% of the vehicle fleet is diesel-powered, emitting pollutants that can reduce air quality.
2. An aging vehicle fleet leading to higher emissions and lower fuel efficiency.

Directly addressed Strategic Goals

1. SGE1 Achieving the city's climate neutrality by 2030.
2. SGT3 Boosting the use, quality and safety of walking, cycling and zero-emission public transport.

Supported Targets

1. ID 11.2. Motorisation rate – less than 0.3 vehicles per capita
2. ID 11. Transport modal share in commuting – less than 30%

Projected benefits

✓ **Reduction of 43,433.45 tCO_2**
Climate City Contract Action Plan Estimations

✓ **Job creation potential: 100–200**

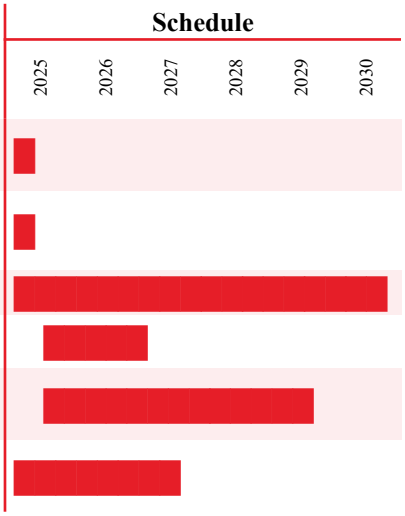
- ✓ Increased efficiency and sustainability of transit systems
- ✓ Reduced GHG emissions and noise
- ✓ Enhanced urban livability
- ✓ Promotion of the clean fuels' adoption
- ✓ Lower operational costs with green hydrogen and potential incentives
- ✓ Innovation in fuel cell technology and improved energy efficiency

Estimated cost savings (EUR per year)

- ✓ Cost savings related to reducing the purchase of diesel – €13,659,000
- ✓ Savings related to the production of own hydrogen used to power public transport hydrogen vehicles – €467,300

Milestones

		Schedule
1	Develop detailed specifications for the procurement of trolleybuses, e-buses, H_2 buses, and charging stations.	
2	Design plans for the modernisation of the contact network, substations, and the installation of the electrolyser and hydrogen storage facility.	
3	Procure and oversee the delivery of 164 trolleybuses, 367 e-buses, 16 H_2 buses and 4 electric boats	
4	Install 250 charging points (50–100 kW each) across the city.	
5	Modernise the contact network and substations to support new vehicles and improve operational efficiency.	
6	Install a 3 MW electrolyser and hydrogen storage facility at the Vilnius thermal power network site.	



Smart City Potential

- The purchase of buses with passenger amenities is a priority, including air conditioning (heating and cooling), Wi-Fi, audio-visual systems to facilitate travel, LCD screens, a passenger counting system to analyse demand and vehicle availability, cameras to improve passenger safety, and USB sockets to charge passengers' devices.
- Equipping buses with ticket vending machines and integrating the system with the existing e-ticketing and automated fare collection system.
- The management system and network infrastructure varies from one part of the city to another. In some cases, it may be necessary to upgrade and adapt the infrastructure to connect electric vehicle charging points.
- Integrating IoT technologies like sensors and cameras in public transport could enable data collection for city-wide decision-making. The bus tracking system in Klaipėda has over 200 sensors, enabling comprehensive monitoring of every aspect of the journey. This data could be employed for a range of purposes, including decision-making, planning maintenance schedules and optimising routes.

Gender Equality and Social Inclusion

- New electric, trolley, and hydrogen buses should include accessibility features like low floors, wide doors, and spaces for prams and mobility aids. Engaging passengers, especially those with specific needs such as parents with young children, elders, and people with mobility difficulties, in the planning process is essential.
- Incorporating well-lit bus stops, CCTV cameras, and emergency buttons at public transport hubs can significantly improve safety, particularly for women traveling at night. Conducting regular gender-sensitive safety audits can help identify areas for further improvement, ensuring a safer environment for all passengers.
- Introducing programs that specifically recruit women into technical and operational roles in the public transport sector is another key strategy. Providing scholarships and mentorship programs for women in transport-related STEM fields can help increase gender representation in technical roles such as mechanics, engineers, and drivers.

T2 Enhancing public transport routes efficiency

Timescale
2025–2029

CapEx € 58,477,000
OpEx € 631,000

Action type
Investment – upgrade/retrofit

Part of the Climate City Contract Action Plan

Action description

The technology most needed in the city is one that comprehensively monitors traffic flow, including public transport passengers and pedestrians. To facilitate the traffic optimisation process, the city plans to implement several initiatives.

By 2030, Vilnius aims to significantly enhance its public transportation infrastructure by adding 47.9 kilometers of road lanes dedicated specifically to public transport. Additionally, the city plans to reconstruct 71 intersections, prioritising the needs of public transport. The suburbs of Vilnius should be included in the optimisation of the public transport network to facilitate access to the centre.

These upgrades will include features such as illuminated passageways for safer pedestrian crossings, lowered pavements to improve accessibility, and the modernisation of walkways to better accommodate wheelchairs and the elderly. In the optimisation process, special attention should be paid to locations near educational institutions, which are often congested and have increased traffic in the mornings and afternoons.

The city also plans to introduce dense greenery along roads, serving as natural barriers between pedestrian areas and traffic lanes. This would also enhance nature and provide a permeable area for drainage.

To further improve the efficiency of public transport, Vilnius plans to implement an intelligent traffic light control system on major public transport routes. This advanced infrastructure will adjust traffic light patterns based on real-time passenger flows, allowing for more optimal route management.

To continually optimise the overall traffic flow on the streets, there is also a need for physical measures to restrict transit on selected residential streets. Therefore, it is necessary to include specific criteria for regulating the flow of traffic on different categories of road.

The implementation of all these solutions will increase the minimum speed of public vehicles in the city.

Furthermore, UAB “ID Vilnius” has done preparatory work to model the macro traffic flow of the city, with plans to extend it to the micro level. Currently, the traffic model is operated by SĮ “Susisiekimo paslaugos, JUDU”. The development and implementation of these digital solutions will allow the integration and creation of a new Automated Traffic Management System (ATMS).

The goal is to reduce travel times, minimize delays, and ensure smoother movement for buses and other public transport, making the system more responsive to the city’s transportation needs. These improvements aim to promote a more accessible, efficient, and eco-friendly public transportation system, encouraging higher usage and contributing to the city’s long-term goals of reducing traffic congestion and lowering emissions.

Targeted results of the action and costs (CapEx)

Increase of street lanes dedicated for public transport in Vilnius (47.9 km of new dedicated lanes for public transport and 71 intersections reconstructed)	€30,777,000
Installation of intelligent traffic light control infrastructure on the Vilnius Public Transport trunk line	€27,700,000

Operational Costs (OpEx)

- Unit cost of reconstruction of 1m² of road (asphalt overlay) – €36/m²*
- Maintenance of traffic lights at intersections – €631,000

*Not expected to occur during the period for which GCAP is established.

Potential action location

To be identified

Source: City of Vilnius

Implementing body

Vilniaus miesto savivaldybės administracija, VMSA

Key supporting actors

SĮ “Susisiekimo paslaugos, JUDU” as the Consultant

UAB ”Vilniaus viešasis transportas, VVT” as the Consultant

Supporting & relevant actions

T1 Renewal and modernisation of public transport fleet and related infrastructure

T4 Development of infrastructure for multimodal points

LU1 Green streets and heat island – investment programme for decreasing perceptible temperature in summer

LU3 Development of local plans and land use standards

Potential sources of financing

- Municipal Budget,
- InvestEU,
- Horizon Europe (Pillar II),
- Programme for the European Union funds’ investments in 2021–2027 (Policy objective 8. Special priority. Sustainable urban mobility. Action 8.1 Promote sustainable multimodal urban mobility as part of the transition to a zero carbon economy, (6€ m),
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)

City’s strategy / policy / plans

- Vilnius Sustainable Urban Mobility Plan (SUMP)

T2 Enhancing public transport routes efficiency

Related Challenges

1. The public transport system faces challenges in terms of poor efficiency, punctuality in peak hours, and coverage (especially in suburbs).
2. Insufficient dedicated bus lanes in the most congested areas and other prioritisation infrastructure for public transport

Directly addressed Strategic Goals

1. SGT2 Increase supply frequency, speed and reliability of public transport by using new means of urban mobility.
2. SGT3 Boosting the use, quality and safety of walking, cycling and zero-emission public transport.

Supported Targets

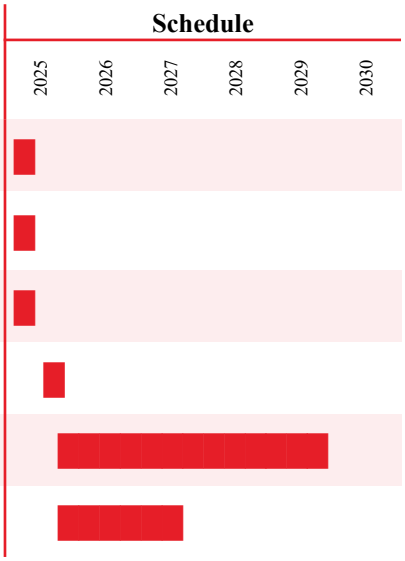
1. ID 11.4. Kilometres of road dedicated exclusively to public transit per 100,000 population – over 40 km
2. ID 11. Transport modal share in commuting – less than 30%

Projected benefits

- ✓ **Job creation potential: 5–10**

- ✓ Faster and more reliable transportation options for commuters
- ✓ Reduced traffic congestion and travel times
- ✓ Reduced air pollution
- ✓ Cost-effective mobility solutions and economic efficiency
- ✓ Enhanced connectivity and improved access to essential services
- ✓ Streamlined traffic flow with intelligent traffic lights
- ✓ Increased safety with prioritised PT signals
- ✓ Timely PT services and improved reliability

Milestones



1	Evaluate technologies and vendors for smart crossings, intelligent traffic light systems, and accessible sidewalk features.
2	Develop detailed specifications for the expansion of 47.9 km of dedicated public transport lanes and 71 intersection upgrades.
3	Design modernisation plans for intersections, including illuminated passages, lowered sidewalks, and green belts.
4	Install intelligent traffic light control systems and optimise public transport routes based on passenger flow data.
5	Reconstruct intersections with a focus on public transport priority, accessibility, and safety features.
6	Complete the installation of green belts, smart crossings, and modernized sidewalks across the designated intersections.

Smart City Potential

- It would be beneficial to ascertain whether the existing traffic light system could be enhanced as part of this project. As highlighted, the current traffic light system is not maintained by the manufacturer, and it would be advantageous to implement an overhaul.
- There are numerous well-developed systems for smart traffic management, including an Automated Traffic Management System (ATMS) that prioritises public transport and public service vehicles. Concurrently, incorporating smart solutions for smart traffic management would be advantageous (AI-equipped traffic cameras to optimise traffic flow, enhance public transport with real-time displays at bus stops (where it is not already installed).
- One of the potential solutions for optimising traffic in the city is to use existing traffic modelling or agent-based modelling solutions to understand traffic patterns and optimise the new routes accordingly.

Gender Equality and Social Inclusion

- To ensure that new road lanes and reconstructed intersections are truly accessible and to include features like lowered pavements, illuminated passageways, and accessible walkways to accommodate prams, wheelchairs, and the elderly. Implementing intelligent traffic light control systems that prioritise public transport vehicles and enhance the safety of pedestrian crossings, including those with prams or mobility aids.
- Involving passengers, particularly those with specific needs, in the planning process ensures that all aspects of road and intersection improvements meet diverse accessibility requirements. Regularly evaluating the accessibility of newly implemented features and making necessary adjustments based on feedback from users, especially vulnerable groups, is key to maintaining high standards of accessibility.
- Designing public transport routes to accommodate the travel patterns of women, who may rely more on public transportation for multitasking such as combining trips for childcare, shopping, and work, is another important consideration. Including community feedback in the planning process helps assess whether routes are effectively meeting their needs.

T3 Expanding and integrating cycling infrastructure and pedestrian pathways

Timescale
2025–2029

CapEx € 279,204,700
OpEx € 91,600

Action type
Investment – new

Part of the Climate City Contract Action Plan

Action description

By 2030, a total of about 320 km of inter-district cycle routes should be constructed/reconstructed, which together with the arterial routes would form a coherent network of about 390 km of main cycle routes for daily cycling access throughout the city. In addition, the implementation of a convenient public bike-sharing system would encourage people to choose cycling for urban trips. It is important to create seamless arteries between suburbs and the city centre.

This should be supported by providing bicycle storage facilities (racks) in public areas of the city and in the vicinity of business centres/office buildings, railway stations, public transport stops; provide bicycle parking and storage facilities for other wheeled mobility devices, including electric ones, in all schools and other educational institutions; provide bicycle storage facilities on the premises of multi-storey buildings. An estimated 60 additional bicycle storage facilities are planned to be installed by 2030.

As part of these investments, it also proposes the development of a dedicated road network specifically for non-motorised transport, often referred in Lithuania as “E” (for walking) and “F” (for cycling) roads. This scheme consists of a separate network designed exclusively for walking and cycling, which would create a safer and more convenient infrastructure for non-motorised transport.

To support the transformation process, it is recommended to conduct a “Bikeconomics” study, which assesses the economic results of bicycle use. Installing cycle and pedestrian counters to monitor the number of users. Investigate the financial benefits of cycling and walking – the city in partnership with a university or other private body.

Pedestrian infrastructure also needs to be developed to support modal shift, development of pavements and pedestrian infrastructure to encourage walking and improve pedestrian comfort.

Creating areas free of mechanical vehicles reduces noise pollution and creates quiet zones.

Targeted results of the action and costs (CapEx)

Construction/reconstruction of inter-district cycle routes (320km)	€226,573,000
Installation of 60 bicycle storage facilities	€3,426,700
Installation of 9,000 bicycle racks in the city’s public spaces, schools, other educational institutions, near VT stops, recreational areas, places visited by tourists, etc.	€1,155,000
Development of a “Bikeconomics” studies and counters	€50,000
Permeable pavement construction (300 km)	€48,000,000

Operational Costs (OpEx)

- Unit cost of reconstruction of 1m of bicycle path with bituminous surface – €107/m^2*
- Unit cost to renovate 1m^2 of pavement – €79/m^2*
- Maintenance costs of cycling storage infrastructure – €91,600

*Not expected to occur during the period for which GCAP is established.

Potential action location

To be identified

Source: City of Vilnius

Implementing body

SĮ “Susisiekimo paslaugos, JUDU”

Key supporting actors

Vilniaus miesto savivaldybės administracija, VMSA as the Consultant

Supporting & relevant actions

B4 Promoting quarterly modernisation of residential buildings

T2 Enhancing public transport routes efficiency

LU1 Green streets and heat island – investment programme for decreasing perceptible temperature in summer

LU3 Development of local plans and land use standards

Potential sources of financing

- Municipal Budget,
- InvestEU,
- Programme for the European Union funds’ investments in 2021–2027 (Policy objective 8. Special priority. Sustainable urban mobility. Action 8.1 Promote sustainable multimodal urban mobility as part of the transition to a zero carbon economy (22,5€m)
- Municipal Companies – SĮ “Susisiekimo paslaugos, JUDU”,
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)

City’s strategy / policy / plans

- Vilnius Sustainable Urban Mobility Plan (SUMP)

T3 Expanding and integrating cycling infrastructure and pedestrian pathways

Related Challenges

1. Lack of safe pedestrian infrastructure, especially in the suburbs.
2. Poor modal shift away from private cars to other public and active modes.

Directly addressed Strategic Goals

1. SGE1 Achieving the city's climate neutrality by 2030.
2. SGT3 Boosting the use, quality and safety of walking, cycling and zero-emission public transport.

Supported Targets

1. ID 11.2. Motorisation rate – less than 0.3 vehicles per capita
2. ID 11. Transport modal share in commuting – less than 30%

Projected benefits

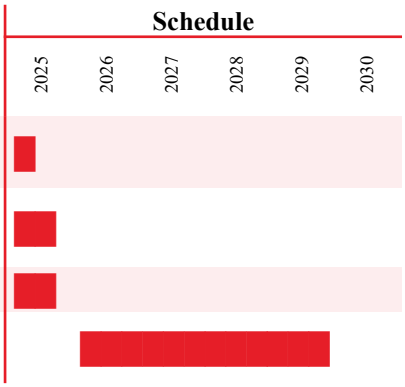
✓ **Reduction of 80,638.21 tCO_2**
Green City Action Plan Estimations

✓ **Job creation potential: 20–50**

- ✓ Safe cycle paths and reduced road accidents
- ✓ Improved pedestrian safety
- ✓ Eco-friendly commuting
- ✓ Improved air quality
- ✓ Increased physical activity of residents
- ✓ Cost-effective transportation and reduced maintenance costs
- ✓ Enhanced community connectivity
- ✓ Secure bike storage and reduced sidewalk clutter
- ✓ Healthier transportation and accessible storage

Milestones

		Schedule
1	Evaluate and select suitable locations for 60 bicycle storage facilities and 9,000 bicycle racks across public spaces and institutions.	
2	Develop detailed plans for the construction and reconstruction of 320 km of inter-district cycle routes.	
3	Design comprehensive pavement construction plans for 300 km of new and improved pathways.	
4	Construction of all 320 km of cycle routes, 300 km of pavements, and installation of all bicycle racks and storage facilities.	



Smart City Potential

- The traffic model that the city is developing should also inform the design of new cycle routes. The city can also use data from existing cycling apps to analyse cycling patterns and identify bottlenecks.
- One effective method for promoting cycling is to implement public dashboards that count bicycles riding in bicycle lanes. This approach can leverage peer pressure to encourage greater participation in cycling. Information about the availability of bicycle parking spaces (inside buildings or otherwise sheltered) should be available in the form of open data for integration with external applications.
- The possibility of promoting an application that incentivises the use of bicycles (such as a rewarding application; the more bikes used, the more vouchers the app provides that can be used in local shops).
- Additional incentives could be provided for companies delivering goods and providing services with cargo bikes, at least within the low-emission zone. This would require data and accounting of current delivery and service methods to detect the change resulting from the incentives.
- The possible introduction of activities such as bike-sharing schemes, park & ride systems and shared micro mobility services, which rely on digital platforms, data analytics, and digital payment systems, will support new entrepreneurs.

Gender Equality and Social Inclusion

- To ensure safe and comfortable cycling for all, including those using adaptive bicycles and to design inter-district cycle routes and arterial paths with features like smooth, wide pathways and accessible crossings. Involving passengers and other community members in the planning and feedback processes. This engagement helps address their specific needs and ensures that cycling and pedestrian infrastructure is inclusive and meets diverse requirements.
- Conducting gender-sensitive safety and accessibility audits of cycling and pedestrian pathways is another important step. These audits ensure that the infrastructure meets the safety needs of all users, providing a secure and welcoming environment for everyone.
- By implementing these strategies, the city can create a more inclusive and accessible cycling and pedestrian network that benefits all members of the community.

T4 Development of infrastructure for multimodal points

Timescale
2025–2030

CapEx € 15,394,000
OpEx € 717,100

Action type
Investment – new

Action description

Construction and development of multimodal communication hubs (for 3-4 types of transport) integrating multi-mobility, micromobility, and sharing services can help to reduce congestion and traffic in the city by creating comfortable and easy access to public transport.

Hubs would fulfil five purposes:

- a significant improvement in convenience and comfort for public transport passengers,
- integration of different types of public transport,
- creating communication hubs as local centers of social life,
- introduction of a congestion charge,
- restriction of car transport.

Along with the multi-modal junction conversion program, the transformation of car parks into energy-independent islands will be implemented, along with greening and increasing permeable pavements to provide additional benefits in terms of adaptation and biodiversity.

These energy islands could comprise photovoltaic panels (car park roofs), energy storage, electric car charging stations or energy management systems. Multimodal hubs will be selected in strategic locations (business centres, universities, existing stations, existing local centers of social life). Depending on the location, the hubs will be the reconstruction of the existing stations, expansion or in justified cases, the construction of new ones. To identify the most effective location for such a hub, which would serve the greatest number of people, development options should be analysed and a technical study of the construction should be executed.

The development of multimodal hubs provides an opportunity to introduce apps and platforms, which will allow the users to choose a wide range of travel possibilities and connections, to make traveling quick and comfortable. The city will require access to data collected by the providers of scooters, shared cars, or bicycles. That data will allow the city to plan new investments in bicycle infrastructure. The activities carried out will take into account the provisions of the strategic document Sustainable Urban Mobility Plan for Vilnius.

The development of multimodal infrastructure will increase the comfort and convenience of travel within the city, allowing additional charges to be levied for entering the city, further encouraging the use of public transport.

Targeted results of the action and costs (CapEx)

Multi-variant concept or location study for a new multimodal transport hub	€176,000
Development of a technical study for the construction of a multimodal interchange	€876,000
Construction of a multimodal transport hub	€14,342,000

Operational Costs (OpEx)

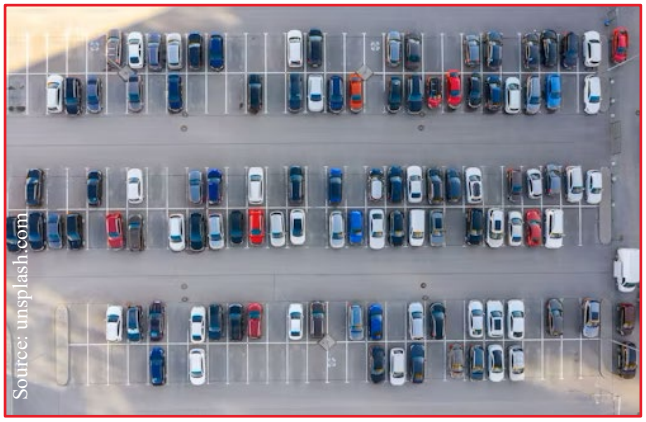
- Maintenance costs of multimodal transport hub – €717,100

City's strategy / policy / plans

- Vilnius Sustainable Urban Mobility Plan (SUMP)

Potential action location

To be identified



Implementing body

SĮ "Susisiekimo paslaugos, JUDU"

Key supporting actors

Vilniaus miesto savivaldybės administracija,
VMSA as the Technical advisor

Supporting & relevant actions

T1 Renewal and modernisation of public transport fleet and related infrastructure

T3 Expanding and integrating cycling infrastructure and pedestrian pathways

T5 Expansion of the network of public charging stations and charging points for electric cars

LU3 Development of local plans and land use standards

Potential sources of financing

- Municipal Budget,
- InvestEU,
- Horizon Europe (Pillar II),
- Programme for the European Union funds' investments in 2021–2027 (Policy objective 8. Special priority. Sustainable urban mobility. Action 8.1 Promote sustainable multimodal urban mobility as part of the transition to a zero carbon economy, (€6 m),
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.).
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc.

T4 Development of infrastructure for multimodal points

Related Challenges

1. Difficulties in applying Transport Oriented Development principles (which also apply to land use etc).
2. Poor modal shift away from private cars to other public and active modes.

Directly addressed Strategic Goals

1. SGT1 Changing residents' mindset and behaviour towards culture and modes of daily travel.
2. SGT3 Boosting the use, quality and safety of walking, cycling and zero-emission public transport.

Supported Targets

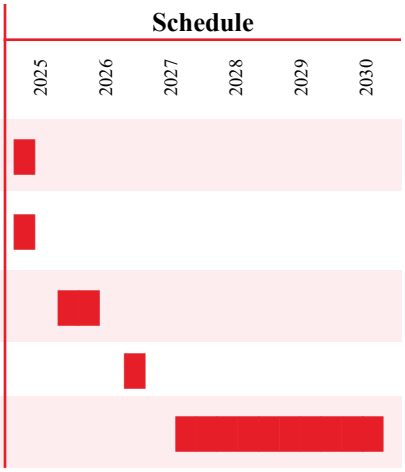
1. ID 11.2. Motorisation rate – less than 0.3 vehicles per capita
2. ID 11. Transport modal share in commuting – less than 30%

Projected benefits

- ✓ **Job creation potential: 100–200**
- ✓ Enhanced travel efficiency with seamless transitions between modes
- ✓ Reduced congestion and travel times, benefiting urban mobility
- ✓ Affordable travel options
- ✓ Improved access for all, creating inclusive urban environments

Milestones

		Schedule
1	Conduct a multi-variant concept or location study to identify optimal sites for the construction of a new multimodal transport hub.	
2	Evaluate potential locations based on accessibility, connectivity, and integration with existing transportation networks.	
3	Develop a detailed technical study outlining the design, infrastructure requirements, and operational plans for the multimodal interchange.	
4	Secure necessary permits and approvals for the construction of the multimodal transportation hub.	
5	Complete construction of the multimodal transportation hub, ensuring full functionality and seamless connectivity across all modes of transport.	



Smart City Potential

- Although the city's route planner is already well-developed, further enhancements could encourage even greater public transport usage. The travel planning application could be expanded to provide real-time information on the most efficient connections, considering delays, traffic, or disruptions to optimise travel routes.
- Digital technologies can play a crucial role in the design, implementation, and operation of this action. On the design side, a traffic model of the city could be used to simulate and optimise routes, ensuring efficient planning and minimising congestion. For operations, smart technologies could be used to enforce the Park & Ride (P&R) system, such as real-time monitoring of parking usage and integration with public transport schedules, ticketing system.
- Integration into existing MaaS applications (cloud-based) would enhance the potential of this project. It is essential that the upgraded infrastructure can be seamlessly integrated into processes already employed by users citywide.

Gender Equality and Social Inclusion

- To ensure that multimodal hubs are truly accessible and to design them with features like ramps, elevators, and clear signage for individuals with disabilities, parents with prams, and elderly passengers. Including amenities such as family restrooms, baby-changing facilities, and areas for prams and strollers within the hubs can significantly support parents and caregivers.
- Providing seamless connections between different types of transport within the hubs. Clear, accessible paths for all users, including those with mobility aids, ensure that everyone can navigate the hubs easily and efficiently.
- Ensuring that energy-independent car parks and hubs include accessible charging stations for electric vehicles is another important step. Providing clear, safe routes for users to access these facilities enhances the overall accessibility and convenience of the hubs.
- Implementing surveillance and security measures at multimodal points is vital to ensure that all genders feel safe when using the facilities, particularly at night. These measures can create a secure environment, encouraging more people to use public transport and multimodal hubs.

T5 Expansion of the network of public charging stations and charging points for electric cars

Timescale
2025–2030

CapEx € 12,538,100
OpEx € 626,900

Action type
Investment – new

Part of the Climate City Contract Action Plan

Action description

Vilnius, like other EU cities, is influenced by the vehicle standards set by the European Union. However, Lithuania's regulations are tightening, and there is a small but growing allocation of subsidies and incentives for the acquisition of electric and hybrid vehicles. This is poised to accelerate the transition away from older, more polluting vehicles. Since municipality do not have power to directly renew private cars or completely restrict the use of them, both pull and push actions should be developed.

As of 1 February 2024, Vilnius had a total of 535 electric vehicle (EV) charging points, consisting of 299 medium-power chargers (up to 22 kW) and 236 high-power chargers (above 22 kW). The city envisions further expansion of this network, with charging hubs being installed along the busiest roads and in parking areas. This development is part of a broader strategy to encourage the adoption of electric vehicles (EVs) by making charging infrastructure more accessible, thereby facilitating the shift from fossil fuel-powered cars to cleaner electric alternatives.

By 2030, Vilnius aims to significantly increase the number of EV charging points to 7,100. Importantly, the city will ensure that the electricity used to power these vehicles is derived from RES, aligning with its commitment to sustainability. The installation of new chargers for electric vehicles should be carried out with full respect for green and recreational areas to avoid harming these spaces.

The use of Smart Local Power Systems will play a crucial role in this transition, as they allow for a greater share of renewable energy in the electricity supply. These systems help stabilize and ensure a continuous supply of renewable energy, even in cases of power disruptions.

Additionally, energy storage solutions and off-grid installations will be employed to maintain energy security, ensuring that electric vehicles can be reliably powered even in the event of grid failures.

This expansion of the EV charging network, combined with the focus on renewable energy, will not only support the growing number of electric vehicles in Vilnius but also contribute to the city's broader goals of reducing carbon emissions and promoting cleaner, greener transportation solutions.

The newly installed electric vehicle charging points will either fill a gap in the car sharing system or be available to the general public, depending on the city's decision. The city can fully manage the network of new electric vehicle chargers as a concession or in a Private Public Partnership (PPP) Build Operate Transfer (BOT) model with parking operators (as in Tainan City).

Targeted results of the action and costs (CapEx)

Installation of 5,500 medium power (22 kW) charging points for electric vehicles	€8,014,800
Installation of 1,600 high power (50 kW) charging points for electric vehicles	€4,523,300

Operational Costs (OpEx)

- Maintenance costs for electric vehicle charging stations – €626,900

City's strategy / policy / plans

- Vilnius Sustainable Urban Mobility Plan (SUMP)

Potential action location

To be identified

Source: unsplash.com

Implementing body

Vilniaus miesto savivaldybės administracija, VMSA

Key supporting actors

SĮ "Susisiekimo paslaugos, JUDU", as the Technical advisor

UAB "Vilniaus apšvietimas" as the Consultant

Supporting & relevant actions

- E5 Developing a flexible energy storage system
- B4 Promoting quarterly modernisation of residential buildings
- T4 Development of infrastructure for multimodal points
- LU3 Development of local plans and land use standards

Potential sources of financing

- Municipal Budget,
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc.,
- InvestEU,
- New Generation Lithuania: Component Green Transformation of Lithuania,
- Climate Change Program,
- National Energy and Climate Action Plan (3. Policies and measures, T7. Promoting the purchase of cleaner vehicles),
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)
- CEF Transport Alternative Fuels Infrastructure Facility (AFIF)

T5 Expansion of the network of public charging stations and charging points for electric cars

Related Challenges

1. Approximately 48% of the vehicle fleet is diesel-powered, emitting pollutants that can reduce air quality.
2. While there has been progress with alternative fuel vehicles, adoption is still at a low level. Further development is limited by insufficient charging infrastructure for electric vehicles (for public and private transport).

Directly addressed Strategic Goals

1. SGEN1 Scaling up renewable energy solutions and achieving energy efficiency and independence.
2. SGT1 Changing residents' mindset and behaviour towards culture and modes of daily travel.

Supported Targets

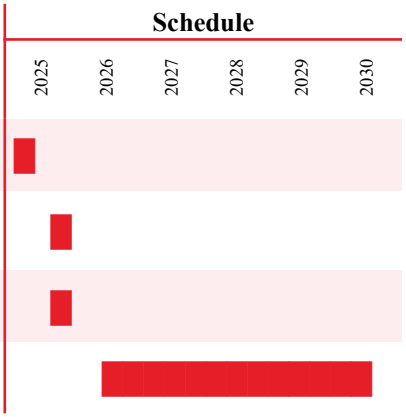
1. ID 11. Transport modal share in commuting – less than 30%

Projected benefits

- ✓ **Job creation potential: 10–20**
- ✓ Expanding charging stations support the transition to electric cars, reducing GHG emissions and noise
- ✓ Sustainable transportation is promoted
- ✓ Increased accessibility and convenience for electric car owners
- ✓ Support for the electric vehicle industry

Milestones

		Schedule
1	Conduct a needs assessment to identify optimal locations for 5,500 medium power (22 kW) and 1,600 high power (50 kW) electric vehicle charging points.	
2	Evaluate and select vendors for the supply and installation of medium high-power charging stations.	
3	Develop a detailed installation plan for the deployment of medium and high-power charging points across the city.	
4	Installation of all 5,500 medium power and 1,600 high power charging points, ensuring full operational readiness.	



Smart City Potential

- An existing or new digital platform/application could act as a one-stop-shop for managing and promoting these actions, potentially serving as a hub for awareness campaigns and knowledge sharing. This platform would facilitate collaboration between the city, government, and private companies to develop an electric car incentive scheme and promote the growth of electric car sharing (combined with action B2 and B4).
- As in Tainan City, sensors and IoT devices can be used to monitor station performance, detect issues early, and predict maintenance needs. The introduction or use of existing mobile apps and reservation systems will allow users to easily locate, reserve and pay for charging points.
- For future phases, Vehicle-to-Grid (V2G) Technology, which enables bi-directional charging, will allow EVs to feed electricity back into the grid during periods of high demand, promoting energy efficiency. It is also important that the city adopts a single integrated operating system (IOS) for all EV charging stations to ensure seamless management, data collection, and user interaction across the network.

Gender Equality and Social Inclusion

- To ensure that EV charging stations are accessible to all users and to design them with features such as low-height charging points and clear signage. These features make it easier for individuals with disabilities to use the stations comfortably and independently.
- Implementing smart charging solutions with a focus on safety. This includes placing charging stations in well-lit and secure locations to address concerns like harassment or safety, which can disproportionately affect women. Ensuring these measures are in place can create a safer and more welcoming environment for all users.

WATER

Summary of Action Plan – Water

Three capital investments have been prepared to monitor and modernise wastewater infrastructure, optimise the use of stormwater for green spaces and eliminate losses, as well as ensure the proper maintenance of the water supply network. The Vilnius Wastewater Treatment Plant has set an ambitious goal of becoming climate-neutral by 2032. One of the GCAP actions will contribute to achieving this objective.

Below is a summary of the planned actions for the water sector.

Table 8 Summary of actions in the water sector

W1 Strengthen the city's resilience to surface water run-off
• Development of surface water treatment plants and storage facilities to reduce the negative impacts of climate change on the environment and urban infrastructure. • Preparation of a specific plan for the management of surface water. • Expansion of 18 km of a surface wastewater network in problematic areas of the city. • The feasibility study and technical design for green space using stormwater to water green areas. • Construction of green space using stormwater to water green areas (0.5 ha).
W2 Power generation installations for water and sewage infrastructure facilities
• Solar photovoltaic power plants (4,000 kW). • Reconstruction of thermohydrolysis digester. • The construction of a sludge mono-incineration plant.
W3 Resilience of water supply system
• Construction of a new water supply networks (170km). • Emergency response in water supply networks. • Replacing submersible pumps. • Repair of wells in water supply networks. • Renovation of water bodies and wells. • Water pumps, renovation of water pump stations. • Waterproofing of water pumping tanks/strengthening of structures • Waterproofing of water tanks • Installation of a digital network (remote reading invasive flowmeters, valve position sensors, hydrant sensors, etc.) • Publicity and education campaigns.

Water sector financing route

CapEx:

» €235,590,000

OpEx (annual):

» €2,729,700

Estimated cost savings (annual):

» €1,076,200

Potential sources of financing:

» Municipal budget

» Municipal Companies

» Private sources through partnership with the city in a form of BOO, BOT, DBO, etc.

» InvestEU,

» Horizon Europe (Pillar II)

» The Innovation Fund

» Modernisation Fund

» NER 300 programme

» New Generation Lithuania: Component Green Transformation of Lithuania

» Climate Change Program

» Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)

Reduction of tCO_{2e} (annual):

» 11,894 tCO_{2e}

7.6 Actions in water sector

Key Conditions

W1 Strengthen the city's resilience to surface water run-off

UAB “Grinda” manages about 2,055 km of surface drainage networks, collects and treats surface water (rain and snowmelt) in Vilnius. Currently, treated surface water is collected from 2,730 ha of the 8,830 ha territory (from 31% of the total area). A total of 13 large surface water treatment plants are in operation, with a capacity of 16,170 l/s. In addition, UAB “Vilniaus vandenys” manages surface water from 884 ha. The varied topography of Vilnius, with elevation differences of up to 120 m, poses a challenge to stormwater management and contributes to frequent street flash flooding due to the underdeveloped collection and treatment system. After scanning 15,500 stormwater manholes in Vilnius and creating hydraulic and numerical models of 500 km of the stormwater network, the company will be able to start modelling different scenarios, assess the system’s capacity to handle higher stormwater flows, and respond accordingly to anticipated urban development or pipeline reconstruction needs.

In its 2023 Financial Report, UAB “Grinda” stated that research results confirm that efforts to systematically manage stormwater in Vilnius through the construction of new surface water treatment plants are yielding exceptionally good results. The section of the Neris River near Žemieji Paneriai, where the river flows through the city’s industrial zone is of greater concern due to higher levels of oil-based pollution. The construction of two new surface water treatment plants on Eigulių Street (including the Savanorių-Giraitė basin and the Vilkpėdė-Savanorių basin) in 2022–2023 has contributed to improving the ecological situation in this part of the Neris. Based on the scheme of development stages for centralised networks, it is worth noting the areas of decentralised domestic wastewater management that may result in inefficient stormwater management. The largest such area is located in the southern part of Vilnius, in Daškūnai, with smaller areas near Pramonės Street and in the north-eastern part of the city.

In addition, city identified locations with potential pollution sources and these sites require in-depth analysis and the development of plans to reduce the risk of wastewater contamination. Currently, on Kalvarijų Street in the central part of Vilnius, a separate surface water collector with a diameter of up to 1.5 m and a length of 2,161 m is being installed along the section from Žaliojo Bridge to Apkasų Street. This will prevent stormwater from mixing with domestic sewage. In addition, an underground surface water treatment plant with a capacity of 620 l/s was installed at Upės Street, where stormwater is treated to remove residual petroleum products and suspended solids.

To support all the necessary surface water management works, J. Rutkausko and Pilaitės Streets have developed a project which aims to revitalise the pond that has turned into a swamp. The designers propose to fill it with surface water from neighbouring properties. It is essential to use blue-green and NBS in a systemic way (vegetated walkways, permeable surfaces, green facades, retention ponds, green car parks, green roofs, constructed wetlands, bioretention areas, green bus stops, rain gardens, underground water storage, bioretention ditches, localised bioretention swales, run-off troughs, absorption ditches, household stormwater tanks, hydrophytic ponds, filter basins) to support the surface water treatment infrastructure.

For example, rain gardens are an effective solution for absorbing and filtering stormwater runoff. These are shallow, vegetated basins that collect and absorb runoff from roofs, streets and pavements. Other examples include green roof systems that capture stormwater, reduce runoff and improve building insulation. In addition, permeable pavements made of porous materials that allow stormwater to infiltrate into the ground. The implementation of water resilient landscaping and local stormwater management solutions will reduce pressure on the combined stormwater and wastewater system.

W2 Power generation installations for water and sewage infrastructure facilities

UAB “Vilniaus vandenys” is partly owned by the municipality and provides water supply and wastewater services to the city of Vilnius and the district municipalities of Vilnius, Švenčionys and Šalčininkai. According to the data, the company operated 33 water bodies, 287 wells, 153 water supply pumping stations, 21 water treatment plants, 422 water intakes and 1,811 km of water supply pipelines. For wastewater treatment the company operated six wastewater treatment plants (the largest of which is the Vilnius City Wastewater Treatment Plant), 258 wastewater pumping stations and 1,530 km of wastewater networks.

In the activity and development plan of UAB "Vilniaus vandenys" for 2023–2027, one of the strategic goals is "Development of renewable energy and circular economy". The main tasks of this goal include activities and projects related to renewable energy, circular economy projects and sewage sludge management. The company plans to achieve energy independence by 2032 through the use of RES such as electricity from sewage sludge, solar energy and wind energy. The existing wastewater treatment plant produces green biogas from the digested sludge and solar power. This produces 25.9% of the company's electricity needs (water and wastewater sector activities including administration buildings).

The company installed solar power plants in 2021–2023. UAB "Vilniaus vandenys", produces almost a quarter of the country's sewage sludge each year. The possibility of burning the sludge in a sludge mono-incinerator is also being considered in order to achieve energy independence for the Vilnius Wastewater Treatment Plant. As the Vilnius Wastewater Treatment Plan already has a biogas plant in operation and all biogas produced from the sludge is used to generate electricity and heat, the full potential of biogas is considered to have been realised. Wastewater sludge is safely disposed of, 90% is composted and used as agricultural fertiliser and 10% is used as biofuel for cement production.

W3 Resilience of water supply system

Most of the drinking water supplied in Vilnius comes from deep underground wells (40 to 245 metres deep). Factors such as the topography of Vilnius, which necessitates pumping water to elevated areas, contribute to an increased risk of leaks and bursts in the water network. Water has to be pumped several times, so reducing energy consumption for water production and delivery is a major challenge. The city is also tackling the problem of ageing pipes, 60% of which are 30 years old and deteriorating.

UAB "Vilniaus vandenys" has developed a long-term strategy that defines strategic goals for reducing water losses and preventing water infiltration. It is necessary to strengthen the existing water supply networks to make them more resilient and better able to cope with disruptions or challenges, while at the same time striving to maximise the energy efficiency of the systems, ensuring that they operate with minimum energy consumption while maintaining effective performance. In the event of a nuclear incident at the Astravo nuclear power plant in Belarus, which could affect the local water supply, the city needs to be prepared for such a scenario and ensure the supply of clean water to residents.

To ensure a continuous and safe water supply, it is essential to diversify water sources, improve infrastructure and prepare for emergency situations. In addition, UAB "Vilniaus vandenys" runs the "White Zones" (lit. "Baltos zonos") programme to support the residents of the areas closest to the city centre within the municipality of Vilnius, where there is no central drinking water supply or domestic sewage network and where the residents still are not able to connect to the central network. In 2025–2026, UAB "Vilniaus vandenys" will extend the water supply and sewerage network and connect the residents of Antakalnio, Naujosios Vilnios, Senamiesčio, Vilkpėdės, Verkių, Šnipiškių and Pilaitės districts to the centralised water supply and sewerage network.

W1 Strengthen the city's resilience to surface water run-off

Timescale
2025–2030

CapEx € 88,693,000
OpEx € 885,600

Action type
Investment – upgrade/retrofit

Action description

This action includes the development of surface water treatment plants and storage facilities. The construction of new surface water treatment plants will increase the proportion of urban areas where water is treated before being discharged into open water, thereby reducing negative environmental impacts. In addition, the planned development of surface water storage facilities will help manage the high surface water flows generated by heavy annual rainfall events caused by climate change. This will not only reduce the risk of flooding to the city's infrastructure and surrounding areas, but also minimise the risk of damage to third parties and protect the health of the city's population.

In addition, a specific plan for managing surface water in the city, including reviewing and refining solutions for problematic sites or structures, will be essential in the next stages. The plan should also include an analysis of the areas most likely to experience the highest rainfall and flooding or inundation. It is therefore recommended to prepare comprehensive risk assessments and develop a robust emergency response plan.

Moreover, it is assumed that 10% or 18 km of the surface water network expansion needs estimated by UAB “Vilniaus vandenys” (180 km) will be reconstructed under this action. The new Special Plan for Development of Surface Water Management Infrastructure, provides information on the needs for the development of surface water management infrastructure in priority areas of Vilnius City: Pilaitė, Smalinė, Zujūnai, Minsko pl. Kuprioniškės, Kalnėnai, Pavilionys, Bajorai, Lentvaris (Vaidegiai) and Naujoji Vilnia (Verbos).

It is recommended that green areas are selected for pilot projects that implement blue-green and NBS, using stormwater for irrigation. Within this task, traditional green areas will be transformed into multifunctional green infrastructure which provide water treatment, water recirculation, and extra storage. Green areas of approx. 0.5 ha have been recommended for pilot projects. The development of a water catchment area system is also an integral part of the construction of green spaces, serving both the infrastructure needs and the recreational spaces of the city. A feasibility study and technical design will need to be conducted before implementation of the pilot project can begin. In addition, the city should consider implementing Water-Sensitive Urban Design (WSUD), which includes stormwater harvesting solutions for green spaces. Citizens will be also encouraged to collect and reuse stormwater for various domestic purposes. Where feasible, collected stormwater can be used for watering lawns or plants.

Targeted results of the action and costs (CapEx)

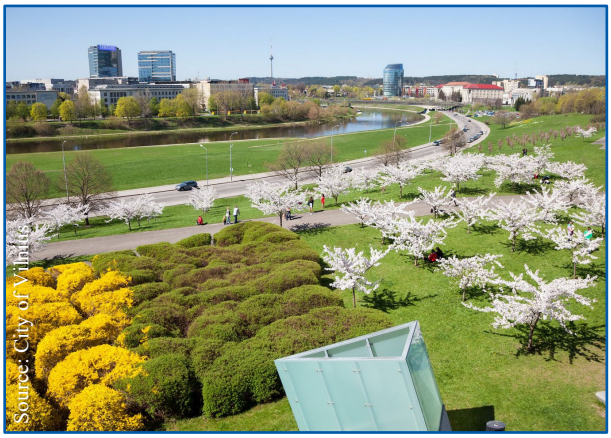
Development of surface water treatment plants and storage facilities to reduce the negative impacts of climate change on the environment and urban infrastructure	€38,872,000
Preparation of a specific plan for the management of surface water	€150,000
Expansion of 18 km of a surface wastewater network in problematic areas of the city	€49,500,000
The feasibility study and technical design for green space using stormwater to water green areas	€64,000
Construction of green space using stormwater to water green areas (0.5 ha)	€107,000

Operational Costs (OpEx)

- The operation and maintenance of the built infrastructure (i.e., repairs, maintenance) and the cost of licences and subscriptions for the use of software – €885,600

Potential action location

To be identified



Implementing body

UAB “Grinda”

Key supporting actors

Vilniaus miesto savivaldybės administracija, VMSA as the Approval authority

Supporting & relevant actions

- W2 Power generation installations for water and sewage infrastructure facilities
- LU2 Protection and restoration of valuable green areas
- LU3 Development of local plans and land use standards
- LU4 Redeveloping existing urban land to increase liveability

Potential sources of financing

- Municipal budget,
- Municipal Companies,
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc,
- InvestEU,
- Horizon Europe (Pillar II),
- The Innovation Fund,
- Modernisation Fund,
- NER 300 programme,
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)

City’s strategy / policy / plans

- UAB “Grinda” Strategic Plan 2025–2027
- UAB “Vilniaus Vandenys” Operational and Development Plan 2023–2027

W1 Strengthen the city's resilience to surface water run-off

Related Challenges

1. Inadequate condition of the stormwater drainage system.
2. Inadequately treated sewage causing pollution.

Directly addressed Strategic Goals

1. SGE3 Establishing infrastructure resilience and implementing city adaptation measures to effectively respond to climate change impacts and urban sprawl pressure.
2. SGW1 Strengthen city stormwater resilience by creation of a stable and robust infrastructure for stormwater collection and the implementation of nature-based solutions.

Supported Targets

1. ID 2. Biochemical Oxygen Demand BOD in rivers and lakes – less than 2 mg/L
2. ID 9. Estimated economic damage from natural disasters floods droughts earthquakes etc. as a share of GDP – less than 0.5% of GDP

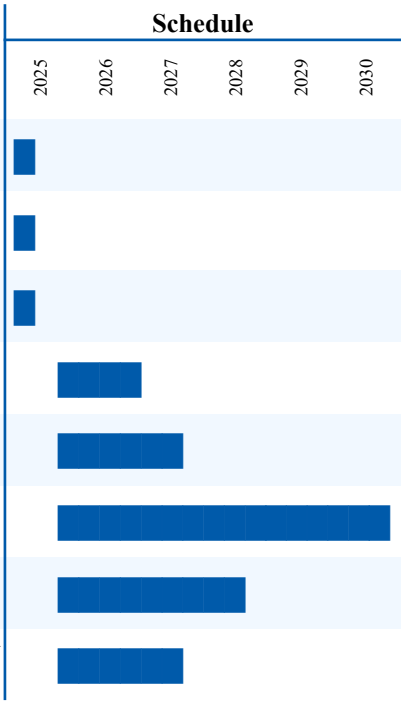
Projected benefits

✓ **Reduction of 9,883.00 tCO_2**
Green City Action Plan Estimations

✓ **Job creation potential: 100–200**

- ✓ Improving water quality
- ✓ Preventing urban flooding
- ✓ Reducing surface water pollution
- ✓ Benefiting health and aquatic ecosystems
- ✓ Enhancing resilience to climate change effects

Milestones



1	Conduct feasibility studies and technical designs for the construction or reconstruction of surface water treatment plants, storage facilities and networks.
2	Inventory and digitise data for the existing stormwater networks to guide reconstruction and monitoring efforts.
3	Secure necessary permits, approvals, and funding for all reconstruction and green infrastructure projects.
4	Start construction of two selected surface water treatment plants, focusing on improving the efficiency and removal of pollutants from wastewater.
5	Restore surface water networks in selected streets and install pollution monitors to monitor water quality in real time.
6	Installation of a new surface water networks to ensure appropriate urban development and integration with existing surface water management infrastructure.
7	Building new surface water reservoirs in problem areas of the city to reduce pressure on existing networks.
8	Select green spaces for pilot projects that implement NBS for stormwater irrigation, based on study recommendations.

Smart City Potential

- Sensors enable real-time monitoring of water levels (hydrostatic sensor), flow rates (ultrasonic flow meter) and water quality (parameters such as pH, temperature, dissolved oxygen, conductivity, and turbidity) offering a comprehensive solution for water management. The remote operation of automated valves and gates allows for the regulation of water flow in storm drains, thereby reducing the risk of flooding and optimising the distribution of stormwater. The results collected by the sensors could be published on the web platform – Hydrometeorological Service.
- RF acoustic sensors are used to detect the location and extent of losses and leaks in pipelines. They are also utilised in prediction with artificial intelligence, analysis with noise loggers, extension of SCADA and IoT WAN communications.
- Upgrade a hydraulic model (including watersheds and the city's water supply system) to detect and predict rainfall patterns, optimise stormwater management operations, and improve the efficiency of the stormwater collection system. Soil moisture sensors are also used to optimise irrigation of the city's green spaces.

Gender Equality and Social Inclusion

- Consider the specific needs of women and underserved groups. This includes designing safe access routes to stormwater-managed green spaces and public areas, particularly in flood-prone areas where women and caregivers may face mobility issues.
- Actively engage women and underserved groups in the planning and design phases of Surface water drainage projects. This can be achieved through gender-responsive community consultations and public participation processes, providing avenues for women to voice their concerns, especially in flood-affected neighborhoods.
- Include women centred training programs on stormwater management and NBS. These programmess can promote women's participation in technical and environmental roles within water resilience projects, empowering them to contribute to and lead these initiatives.

W2 Power generation installations for water and sewage infrastructure facilities

Timescale
2025–2030

CapEx € 98,323,000
OpEx € 1,363,600

Action type
Investment – upgrade/retrofit

Part of the Climate City Contract Action Plan

Action description

UAB "Vilniaus vandenys" plans to continue the solar project in 2024-2027 by building a larger number of solar power plants for its own needs – this involves purchasing batteries for energy storage. In 2023, the third phase of photovoltaic power plant installation began, with the installation of ground-based solar power plants on water reservoirs used by the company. In the final stage, photovoltaic power plants will be installed on the roofs of buildings at the Vilnius Wastewater Treatment Plant.

A decade ago, UAB "Vilniaus vandenys" invested around €45 million in specialist equipment to produce green energy from the biogas. This electricity was used to power the plant and generate thermal energy for sludge drying. To make efficient use of the biogas produced at the company's treatment plants, the company is currently investing in the reconstruction of thermohydrolysis digester. The new thermohydrolysis digester will allow maximum utilisation of the biogas, increase the amount of green electricity, ensure uninterrupted power generation during downtimes and allow electricity to be produced from a larger volume of biogas. The capacity of the rebuilt plant will be 72 tonnes of wastewater per day.

Natural gas is used in the sludge drying process at UAB "Vilniaus vandenys". The aim is to use sludge mono-incineration for energy production. The construction of a sludge mono-incineration plant by UAB "Vilniaus vandenys" would use the heat generated to dry the sludge, resulting in a closed process. The planned mono-digester will have the capacity to process 12,000 tonnes of dry material per year, i.e. the capacity of the plant will be about 30% higher than at present. The additional production will cover up to 15% of the company's total electricity needs. Once the project is completed, the company will be able to meet 38% of its annual electricity demand.

Targeted results of the action and costs (CapEx)

Solar photovoltaic power plants (4,000 kW)	€4,698,000
Reconstruction of thermohydrolysis digester	€5,000,000
The construction of a sludge mono-incineration plant	€88,625,000

Operational Costs (OpEx)

- Operating and maintenance costs of photovoltaic panels on the PV farms – €44,600
- Operational costs of mono-incineration plant– €1,319,000

City's strategy / policy / plans

- UAB "Vilniaus Vandenys" Activity and development plan for 2023–2027
- Comprehensive Plan of Vilnius
- Vilnius Strategic Development Plan 2030
- Sustainable Energy and Climate Change Action Plan 2030

Potential action location

Titnago g. 74, Vilnius

Implementing body

UAB "Vilniaus vandenys"

Key supporting actors

Vilniaus miesto savivaldybės administracija, VMSA as the Approval authority

Supporting & relevant actions

- E4 Building Renewable Energy Community
- E5 Developing a flexible energy storage system
- W1 Strengthen the city's resilience to surface water run-off
- W3 Resilience of water supply system

Potential sources of financing

- Municipal Companies,
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc,
- InvestEU,
- Horizon Europe (Pillar II),
- The Innovation Fund,
- Modernisation Fund,
- NER 300 programme,
- New Generation Lithuania: Component Green Transformation of Lithuania,
- Climate Change Program,
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)

W2 Power generation installations for water and sewage infrastructure facilities

Related Challenges

1. Low energy independence in water supply and water treatment infrastructures.
2. Vulnerability of existing system on climate change.

Directly addressed Strategic Goals

1. SGE1 Achieving the city's climate neutrality by 2030.
2. SGW2 Ensuring energy independence and climate resilience in water infrastructure support by renewable energy sources and digital solutions.

Supported Targets

1. ID 23 Proportion of total energy derived from RES as a share of total city energy consumption in TJ – more than 27%
2. ID 22.2. Share of district heating from carbon intensive sources – less than 10%

Projected benefits

✓ **Reduction of 2,011.00 tCO_2**
Climate City Contract Action Plan Estimations

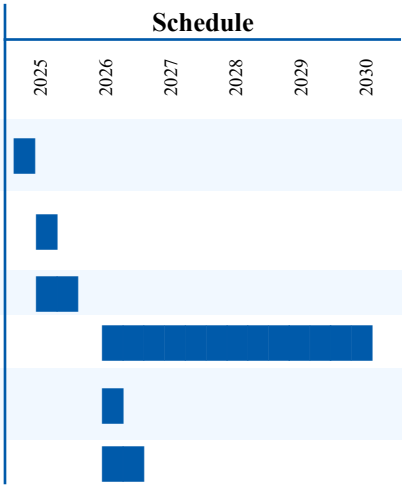
✓ **Job creation potential: 10–50**

- ✓ Energy transition
- ✓ Reduced reliance on external energy, enhanced resilience
- ✓ Lower operational costs and utility bills
- ✓ Continued operation during extreme weather and grid failures
- ✓ Fostered innovation and potential funding
- ✓ Long-term stability with energy independence by 2030

Estimated cost savings (EUR per year)

- ✓ Savings from own energy production – €1,076,200

Milestones



1	Conduct a comprehensive energy audit of water and sewage infrastructure facilities to assess current energy usage and identify potential for on-site power generation.
2	Develop a detailed implementation plan for the installation of power generation systems across water and sewage facilities, including timelines and resource requirements.
3	Develop detailed engineering designs and specifications for the mono-incineration plant.
4	Carry out the construction of the mono-incineration plant according to the detailed design.
5	Secure necessary permits, approvals, and funding for the installation of renewable energy systems at the identified sites.
6	Reconstruction of thermohydrolysis digester.

Smart City Potential

- To meet the demand for green electricity, the city could join a power purchase agreement (PPA) from a renewable source, such as wind or a power farm. It would involve using digital platforms for tracking energy production, consumption, and compliance with contract terms. This would encourage private investors in renewable energy to develop renewable energy parks and provide the city with clean energy.
- Integrating an energy management system (EMS) into the wastewater treatment plant is essential. This system would require additional sensors and smart meters within the plant to monitor energy consumption and production in real time. It should include smart meters – devices that measure the energy consumption of various processes within the wastewater treatment plant and provide data for analysis and optimisation; IoT sensors that can monitor the performance of RES, such as solar panels, to ensure they are operating at peak efficiency; and other environmental sensors that can track conditions, such as temperature and humidity, that can affect energy production and system performance.

Gender Equality and Social Inclusion

- Enhanced green energy production and reduced reliance on fossil fuels significantly improve air quality and environmental conditions. These benefits are particularly impactful for vulnerable groups, such as those with caregiving responsibilities or individuals living in areas heavily affected by pollution.
- Leveraging the development of power generation infrastructure to create employment opportunities is a key strategy. By focusing on technical and management roles, we can ensure diverse representation in the renewable energy sector. Introducing training programmes focused on renewable energy and energy management is essential for achieving employment parity. These programs can equip individuals from underrepresented groups, including women, people with disabilities, and others facing barriers, with the skills and knowledge needed to thrive in this industry.

W3 Resilience of water supply system

Timescale
2025–2030

CapEx € 48,574,000
OpEx € 480,500

Action type
Investment – upgrade/retrofit

Action description

The average age of the water supply networks should be 25 years (50% depreciation), otherwise the risk of accidents and environmental pollution increases – continuous modernisation is necessary.

The company stated that 170 km of water supply networks need to be developed and that the demand for apartments connected to centralised water supply networks is 5,000. UAB "Vilniaus vandenys" expects to improve the water loss rate in the network from 13.6% to 9% by 2033, for this reason, work on emergency response in water supply networks is required.

The strategy suggests that the only way to reduce losses in residential buildings to the permitted 2% (previously 10%) is to install ultrasonic (or similarly accurate) water meters with remote reading. It is planned that all meters will be equipped with remote reading by 2030.

Emergency response in water supply networks refers to the coordinated actions and strategies implemented to quickly address and resolve incidents that disrupt the normal operation of a water supply system. In order to reduce water losses (caused by leaks, accidents in the main and district networks and failures in the internal networks of buildings, inaccuracies in the meters, lack of reporting discipline in multi-family houses), the company plans to continue the already initiated project of installing ultrasonic meters with remote reading in apartments, private houses and companies (part of the Action E3).

It is also noted that due to the growing number of users and the desire to improve the efficiency of water management facilities, renovations of reservoirs and wells, installation of waterproofing of water pumping tanks are planned. Energy-efficient solutions will be sought to replace or renovate the existing worn-out pumps, classified according to a ranking methodology, with low-energy pumps.

Consumer education on water saving is crucial for fostering a responsible approach to water consumption. Highlighting its importance, a publicity and education campaign can effectively raise awareness and encourage sustainable water use practices among the public.

Targeted results of the action and costs (CapEx)

Construction of a new water supply networks (170km)	€40,800,000
Emergency response in water supply networks	€1,830,000
Replacing submersible pumps	€495,000
Repair of wells in water supply networks	€2,591,000
Renovation of water bodies and wells	€1,008,000
Water pumps, renovation of water pump stations	€410,000
Waterproofing of water pumping tanks/strengthening of structures	€200,000
Waterproofing of water tanks	€150,000
Installation of a digital network (remote reading invasive flowmeters, valve position sensors, hydrant sensors, etc.)	€570,000
Publicity and education campaigns	€520,000

Operational Costs (OpEx)

- The operation and maintenance of the built infrastructure (i.e., repairs, maintenance) and the cost of licences and subscriptions for the use of software – €480,500

Potential action location

To be identified


Source: unsplash.com

Implementing body

UAB "Vilniaus vandenys"

Key supporting actors

Vilniaus miesto savivaldybės administracija,
VMSA as the Approval authority

Supporting & relevant actions

B1 Upgrading municipal buildings and their systems

B2 Promoting the modernisation of multi-apartment buildings

W1 Strengthen the city's resilience to surface water run-off

W2 Power generation installations for water and sewage infrastructure facilities

Potential sources of financing

- Municipal budget,
- Municipal Companies,
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc,
- InvestEU,
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)

City's strategy / policy / plans

- Long-Term Strategy of UAB "Vilniaus vandenys" for 2024–2033
- UAB "Vilniaus Vandenys" Activity and development plan for 2023–2027
- Comprehensive Plan of Vilnius
- Vilnius Strategic Development Plan 2030

W3 Resilience of water supply system

Related Challenges

1. Deterioration of the water supply network pipelines.
2. Insufficient leak identification and repair.

Directly addressed Strategic Goals

1. SGE3 Establishing infrastructure resilience and implementing city adaptation measures to effectively respond to climate change impacts and urban sprawl pressure.
2. SGW2 Ensuring energy independence and climate resilience in water infrastructure support by renewable energy sources and digital solutions.

Supported Targets

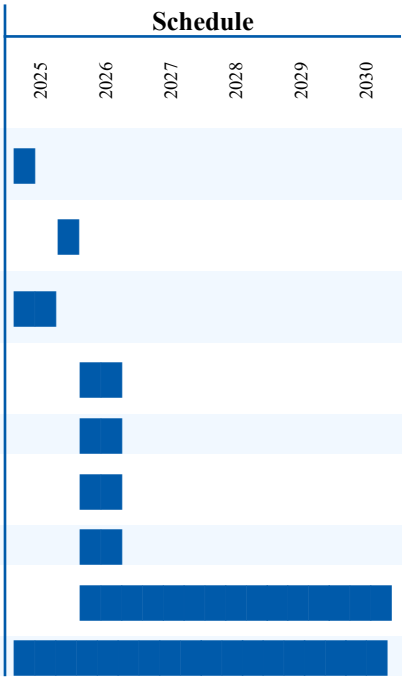
1. ID 2. Biochemical Oxygen Demand BOD in rivers and lakes – less than 2 mg/L
2. ID 9. Estimated economic damage from natural disasters floods droughts earthquakes etc. as a share of GDP – less than 0.5% of GDP

Projected benefits

✓ **Job creation potential: 50–100**

- ✓ Water saving
- ✓ Enhanced resilience
- ✓ Reduced energy reliance and lower costs
- ✓ Consistent, high-quality water delivery
- ✓ Lower maintenance costs and improved efficiency
- ✓ Future-ready infrastructure with digital networks and sensor technology

Milestones



1	Conduct a detailed survey and assessment to map out the route and design for the new 170 km water supply network.
2	Secure necessary permits, approvals, and funding for the construction of the new water supply network.
3	Install real-time monitoring systems to detect and alert teams to potential issues in the water supply network.
4	Replacement of submersible pumps in high-priority areas where performance issues are most critical.
5	Repairs on the most critical wells, focusing on structural integrity and water quality restoration.
6	Renovation of the most critical water bodies and wells, focusing on restoring structural integrity and water quality.
7	Renovation work on high-priority pump stations, focusing on improving efficiency and reliability.
8	Installation of a new water supply pipelines and related infrastructure, ensuring proper alignment and connection to existing networks.
9	Publicity and education campaigns

Smart City Potential

- The incorporation of sensors into a unified system for monitoring water flow and controlling the city would be an effective supplementary solution to this initiative. To achieve this, telemetry and metering technologies should be deployed throughout the pipeline. Specifically, flow and pressure meters can be used to monitor the movement and pressure of water within the system, while a Supervisory Control and Data Acquisition (SCADA) system can provide real-time data collection, control, and analysis. This integration will help minimise loss and leakage rates in the city's water network and reduce operating costs through remote meter reading.
- The Water Supply Unit should also further develop District Metered Areas (DMA) to address the challenge of water leakage.
- Additionally, this initiative would enhance and further feed the GIS platform of the water supply and distribution system, providing a stable basis for developing a digital twin of the entire system.

Gender Equality and Social Inclusion

- Improved water supply infrastructure and reduced water losses significantly enhance water quality and availability, benefiting the entire society. This is especially crucial for households where vulnerable individuals, such as the elderly and low-income families, are primarily responsible for managing water-related tasks.
- Given that women, particularly in low-income or elderly households, often bear the responsibility for managing water resources, it is important to prioritise the implementation of household-level water-saving technologies, which can significantly reduce the workload and stress associated with water management.
- Providing capacity-building programs focused on water conservation, household water management, and community water governance is another key strategy. These programs can empower women and other underrepresented groups to take on decision-making roles and include technical training for women in the maintenance and operation of water infrastructure.

SOLID WASTE

Summary of Action Plan – Solid waste

The solid waste sector includes five capital investments, such as the construction of DĖK'UI stations and DGASA bulky waste collection sites, establishment of an educational centre, development of a smart waste management system as well as improvements to food waste treatment infrastructure. The solutions will facilitate a significant increase in recycling and solid waste separation at the source, thereby reducing the sorting that occurs at a later stage. In order to promote the innovations undertaken by the city and to raise awareness of the population about circular waste management (separate collection, processing and recovery), it is recommended to carry out a series of public campaigns and workshops.

Beside is a summary of the planned actions for the solid waste sector.

Solid waste sector financing route

CapEx:

- €34,334,700

OpEx (annual):

- €3,796,000

Potential sources of financing:

- Municipal Budget
- Municipal Companies – VAATC
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc.
- InvestEU
- Horizon Europe (Pillar II)
- The Innovation Fund
- Modernisation Fund
- New Generation Lithuania: Component Green Transformation of Lithuania
- Climate Change Program
- National Energy and Climate Action Plan (K3. Prevention of food waste)
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)

Table 9 Summary of actions in the solid waste sector

SW1 Preventing waste generation through raising awareness and education
• Publicity and education campaigns. • Organisation of two large marketing/educational event focused on sorting waste for all residents. • Organisation of seven small marketing/educational workshops focused on sorting waste for all residents. • Establishment of the Educational Center. • Organise campaigns to promote reusable products and waste prevention through educational activities. • Promote the separate collection of various types of waste through publicity campaigns. • Continue the project to educate the Vilnius region's population on waste sorting, involving direct engagement with residents and dissemination of information through various media. • Develop a network of public drinking water stations to reduce plastic packaging waste. • Implement publicity measures to reduce food waste and improve people's food consumption skills.
SW2 Expanding the network of DĖK'UI stations
• Establishment of 11 additional DĖK'UI stations.
SW3 Further introduction of DGASA (lt. Didelių gabaritų atliekų surinkimo aikštelės) – bulky waste collection sites
• Development of nine DGASA points.
SW4 Upgrade of the local MBT facility
• A feasibility study to explore alternative treatment options for the liquid pulp derived from food waste. • Establishment of an infrastructure for the management of separately collected food waste. • Conduct a feasibility study to assess the potential for hydrogen production from municipal waste.
SW5 Developing a smart municipal waste management system
• The implementation of the smart waste management system in Verkiai district (for 10% or 5,800 people of the district).

7.7 Actions in solid waste sector

Key Conditions

SW1 Preventing waste generation through raising awareness and education

Current waste management activities in Vilnius are based on the national, regional and Vilnius Waste Prevention and Management Plan (2021–2027) and focus on waste prevention. The aim of waste prevention is to take action before a product or material becomes waste in order to reduce the amount of waste generated (in line with the EU waste hierarchy), reduce negative impacts on the environment and public health, and reduce the number of harmful substances in materials and products.

The population of Vilnius has increased by more than 10% in the last 10 years, but the amount of waste generated per capita has not followed a clear pattern. In the last decade (2012–2022), waste generation per capita decreased from 665 to 340 kg, however in the meantime the methodology of waste calculation has changed. The government has set a target that from 2025 the annual waste generation per capita should be below the EU average. While waste generation per capita in the EU has increased in recent years (with a slight decrease in 2022 to 513 kg), waste generation in Vilnius deviates positively from the EU average.

Currently the trend towards reuse is being promoted in Vilnius via:

- sharing infrastructure (e.g. "DĖK'UI" stations, sharing groups, etc.).
- VAATC educates citizens through Waste Culture initiative (www.atliekukultura.lt) and "DĖK'UI" website (www.stoteledekui.lt).
- SĮ "Vilniaus atliekų sistemos administratorius, VASA" runs the educational activity "Waste Basketball", which encourages the youngest citizens of Vilnius to understand the principles of responsible waste management and sorting. VASA also organises campaigns for businesses on waste management and sorting.

Furthermore, efficient waste management practices, recycling and upcycling strategies, composting and waste-to-energy conversion can mitigate the impact. The transition to a circular economy, where waste is minimised and materials are kept in use for as long as possible, is seen as a key approach to reducing the waste sector's carbon footprint and combating climate change.

SW2 Expanding the network of DĖK'UI stations

Sharing culture is improving – the trend towards reuse is gaining momentum and people are making more use of sharing infrastructure (e.g. "DĖK'UI" stations, sharing groups, etc.). DĖK'UI stations are drop-off and exchange points where residents can leave their unused items.

In Lithuania and other countries, various ways of sharing or exchanging items have already been created and are being newly implemented, but the idea implemented by VAATC – exchange stations for DĖK'UI is the first not only by its name, but also by its different principle of operation. Residents can view a virtual inventory on the website www.stoteledekui.lt and reserve items. When picking up, they can also take items they have not reserved. The DĖK'UI item exchange station is a true example of community involvement. The benefits of the DĖK'UI network of stations are mutual: residents are given the opportunity to dispose of unwanted items in good condition, legally, conveniently and without harm to the environment. People will not be charged for the delivered items; they go to their new owners free of charge.

SW3 Further introduction of DGASA (lt. Didelių gabaritų atliekų surinkimo aikštelės) bulky waste collection sites

Effective DGASA are an integral part of the city's municipal waste management system. The main objective of waste sorting facilities is to improve the separation of different types of waste, improve their quality as raw materials and sell them to waste recyclers. In addition to bulky waste (furniture, textile products, household appliances, car tyres), DGASA collection points also accept waste that can be processed into secondary raw materials (glass, plastics, metals, waste paper), construction and demolition waste (waste from the repair of dwellings and from yard waste). DGASA collection points do not accept waste from legal entities. They enable the safe and controlled disposal of waste, its proper management and achievement of the legally required levels of municipal waste recycling.

The idea of DGASA allows residents to dispose municipal waste, including hazardous waste. DGASA ensures that there is no illegal waste disposal by reducing the number of illegal

dumping incidents. Separate collection of bulky and hazardous waste reduces the risk of environmental pollution and enables waste separation and processing, which increases the possibilities of recycling and reuse of materials.

SW4 Upgrade of the local MBT facility

From January 2024, city residents collect food waste separately at the point of generation. Food waste separated by Vilnius residents in orange bags is collected in shared mixed waste containers.

Currently, food waste collected in orange bags is processed by mechanical biological treatment plant (MBT) along with other mixed municipal waste. The existing MBT facility will be upgraded for treatment of food waste, with a capacity of 20,000 Mg/year.

UAB "Energesman", the company operating the Vilnius MBT facility in the Vilnius region, invested €1 million in a pilot project for insect larvae technology in early 2024. This technology can process food waste collected to produce industrial proteins, biofuels and fertilisers.

Alternatively, the pulp can be used:

- for the production of compost, after mixing with food waste, at the same MBT facility,
- for biogas production, by transferring/selling the pulp to biogas producing companies (currently not considered by the city).

There are also plans to develop infrastructure to produce hydrogen from municipal waste, which could power vehicles such as public transport buses. The feasibility of such projects depends on proven technology that can effectively convert waste into hydrogen.

SW5 Developing a smart municipal waste management system

The municipal solid waste (MSW) management in Vilnius is administered by the local authority's public service organisations. Vilnius has established several DGASA sites in the city and has implemented various initiatives to encourage separation at source of dry recyclables and minimise mixed waste stream. The amount of mixed municipal solid waste collected per capita, however still high, decreases each year. In 2022 it was total of 192,660 tonnes of municipal solid waste. The nominal volume of mixed municipal solid waste increases slightly, in line with population grows. A decrease in municipal solid waste was observed only in 2020, when 145,000 tonnes of municipal solid waste was collected (decrease of 5.3% yty), which can be attributed to the effects of the pandemic and changes in consumption patterns but also waste categorisation/calculation methodology changes.

In Vilnius city waste collection methods include household containers, underground, semi-underground and above-ground containers (collection of mixed municipal waste and secondary raw materials: paper, plastic, glass, metal and textiles).

SW1 Preventing waste generation through raising awareness and education

Timescale
2025–2027

CapEx € 4,346,700
OpEx € 240,000

Action type
Investment – new

Part of the Climate City Contract Action Plan

Action description

Action steps include conducting a thorough needs assessment to evaluate community interests and educational priorities, followed by detailed planning and facility design.

Several educational initiatives are currently being implemented in the city; 1) The Education Centre - the interior of the building will be a living example of sustainability, as it will be built using various reused materials; 2) Organise campaigns to promote reusable packaging and waste prevention through educational activities. Develop a public information strategy targeting different audiences and monitor the effectiveness of these measures; 3) Encourage caterers to replace disposable products with reusable alternatives; 4) Encourage businesses and NGOs to adopt waste prevention practices by identifying and incentivising activities that contribute to waste prevention; 5) Promote the separate collection of different types of waste through publicity campaigns; 6) Continue the project to educate the population of the Vilnius region on waste sorting, including direct contact with residents and dissemination of information through various media; 7) Organise annual litter-picking campaigns to clean public spaces, involving cooperation between volunteers, waste managers, municipalities and NGOs; 8) Develop a network of public drinking water stations to reduce plastic packaging waste; 9) Conduct public awareness campaigns to reduce food waste and improve people's food consumption skills; 10) Establishing a community of educators to unify and improve waste management awareness, ensuring that everyone is engaged consistently and effectively.

All identified educational solutions will be differentiated according to the different target groups (citizens, students, medical facilities, businesses, etc.). It is also recommended to create a map of sustainable waste reduction projects to improve coordination and foster the exchange of best practices.

Targeted results of the action and costs (CapEx)

Publicity and education campaigns	€520,000
Organisation of two large marketing/educational event focused on sorting waste for all residents	€9,000
Organisation of seven small marketing/educational workshops focused on sorting waste for all residents	€7,700
Establishment of the Educational Centre	€2,000,000
Organise campaigns to promote reusable products and waste prevention through educational activities	€200,000
Promote the separate collection of various types of waste through publicity campaigns	€20,000
Continue the project to educate the Vilnius City's population on waste sorting, involving direct engagement with residents and dissemination of information through various media	€60,000
Develop a network of public drinking water stations to reduce plastic packaging waste	€1,500,000
Implement publicity measures to reduce food waste and improve people's food consumption skills	€30,000

Operational Costs (OpEx)

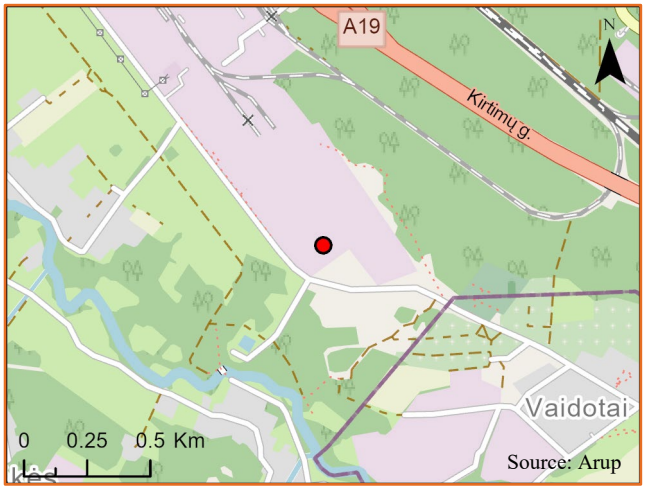
- 10 FTEs for maintenance and service in education centre – €240,000

City's strategy / policy / plans

- Vilnius City Municipality Waste Prevention and Management Plan 2021–2027

Potential action location

Graičiūno 36d, Vilnius



Implementing body

VAATC

Key supporting actors

Vilniaus miesto savivaldybės administracija, VMSA as the Approval authority

UAB "Vilniaus vandenys" as the Implementing partner

SĮ "Vilniaus atliekų sistemos administratorius, VASA" as the Implementing partner

Supporting & relevant actions

- B1 Upgrading municipal buildings and their systems
- B2 Promoting the modernisation of multi-apartment buildings
- SW2 Expanding the network of DĖK'UI stations
- SW3 Further introduction of DGASA (lt. Didelių gabaritų atliekų surinkimo aikštelės) – bulky waste collection sites

Potential sources of financing

- Municipal Budget,
- Municipal Companies – VAATC,
- New Generation Lithuania: Component Green Transformation of Lithuania,
- National Energy and Climate Action Plan (K3. Prevention of food waste),
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)

SW1 Preventing waste generation through raising awareness and education

Related Challenges

1. As the City's economy continues to develop, waste generation is expected to continue rising.
2. Poor citizen awareness about their waste management obligations.

Directly addressed Strategic Goals

1. SGSW1 Strengthening a robust waste management system through the integration of public-private partnerships.
2. SGSW2 Enhancing the realisation and utilisation of circular economy principles along with citizens and businesses awareness and education.

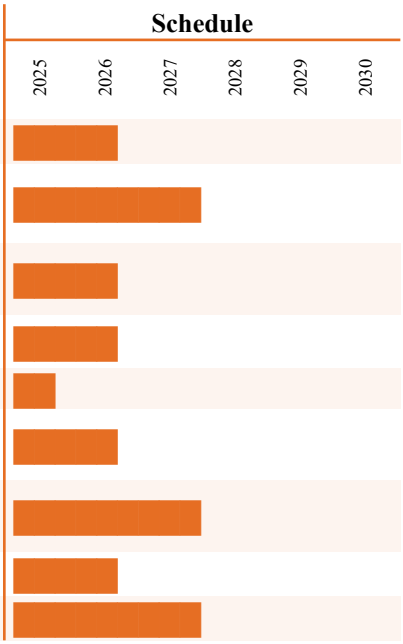
Supported Targets

1. ID 29. Total solid waste generation per capita – less than 300 kg/year/capita
2. ID 30.2. Proportion of organic waste – over 20%

Projected benefits

- ✓ **Job creation potential: 10–20**
- ✓ Access to diverse educational resources, improved education quality
- ✓ Hub for community activities, enhanced sense of belonging
- ✓ Specialised training and skill development, improved employability
- ✓ Research promotion, driven innovation and technological advancements
- ✓ Education on sustainability, encouraged environmentally responsible behavior

Milestones



1	Build an Education Centre on waste management.
2	Organise campaigns to promote reusable products and waste prevention through educational activities.
3	Encourage catering businesses to replace single-use packaging with reusable packaging through communication efforts.
4	Support businesses and NGOs in adopting waste prevention practices.
5	Promote the separate collection of various types of waste through publicity campaigns.
6	Continue the project to educate the Vilnius City's population on waste sorting, involving direct engagement with residents and dissemination of information through various media;
7	Organise annual litter picking campaigns to clean public spaces, involving cooperation between volunteers, waste managers, municipalities, and NGOs
8	Develop a network of public drinking water stations to reduce plastic packaging waste
9	Implement publicity measures to reduce food waste and improve people's food consumption skills

Smart City Potential

- The creation of a website or application, along with a service providing information on educational campaigns and programmes. This should also include a forum for the exchange of experience, information and good practice.
- In addition, an online grants book and a list of services purchased from organisations conducting tasks for the benefit of city residents is recommended.
- In order to monitor the results of awareness and education, real-time waste tracking and data analysis is needed to engage communities and encourage waste-conscious habits.
- Furthermore, social media campaigns and AI-driven feedback systems can target specific demographics, providing tailored guidance on reducing waste.

Gender Equality and Social Inclusion

- The Education Centre and its educational campaigns will offer valuable learning opportunities for all community members, including vulnerable groups such as the elderly and low-income families. These initiatives aim to empower individuals with knowledge about sustainability and waste management. By promoting reusable packaging and waste reduction, these efforts can enhance public health and safety, particularly benefiting those who manage household waste and care for family health.
- Designing educational campaigns that specifically target women-headed households and low-income families. These campaigns can highlight the benefits of waste prevention, reuse, and recycling, focusing on women who are often responsible for household waste management. To ensure these educational workshops are accessible, it is important to provide flexible schedules and childcare options.

SW2 Expanding the network of DĖK'UI stations*

Timescale
2025–2027

CapEx € 1,000,000
OpEx € 264,000

Action type
Investment – new

Part of the Climate City Contract Action Plan

Action description

Vilnius currently has five "DĖK'UI" exchange stations, with plans to expand the network by another 11 stations by 2027 and possibly more by 2030, depending on community needs.

These stations are part of the city's infrastructure designed to encourage the reuse and recycling of items that are no longer needed but are still functional. Through the "DĖK'UI" initiative, residents can drop off and share unwanted goods, promoting a culture of sustainability by reducing waste and giving items a second life.

In addition to expanding the exchange stations, Vilnius plans to further grow the DĖK'UI initiative by integrating repair workshops. These workshops would focus on repairing damaged items so that they can be reused and returned to the local market rather than discarded. In partnership with social partners and other NGOs, these repair workshops could also serve as training centres for members of vulnerable social groups. The aim is to provide these individuals with practical skills in repair and other trades, thereby increasing their employability and facilitating their reintegration into the labour market.

This expanded initiative combines environmental sustainability with social responsibility. By promoting the repair and reuse of goods, Vilnius is supporting the development of a circular economy and reducing the amount of waste sent to landfill.

At the same time, the workshops create new opportunities for people from marginalised communities, helping them to acquire valuable skills that can lead to stable employment. Overall, the DĖK'UI stations and workshops are a key part of the city's broader strategy to create a more inclusive, greener future.

Targeted results of the action and costs (CapEx)

Establishment of 11 additional DĖK'UI stations	€1,000,000

Operational Costs (OpEx)

- 11 FTEs for maintenance and service in stops – €264,000

City's strategy / policy / plans

- Vilnius City Municipality Waste Prevention and Management Plan 2021–2027
- Vilnius Region Waste Prevention and Management Plan for 2021–2027

Potential action location

To be identified


Source: unsplash.com

Implementing body

VAATC

Key supporting actors

Vilniaus miesto savivaldybės administracija, VMSA as the Approval authority

Supporting & relevant actions

B2 Promoting the modernisation of multi-apartment buildings

SW1 Preventing waste generation through raising awareness and education

SW4 Upgrade of the local MBT facility

SW5 Developing a smart municipal waste management system

Potential sources of financing

- Municipal Budget,
- Municipal Companies – VAATC,
- New Generation Lithuania: Component Green Transformation of Lithuania,
- Climate Change Program,
- National Energy and Climate Action Plan (K4. Improvement of waste sorting skills among residents),
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)

*DĖK'UI stations are drop-off and exchange points where residents can leave their unused items.

SW2 Expanding the network of DĖK`UI stations

Related Challenges

1. Poor separation of waste at source.
2. As the City's economy continues to develop, waste generation is expected to continue rising.

Directly addressed Strategic Goals

1. SGSW1 Strengthening a robust waste management system through the integration of public-private partnerships.
2. SGSW2 Enhancing the realisation and utilisation of circular economy principles along with citizens and businesses awareness and education.

Supported Targets

1. ID 29. Total solid waste generation per capita – less than 300 kg/year/capita
2. ID 30.2. Proportion of organic waste – over 20%

Projected benefits

- ✓ **Job creation potential: 5–10**

- ✓ Stronger sense of community
- ✓ Reduced landfill waste
- ✓ Reduced waste generation
- ✓ Enhanced environmental protection
- ✓ Improved public eco-consciousness
- ✓ Promoted resource reuse
- ✓ Supported sustainable resource management
- ✓ Improved city cleanliness
- ✓ Reduced illegal dumping and littering

Milestones

		Schedule
		2025 2026 2027 2028 2029 2030
1	Identify optimal locations for the installation of 11 additional DĖK'UI stations based on community needs and accessibility.	
2	Launch a public awareness campaign to promote the use of the new DĖK'UI stations and encourage community participation.	
3	Complete the establishment of all 11 DĖK'UI stations, ensuring they are fully operational and accessible.	

Smart City Potential

- Collaborating with second-hand marketplaces could be an attractive way forward. The city could integrate these marketplaces with DĖK'UI stations or develop a similar app. This would enable more turnover of goods in the stations: people would see the things that are in the station and could go there to pick them up.

Gender Equality and Social Inclusion

- Developing targeted outreach and training programs that cater to all gender needs, particularly those from marginalised communities. These programs can include workshops designed to build skills in areas such as repair and entrepreneurship, empowering individuals to create economic opportunities.
- Ensuring that DĖK'UI stations are accessible to women, the elderly, and people with disabilities. Thoughtful consideration should be given to the location of these stations, making sure they are placed in areas where women and caregivers can easily and safely access them.
- Including workshops or training programs at DĖK'UI stations that focus on teaching repair and upcycling skills can create pathways for them to turn waste into economic resources. These initiatives not only promote sustainability but also provide valuable skills that can lead to economic empowerment.

SW3 Further introduction of DGASA (lt. Didelių gabaritų atliekų surinkimo aikštelės) – bulky waste collection sites

Timescale
2025–2028

CapEx € 9,500,000
OpEx € 1,795,000

Action type
Investment – new

Action description

There are currently five DGASA sites in Vilnius, but capacity constraints and accessibility issues require further development of the infrastructure. Residents can also request a bulky waste collection service from their home once a year.

The city estimates that 14 such sites would be optimal to effectively manage waste collection. Lack of suitable land and difficulties in obtaining building permits have hindered the construction of additional DGASA. In planning the construction of the next DGASA sites, Vilnius must meet the requirements set out in the National Waste Prevention and Management Plan for 2021–2027.

Identifying suitable sites and securing them for future construction is critical. If no land is available for DGASA siting, alternatives will be explored based on European best practice. It is possible to implement a combination of alternative solutions, for example by re-evaluating existing urban areas or introducing mobile DGASA points for municipal waste.

The proposed action includes the analysis of sites and options for the development of DGASAs, and the creation of nine new DGASAs. The solutions implemented will ensure the collection of paper, metals, plastics, glass, multi-material packaging waste, hazardous waste, used batteries and accumulators, waste electrical and electronic equipment, furniture and other bulky waste, used tyres, used textiles and clothing, and household construction and demolition waste.

The development of any DGASA site would be subject to a detailed site assessment. It is important that the new separate collection facilities for municipal waste are user-friendly and offer a high level of service and availability (e.g. different opening hours).

Targeted results of the action and costs (CapEx)

Development of nine DGASA points	€9,500,000

Operational Costs (OpEx)

- Maintenance of nine DGASA, the preparation of waste for recycling, its transport and proper management in accordance with legal requirements – €1,795,000

City's strategy / policy / plans

- Vilnius City Municipality Waste Prevention and Management Plan 2021–2027
- Vilnius Region Waste Prevention and Management Plan for 2021–2027

Potential action location

To be identified

Implementing body

VAATC

Key supporting actors

Vilniaus miesto savivaldybės administracija, VMSA as the Approval authority

SĮ "Vilniaus atliekų sistemos administratorius, VASA" as the Technical advisor

Supporting & relevant actions

B2 Promoting the modernisation of multi-apartment buildings

SW1 Preventing waste generation through raising awareness and education

SW4 Upgrade of the local MBT facility

SW5 Developing a smart municipal waste management system

Potential sources of financing

- Municipal Budget,
- Municipal Companies – VAATC,
- New Generation Lithuania: Component Green Transformation of Lithuania,
- Climate Change Program,
- National Energy and Climate Action Plan (K4. Improvement of waste sorting skills among residents),
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)

SW3 Further introduction of DGASA (lt. Didelių gabaritų atliekų surinkimo aikštelės) – bulky waste collection sites

Related Challenges

1. As the City's economy continues to develop, waste generation is expected to continue rising.
2. Poor separation of waste at source.

Directly addressed Strategic Goals

1. SGSW1 Strengthening a robust waste management system through the integration of public-private partnerships.
2. SGSW2 Enhancing the realisation and utilisation of circular economy principles along with citizens and businesses awareness and education.

Supported Targets

1. ID 30.2. Proportion of organic waste – over 20%
2. ID 29. Total solid waste generation per capita – less than 300 kg/year/capita

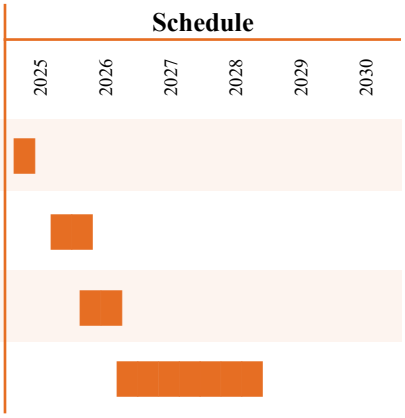
Projected benefits

✓ **Job creation potential: 20–50**

- ✓ Reduced landfill waste
- ✓ Enhanced environmental protection
- ✓ Increased recycling and waste segregation
- ✓ Improved public eco-consciousness
- ✓ Promoted resource reuse
- ✓ Supported sustainable resource management
- ✓ Improved city cleanliness
- ✓ Reduced illegal dumping and littering

Milestones

		Schedule
1	Conduct a location analysis to identify the most suitable sites for the development of nine DGASA household waste recycling points.	
2	Develop detailed design and layout plans for each DGASA recycling point, ensuring efficient waste sorting and collection.	
3	Secure necessary permits and approvals for the construction and operation of the DGASA recycling points.	
4	The construction of all nine DGASA recycling points, ensuring they are fully equipped and operational.	



Smart City Potential

- Developing a mobile app to inform residents about the location of DGASA points and their operating hours to improve community engagement. The app could be used to make easy to order and encourage use and promote Individual DGA collection service. Furthermore, in terms of gamification, the city could introduce incentives for residents who regularly use the collection sites, such as rewards points that can be redeemed for discounts or local services. This application will be integrated with the action SW5.
- Real-time data collection and analytics facilitate optimised sorting processes, improving the quality of materials for recyclers. Automation reduces manual labour, increases throughput, and lowers costs.
- To enhance the functionality of these collection points, technologies such as smart waste bins equipped with IoT sensors can provide real-time monitoring of fill levels, enabling efficient collection scheduling and reducing overflow.

Gender Equality and Social Inclusion

- Increasing the number of DGASA sites significantly improves accessibility for all residents, including vulnerable groups who may be primary caregivers or responsible for managing household waste. Enhanced accessibility makes it easier for these individuals to participate in waste separation and recycling efforts, contributing to more equitable waste management practices.
- Encouraging the hiring of women in technical and operational roles at DGASA sites. Providing training and mentorship opportunities can prepare women for employment in this sector, empowering them to take on these roles confidently.
- Actively involving women and under-served groups in the planning and decision-making processes related to DGASA locations ensures that their waste management needs are addressed. This inclusive approach helps create a waste management system that is responsive to the needs of all community members.

SW4 Upgrade of the local MBT facility

Timescale
2025–2030

CapEx € 12,011,000
OpEx € 480,000

Action type
Investment – upgrade/retrofit

Part of the Climate City Contract Action Plan

Action description

This initiative focuses on developing the food waste management processes at the Mechanical-Biological Treatment (MBT) facility.

The first step should be to identify food waste hotspots based on data integration between waste carriers and handlers.

A key measure is the conversion of the waste reception area at the MBT plant into a fully automated line for the separation of organic waste collected in colour-coded (orange) sacks from the wider MSW stream.

In addition, the project includes the purchase of specialised equipment to process selectively collected food waste, transforming it into a liquid mass (pulp) for further treatment.

If the pilot project led by UAB "Energesman", proves successful, the next phase would involve scaling-up the operation and potentially increasing the volume of food waste processed. This expansion could include the use of biotunnels, which the MBT plant already uses for the bio-drying of organic waste. The biotunnels would increase the efficiency of breaking down organic matter into usable forms such as compost or biogas.
A feasibility study is also recommended as part of this initiative, to explore alternative methods of managing the liquid pulp derived from food waste. The study would analyse different treatment options based on current market conditions and evaluate the results of an innovative pilot project using fly larvae to process the pulp. This alternative approach, if viable, could provide a sustainable and scalable method of food waste management, contributing to the city's wider waste reduction and circular economy goals. By improving its food waste management infrastructure, Vilnius aims to reduce the environmental impact of organic waste, maximise resource recovery and explore innovative, sustainable methods of waste processing.

In addition to supporting waste management in the city, there are currently plans to build infrastructure to produce hydrogen from municipal waste. The hydrogen would also be used to fuel vehicles such as public transport (buses) and waste collection trucks. However, the feasibility of this project depends on proven technology that can efficiently convert waste into hydrogen. Working with technology providers that specialise in waste-to-hydrogen conversion could reduce the risks associated with early-stage technology adoption. Investors should seek to partner with companies that have a track record in this area, possibly through joint ventures or research collaborations. It is recommended to perform a technical review covering hydrogen demand analysis and feasibility study. Following the findings and recommendations of the feasibility study, a decision will be made on the next steps.

Targeted results of the action and costs (CapEx)

A feasibility study to explore alternative treatment options for the liquid pulp derived from food waste	€211,000
Establishment of infrastructure for the management of separately collected food waste	€11,500,000
Conduct a feasibility study to assess the potential for hydrogen production from municipal waste	€300,000

Operational Costs (OpEx)

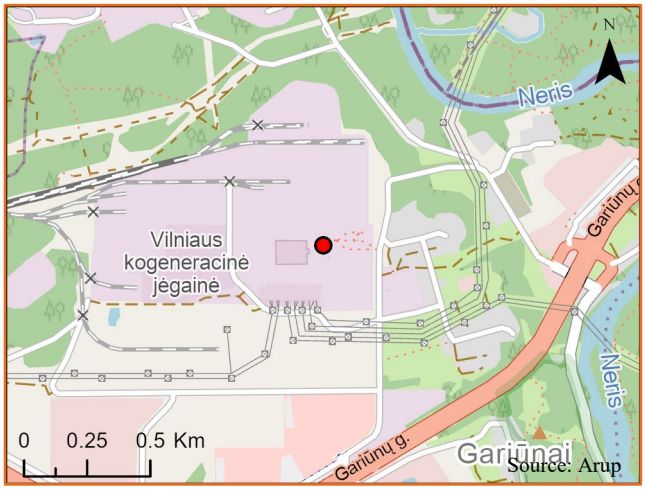
- 20 FTEs for maintenance and service in stops – €480,000

City's strategy / policy / plans

- Vilnius City Municipality Waste Prevention and Management Plan 2021–2027
- Vilnius Region Waste Prevention and Management Plan for 2021–2027

Potential action location

Jočionių st. 13, Vilnius



Implementing body

UAB "Energesman", VAATC

Key supporting actors

Vilniaus miesto savivaldybės administracija, VMSA as the Approval authority

Supporting & relevant actions

SW1 Preventing waste generation through raising awareness and education

SW2 Expanding the network of DĖK'UI stations

SW3 Further introduction of DGASA (lt. Didelių gabaritų atliekų surinkimo aikštelės) – bulky waste collection sites

SW5 Developing a smart municipal waste management system

Potential sources of financing

- Municipal Budget,
- Municipal Companies – VAATC ,
- New Generation Lithuania: Component Green Transformation of Lithuania,
- National Energy and Climate Action Plan (K3. Prevention of food waste),
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc.

SW4 Upgrade of the local MBT facility

Related Challenges

1. High costs of the treatment technology, leading to high waste management costs.
2. Poor separation of waste at source.

Directly addressed Strategic Goals

1. SGSW1 Strengthening a robust waste management system through the integration of public-private partnerships.
2. SGSW2 Enhancing the realisation and utilisation of circular economy principles along with citizens and businesses awareness and education.

Supported Targets

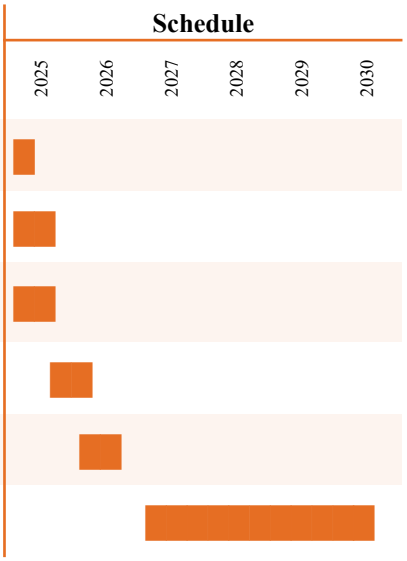
1. ID 30.2. Proportion of organic waste – over 20%
2. ID 29. Total solid waste generation per capita – less than 300 kg/year/capita

Projected benefits

- ✓ **Job creation potential: 20–50**
- ✓ Sustainable way to convert organic waste into renewable energy, reducing landfill pressure and emissions
- ✓ Supporting a circular economy
- ✓ Decreased methane emissions from landfills
- ✓ Recovering nutrients for composting or energy generation
- ✓ Conserving resources
- ✓ Enhanced sanitation and public health
- ✓ Revenue from compost production

Milestones

		Schedule
1	A feasibility study to explore alternative treatment options for the liquid pulp derived from food waste.	
2	Conduct a feasibility study to assess the potential for hydrogen production from municipal waste, including available technologies and resource requirements.	
3	Conduct an assessment of the current waste reception area at the MBT facility to determine requirements for conversion to an automated MSW separation line.	
4	Develop a detailed design and layout plan for the automated separation line, integrating the processing of MSW collected in color-coded bags.	
5	Secure necessary permits and approvals for the conversion of the waste reception area and the installation of new equipment.	
6	Complete the conversion of the MBT facility and ensure full operational capability of the new automated line and pulp production process.	



Smart City Potential

- The implementation of various optimisation functions and technologically advanced components allows for the coordination and monitoring of processes, as well as the decision-making on the use of pulp.
- By implementing advanced technologies such as AI-driven sorting systems, IoT sensors, and automated processes, food waste can be more accurately identified and separated for optimal processing.
- Real-time monitoring and data analytics can enhance the efficiency of composting and biogas production, maximising resource recovery.

Gender Equality and Social Inclusion

- The development and scaling up of food waste processing infrastructure, including the use of biotunnels and other equipment, can create numerous job opportunities. These roles can benefit both men and women, with targeted training programmes designed to include vulnerable individuals, particularly in technical and operational positions.
- Engaging individuals, especially those responsible for household food preparation, in educational campaigns on food waste reduction and composting. These campaigns can focus on practical ways to reduce food waste and manage it effectively at the household level, empowering individuals to make a positive impact.
- Promoting employment and entrepreneurship opportunities for women and underrepresented groups in food waste recycling technologies, such as composting and biogas production, is another key strategy. Offering skills training and technical support can help women enter and thrive in these fields, turning waste into valuable resources and creating sustainable business opportunities.

SW5 Developing a smart municipal waste management system

Timescale
2025–2030

CapEx € 7,477,000
OpEx € 1,017,000

Action type
Investment – pilot

Action description

The implementation of this action should be preceded by a comprehensive feasibility study to assess the technical, economic and environmental viability of the project. This study should include an analysis of the current waste management practices, the potential challenges and the expected benefits of the new system. The implementation of the action should take the form of a pilot project in a defined area of the city, such as a selected neighbourhood, to evaluate its effectiveness and gather data for further optimisation.

The project involves the design, supply and commissioning of a comprehensive system for the individual sorting of municipal waste in multi-apartment buildings throughout the city. The investment includes the installation of a new waste collection system and the purchase of mechanical equipment for the collection of municipal waste. The equipment will consist of smart containers and modules equipped with access control, volume measurement and CCTV for monitoring purposes. The installation of this equipment will take place in the designated district, followed by the commissioning of both the equipment and the associated IT system. In addition, the project will provide access and licences for the relevant software required to operate the system.

A sensor network (using GSM and LoRaWAN) needs to be set up to remotely monitor container occupancy. This will allow the optimal frequency for emptying each container to be determined and the routes of our waste collection vehicles to be optimised (new route optimisation software will be required). Other sensors can also be used to monitor environmental conditions or to track waste collection vehicles.

Initially, the programme will be implemented in the largest housing estates in Vilnius. In the following years, based on the results and feedback from the pilot project, the system could be extended to other districts with multi-apartment buildings. Households covered by the system will receive a set of QR codes for each type of waste, making the sorting process easier.

One potential use of smart technology in this project is the development of a free mobile application. This app would remind residents of waste collection deadlines, inform them of any changes to the collection schedule, and allow them to report irregularities by providing their GPS location and attaching a photo. This feature aims to increase user engagement and ensure the smooth operation of the waste management system.

Targeted results of the action and costs (CapEx)

The implementation of the smart waste management system in Verkiai district (for 10% or 5,800 people of the district)	€7,477,000

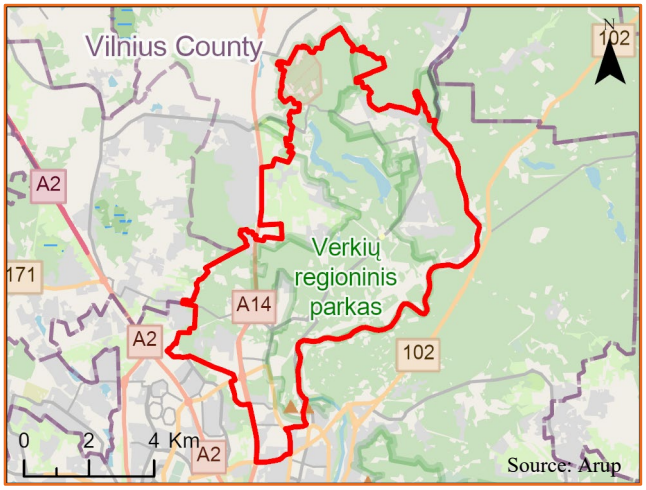
Operational Costs (OpEx)

- Training, expenditure on salaries and derivatives of 40 employees involved in the operation of the waste management system, together with other current expenditure in the performance of their duties, including: purchase of consumables, office supplies, equipment, energy charges, telecommunication services – €1,017,000

City's strategy / policy / plans

- Vilnius City Municipality Waste Prevention and Management Plan 2021–2027
- Vilnius Region Waste Prevention and Management Plan for 2021–2027

Potential action location Verkiai district, Vilnius



Implementing body

SĮ "Vilniaus atliekų sistemos administratorius, VASA"

Key supporting actors

Vilniaus miesto savivaldybės administracija, VMSA as the Approval authority

VAATC as Technical advisor

Supporting & relevant actions

B2 Promoting the modernisation of multi-apartment buildings

SW1 Preventing waste generation through raising awareness and education

SW3 Further introduction of DGASA (lt. Didelių gabaritų atliekų surinkimo aikštelės) – bulky waste collection sites

LU3 Development of local plans and land use standards

Potential sources of financing

- Municipal budget,
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc.
- InvestEU,
- Horizon Europe (Pillar II),
- The Innovation Fund,
- Modernisation Fund,
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)

SW5 Developing a smart municipal waste management system

Related Challenges

1. Poor separation of waste at source.
2. Poor recycling rates as a result of waste separation difficulties.

Directly addressed Strategic Goals

1. SGSW1 Strengthening a robust waste management system through the integration of public-private partnerships.
2. SGSW2 Enhancing the realisation and utilisation of circular economy principles along with citizens and businesses awareness and education.

Supported Targets

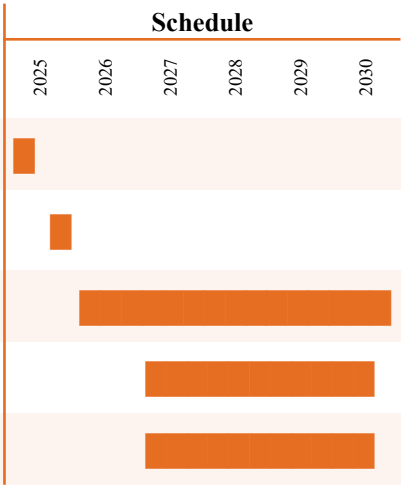
1. ID 29. Total solid waste generation per capita – less than 300 kg/year/capita
2. ID 30.2. Proportion of organic waste – over 20%

Projected benefits

- ✓ **Job creation potential: 10–20**

- ✓ Improved access to services
- ✓ Maximised reuse of materials, reduced need for virgin resources
- ✓ Decreased landfill waste
- ✓ Minimized soil and water pollution
- ✓ Lower disposal costs
- ✓ Revenue from recovered materials

Milestones



1	Conduct a comprehensive assessment to identify the needs and goals for implementing a smart municipal waste management system.
2	Develop a detailed design and implementation plan for the smart waste management system, including sensor deployment, data integration, and system management.
3	Installation of smart sensors on waste bins, trucks, and other relevant infrastructure to enable real-time monitoring and data collection.
4	Integrate the smart waste management system with municipal operations, ensuring seamless communication between waste collection services and the data platform.
5	Launch a public information campaign to educate residents on the projected benefits and functionality of the smart waste management system.

Smart City Potential

- The application will be used to remind people of their waste collection date, inform them of changes to their collection schedule and allow them to notify the authorities of the need for collection, provide access to information on the separate collection of municipal waste and guidance on the correct separation of waste.
- In a further step, an innovative system of individual waste segregation will be introduced with the use of smart bins, the “Electronic Counter of Municipal Waste”. Residents will be able to open them using stickers with individual codes. The system will enable correct billing of fees and waste separation declarations. In the future, the possibility of creating a system of rewards for pro-ecological behaviour in the field of waste recycling will also be considered.

Gender Equality and Social Inclusion

- Offer equal opportunities for workshops and training sessions on waste sorting and the use of new technology. These sessions should address the needs of all genders and include practical demonstrations on using intelligent waste containers and mobile applications.
- The new waste management system must accommodate people with disabilities and those in vulnerable situations. This involves designing systems that are easy to use for individuals with limited mobility and providing support for those who may face challenges in using new technology.
- Collecting gender-disaggregated data within the smart waste management system. This data helps understand the different waste management behaviours of men and women, allowing for the design of gender-responsive waste management policies.
- Conducting targeted public information campaigns on the projected benefits of smart waste management systems. These campaigns can highlight how such systems help manage household waste more efficiently, providing valuable support to those who often bear the responsibility for waste management.

LAND USE

Summary of Action Plan – Land use

The actions described in this sector are designed to ensure integrated urban planning, the protection of existing green and biodiverse areas, and the revitalisation of neglected parts of the city through the implementation of green infrastructure projects. It is also necessary to focus on strengthening care and maintenance for existing greenery, including the public cadastre of greenery and the strengthening of partnerships with citizens for the care of greenery.

Beside is a summary of the planned actions for the land use sector.

Land use sector financing route

CapEx:

- €104,062,600

OpEx (annual):

- €9,345,700

Potential sources of financing:

- Municipal Budget
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc.
- InvestEU
- Horizon Europe (Pillar II)
- The Innovation Fund
- Modernisation Fund
- New Generation Lithuania: Component Green Transformation of Lithuania
- Climate Change Program
- National Energy and Climate Action Plan (K3. Prevention of food waste)
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)

Reduction of tCO_{2e} (annual):

- 3,747.58 tCO_{2e}

Table 10 Summary of actions in the land use sector

LU1 Green streets and heat island – investment programme for decreasing perceptible temperature in summer
• Improvements to 12 public spaces in the identified locations covering a surface area of around 13 ha (Square in Jeruzalėje, both sides of Maumedžių; public space in Žirmūnuose; square at Pelesos and Liepkalnio; Šv. Florijono square between Mortos and T. Ševčenkos; Šv. Stepono square and Šv. Stepono; Architektų; Šnipiškių arcade; S. Gucevičiaus square; square at Pamėnkalnio; square at Fr. B. Laurinavičiaus monument; public space at Ukmergės and square in front of Šv. Onos Church). • Lighting controller installation, • Identification of heat islands through measurements and preparation of mitigation plans.
LU2 Protection and restoration of valuable green areas
• Legal framework development study. • Pilot land redevelopment program. • Development of a multi-branch technical concept for the implementation of the restoration project for selected sites. • Acquisition of urban land for municipality ownership to protect and restore it. • Monitoring of designated areas of natural value in the Vilnius.
LU3 Development of local plans and land use standards
• Preparation of guidelines and local plans for neighbourhoods and areas within the city local plans for neighbourhoods and areas within the city. • Preparation of six local plans in the area of Šeškinė, Fabijoniškės, Pašilaičiai, Vilkpėdė, Naujoji Vilnia, Rasos (Markučiai), including conducting research and analysis of current state required for conducing the local plans in the six selected city areas (83.10 km^2 of area). • Publicity and education campaign.
LU4 Redeveloping existing urban land to increase liveability
• Revitalisation of 13 public spaces in the identified sites, covering an area of around 44 ha (Bendorių/Raisteniškių g. square (Tarandė); square at S. Žukausko; public space between Karaliaučiaus and Varnės; public space at Perkūnkiemio; public space at V. Maciulevičiaus; space near Afindevičių (beach); square nearby Naujosios Vilnios eldership and the Kultūros Centre; Vilkpėdės square between Gerosios Vilties; Joensū square at L. Asanavičiūtė Street and Sausio 13-osios Street; public space with the fountain sculpture "Pumpuras"; Ugnijos square and Čikagos aleja; Vėtrungės square and Tbilisio square).
LU5 Strengthening of the Public Participation in urban planning
• Development of standards for the process of community engagement in urban planning in accordance with national standards and regulations. • Setting-up and management of a citizen engagement website. • Increasing access to education for children (also for children with special needs and disabilities): Creating environments for inclusive education in Vilnius Vyturys Primary School using universal design principles. Creating environments for inclusive education and all-day school activities by applying universal design principles at Vilnius Šeškinė Primary School, Vilnius Adam Mickiewicz Lyceum and Vilnius Vilties Special School. • Renovation of two identified locations of approximately 1.5 ha (Šeškinės centre / central square, Šeškinė and Public space near Naugarduko).

7.8 Actions in land use sector

Key Conditions

LU1 Green streets and heat island – investment programme for decreasing perceptible temperature in summer

In the face of extreme temperatures that pose a significant risk to citizens, particularly vulnerable groups such as children, the elderly and pregnant women, it is crucial to take decisive action. By implementing greenery and creating shaded squares, alleys, boulevards, and streets, the city can combat these perceptible temperatures and mitigate the Urban Heat Island effect. Furthermore, green infrastructure areas are unevenly distributed around the city; the central and middle areas are characterised by high levels of green space, but the central area lacks accessible, high quality green and recreational spaces (playgrounds, walking paths, sports facilities) that meet the needs of residents. The city has carried out an investigation into the actual heat island effect and has identified the areas that suffer the most from it. The first areas to be covered by the pilot project were carefully selected by the Vilnius Municipality.

The Green Wave initiative in Vilnius is leading the way, transforming the city's 2,000 kilometres of streets into verdant corridors. In addition, adequate street lighting is one of the most important factors in ensuring road safety – it reduces the number of accidents, injuries and fatalities, helps to prevent crime and maintains the general comfort of the community in the dark. This initiative is not just about beautification – it is a strategic move to protect both the horizontal and vertical surfaces of the city with green spaces and safety.

Simultaneously, SĮ "Susisiekimo paslaugos, JUDU" is spearheading the commissioning of four major design studies for Calm Streets. This programme is committed to creating sustainable and universally designed streets and public spaces that cater to all users and functions. From prioritising public transport to promoting walking, cycling, and recreation, the changes in road infrastructure are designed to influence car users and encourage a shift in travel mode choices.

As part of the project, the following is expected:

- Tree and shrub planting,
- Construction of bicycle paths (as part of the Action T3),
- Introduction of NBS (as part of the Action W1),
- Creation of biodiversity conditions in road lanes,
- Development of permeable pavements (as part of the Action T3),
- Introduction of smart elements in small architecture for emergency notifications, adapted for disabled people,
- Expansion of bus lanes for fast travel on high-traffic roads (as part of the Action T2),
- Street lighting.
- Identification of heat islands through measurements and preparation of mitigation plans.

It is important to remember that all upgrades and retrofits must be carried out in accordance with the 10 Rules of Urban Planning and Architecture and a Standard for Vilnius Streets (tree always comes first, trees and bushes between cars and pedestrians, running parts without exceeds width, enough safe pedestrian crossings, lighting – pedestrians first, all streets elements are black, surface enforce pedestrian priority, car parking is available on most streets, usually parallel, covering creates the character of the streets, visual cleanliness – freedom from excessive elements, street meter – for householders, minimum intersections and turning radius).

LU2 Protection and restoration of valuable green areas

Access to green areas, open spaces, and water bodies ensures a better quality of life and well-being for residents by providing a high-quality environment for daily living. Additionally, increasing the number of green spaces in the city can positively affect the mental and physical health of its inhabitants.

Green spaces support protection against climate change and ecological disasters, for example, by trapping carbon dioxide and preventing soil erosion. Natural spaces support adaptation to climate change, help to improve air quality, and enhance the city's microclimate. Restoring connections between previously isolated natural spaces helps to increase the city's biodiversity and improve the mobility of organisms. Promoting smart and integrated development ensures effective and consistent use of the city's limited space.

LU3 Development of local plans and land use standards

The city of Vilnius is divided into three functional zones, which differ in their specificity, intensity and density of development and number of attractions:

1. Central urban area.
2. Middle urban area.
3. Peripheral urban area.

Some neighbourhoods are functioning effectively despite their low population density. There is a population group living in outdated Soviet-era buildings that are not adequately equipped with the necessary services and lack adequate areas for community integration. These conditions are not in line with the principles of a 15-minute city and create a disconnect within the urban fabric.

Effective land use and building management in the Vilnius region is a major challenge. The complex and fragmented land ownership in Vilnius is the result of a number of factors, including historical changes in land use and ownership patterns, as well as the rapid growth and development of the city. It can lead to difficulties in coordinating development projects, as multiple stakeholders may be involved. This can lead to delays and increased costs, hindering the city's ability to efficiently implement its development plans. Complex land ownership can also affect the city's ability to manage its urban spaces effectively. This complexity can also contribute to spatial inequalities within the city. Certain areas may see more development and investment than others, leading to disparities in access to services and amenities.

The Comprehensive Plan of Vilnius identifies the overarching land use needs, which are: internal development of the territory, creating a compact city in the central and middle areas of the city (with public social, transport and green spaces); modernisation and renovation of Soviet-era mass housing estates; reuse of brownfield sites; conversion of horticultural community areas into residential areas (1-apartment flats); final formation of multi-apartment buildings according to their morphological urban structure, improving areas of intensive development near transport corridors with access to public transport; creation of local centres and sub-centres; new development towards the northern part of Pilaitė and the Minsko motorway; halting urban sprawl in the peripheral zone.

Despite the city's efforts to optimise land use, problems persist due to high demand and inadequate quality of growth in the city centre, contributing to urban sprawl and related problems. This situation highlights the inconsistent planning of residential areas, which contributes to incoherent urban development processes. In addition, urbanisation at different scales and speeds poses a threat to ecosystems, potentially leading to the degradation or loss of green spaces essential for environmental health.

LU4 Redeveloping existing urban land to increase liveability

In 2015, the percentage of development on existing urban land was very low (2.21%), suggesting that most development takes place on greenfield sites. The EBRD GCAP benchmarks recommend that sustainable urban development should include more than 40% of development on existing urban land. Low urban growth on existing urban land leads to unsustainable urban sprawl, resulting in loss of green space, increased infrastructure costs and social inequality.

The Comprehensive Plan of Vilnius identifies overarching land use needs, including the modernisation and renovation of Soviet-era mass housing estates, the reuse of brownfield sites, and the creation of local centres and sub-centres. In addition, the Comprehensive Plan of Vilnius calls for green spaces to be located within 200–300 metres of residents and large city parks within 2,000 metres.

Vilnius, a city where green spaces cover almost 61% of the total area, is committed to ensuring that these spaces are accessible to everyone and protected from urban development. The document "Vilnius Sustainable Development Strategy 2024–2029 Draft" identified the problem that the central area lacks accessible, high-quality green and recreational spaces (playgrounds, walking paths, sports facilities) that meet the needs of the population. The central area of the territory is characterised by a low quality of living environment. This commitment extends to addressing issues related to the spatial distribution, maintenance and quality of these green spaces. The city has also implemented the Green Index, a pioneering initiative that sets a new standard for future developments.

LU5 Strengthening of the Public Participation in urban planning

There is a need to establish a method of communication between the municipality, citizens and NGOs to facilitate discussions on planning issues. Involving communities in the

planning process helps to increase buy-in and transparency and has the potential to reduce planning conflicts. It will increase citizens' sense of ownership and co-creation of urban space.

Citizen education and awareness is essential to improve cities and support the implementation of sustainable, green and balanced solutions in the built environment. High citizen awareness helps to build community support for challenging but necessary solutions in the city. A strong community enables the creation of spaces that are safe and enjoyable for all.

The action will include the introduction of participatory planning tools that allow for active participation and provide a space for citizens to offer their ideas and suggestions.

LU1 Green streets and heat island – investment programme for decreasing perceptible temperature in summer

Timescale
2025–2030

CapEx € 45,208,000
OpEx € 6,824,000

Action type
Investment – upgrade/retrofit

Part of the Climate City Contract Action Plan

Action description

The aim is to mitigate the urban heat island effect and improve environmental conditions through scalable changes to roads, parking lots, cycle paths and footpath.

The action will start with a set of pilot projects, such as creating greener street connections with the city's "Calm Streets" redevelopment programme, planting vegetation, and exploring cool pavement technologies. The projects will also renovate pedestrian pathways, basketball courts, landscaping, and create new playgrounds, fitness areas, rain gardens, drinking fountains, public restrooms and community spaces with the installation of video surveillance cameras for safety. A colourful cycle path for children and an outdoor area for older people and parents will be created. It is important to ensure that infrastructure is easily accessible to all vulnerable groups. Benches, bins, lamps, chess and table tennis tables will be installed. Passive recreation areas, including hammocks, an amphitheatre and an event box, will be added to enable community gatherings.

Over time, these solutions will be scaled up citywide. Street reconstruction will prioritise sustainable transport along with the planting of vegetation, stormwater management, the construction of playgrounds and recreational areas, open-air gyms, skate parks and a dog-walking area. Awareness-raising campaigns will be carried out to inform citizens about the changes to their streets, squares and alleys, and to encourage changes in attitudes towards choosing transport options.

Furthermore, air flow modelling could be a potential solution for identifying heat island effects and assessing the impact of green policies. By simulating the movement of air in urban areas, these models can identify heat islands and assess how green infrastructure, such as parks and green roofs, can mitigate these effects. This helps city planners make informed decisions to improve urban climate resilience.

The city has carried out an investigation into the actual heat island effect and has identified the areas that suffer the most from it. The first areas to be covered by the pilot project were carefully selected by the Vilnius Municipality, where designated areas were to be made more attractive and transformed into green spaces: square in Jeruzalėje, both sides of Maumedžių; public space in Žirmūnuose; square at Pelesos and Liepkalnio; Šv. Florijono square between Mortos and T. Ševčenkos; Šv. Stepono square and Šv. Stepono; Architektų; Šnipiškių arcade; S. Gucevičiaus square; square at Pamėnkalnio; square at Fr. B. Laurinavičiaus monument; public space at Ukmergės and square in front of Šv. Onos Church.

To ensure the safety of new roads, the lighting controllers will dim the luminaires according to a remotely-set schedule and measure the electrical parameters of the luminaires, resulting in a more economical and sustainable use of electricity. The system currently exists in the city; however, the coverage is about 50%. As of 2024, there are around 27,000 controllers installed in the city, with an additional 36,000 controllers needed to reach the 2030 target. In addition, by 2025, the Vilnius Municipality's initiative plans to plant around 100,000 trees, 10 million shrubs, and 300,000 climbing plants.

Targeted results of the action and costs (CapEx)

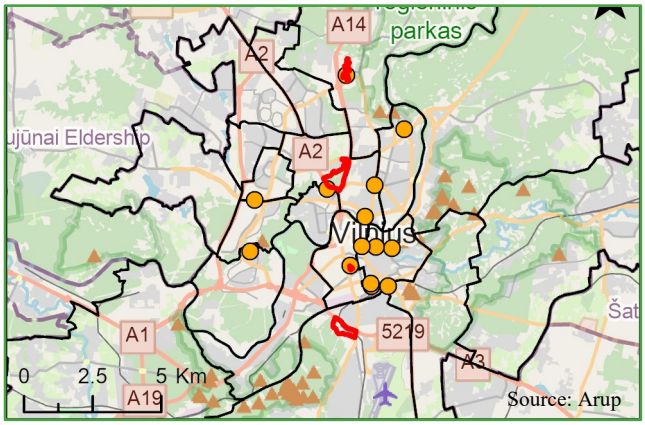
Improvements to 12 public spaces in the identified locations covering a surface area of around 13 ha	€43,768,000
Lighting controller installation	€1,440,000
Identification of heat islands through measurements and preparation of mitigation plans	-

Operational Costs (OpEx)

- Greenery maintenance – €6,781,000
- Maintenance service for the installation of new luminaire controllers – €43,000

Potential action location

Multiple locations



Implementing body

Vilniaus miesto savivaldybės administracija, VMSA

Key supporting actors

- UAB "Vilniaus apšvietimas" as the Implementing partner
- Žemės tvarkymo ir administravimo skyrius as the Technical advisor
- Miesto aplinkos skyrius as the Technical advisor

Supporting & relevant actions

T3 Expanding and integrating cycling infrastructure and pedestrian pathways

LU2 Protection and restoration of valuable green areas

LU4 Redeveloping existing urban land to increase liveability

LU5 Strengthening of the Public Participation in urban planning

Potential sources of financing

- Municipal Budget,
- Programme for the European Union funds' investments in 2021–2027 (Policy objective 2. A greener Lithuania, Action 2.1 Promote energy efficiency and reduce greenhouse gas emissions (€92m),
- Climate Change Program,
- LIFE Programme Nature and Biodiversity subprogramme,
- Private financing – crowdfunding,
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.),
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc.

City's strategy / policy / plans

- Comprehensive Plan of Vilnius
- Strategy for Sustainable Development of Vilnius 2024–2029

LU1 Green streets and heat island – investment programme for decreasing perceptible temperature in summer

Related Challenges

1. Inconsistent planning of residential areas and fragmented housing policies result in uncoordinated urban development.
2. Difficulty implementing complex urban renewal projects.

Directly addressed Strategic Goals

1. SGE3 Establishing infrastructure resilience and implementing city adaptation measures to effectively respond to climate change impacts and urban sprawl pressure.
2. SGLU1 Balancing city development while emphasising diversity and inclusivity, ensuring equal access to high-quality services through an effective land management system and legal framework.

Supported Targets

1. ID 7.4 Connectivity of natural area – over 60% of natural area
2. ID 6.2 Share of population living within 400m of open green space of at least 0.5ha – over 70% of population

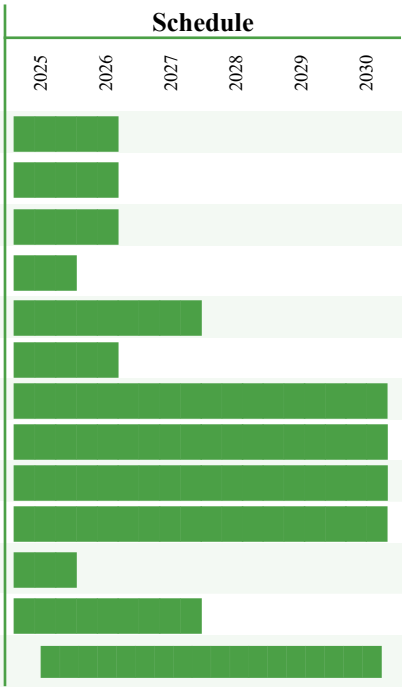
Projected benefits

✓ **Reduction of 2,854.28 tCO_2**
Climate City Contract Action Plan Estimations (2,600 tCO_2)
Green City Action Plan Estimations (254.28 tCO_2)

✓ **Job creation potential: 50–100**

- ✓ By enhancing green spaces and using cool pavement technologies, the initiative helps lower temperatures in urban areas
- ✓ Prioritising public transport, cycling, and walking reduces reliance on cars, lowering emissions.
- ✓ The use of smart lighting systems reduces energy consumption and costs.
- ✓ Compact city / walkable neighbourhood
- ✓ Social cohesion and neighborhood interaction
- ✓ Habitat protection and pollution reduction
- ✓ Promotion of physical activity and mental well-being

Milestones



1	Improvement of the public space in square in Jeruzalėje, both sides of Maumedžių
2	Improvement of the public space in Žirmūnuose
3	Improvement of the public space in square at Pelesos and Liepkalnio;
4	Improvement of the public space in Šv. Florijono square between Mortos and T. Ševčenkos
5	Improvement of the public space in Šv. Stepono square and Šv. Stepono
6	Improvement of the public space in Architektų g. 152
7	Improvement of the public space in Šnipiškių arcade
8	Improvement of the public space in S. Gucevičiaus square
9	Improvement of the public space in square at Pamėnkalnio
10	Improvement of the public space in square at Fr. B. Laurinavičiaus monument
11	Improvement of the public space in Ukmergės
12	Improvement of the public space in square in front of Šv. Onos Church.
13	Lighting controller installation

Smart City Potential

- Maintaining green infrastructure can be challenging, but smart technologies like soil moisture sensors, automated irrigation, smart stormwater systems, and remote monitoring could help. Soil moisture sensors optimise irrigation, reducing water waste and maintenance. Smart stormwater systems store and distribute water sustainably, supporting irrigation during dry spells.
- The latter represents a good alternative to traditional stormwater harvesting systems, which collect water to be used for irrigation. GIS-based tracking systems and mapping can be used to ensure updated information on undertaken activities and corridors created. Similarly, satellite-based tree coverage technology can be employed to ensure monitoring and valuation of each tree planted.

Gender Equality and Social Inclusion

- To ensure that improvements to public spaces such as playgrounds and cycle paths meet the needs of caregivers and families and to incorporate features like safe, accessible paths for strollers and easily accessible recreational areas. These considerations make public spaces more welcoming and usable for everyone.
- Upgrades to lighting infrastructure ensures that new installations enhance safety and security, particularly in areas frequented by children and other vulnerable groups. Proper lighting in public spaces can significantly improve safety and encourage more frequent use of these areas, making them more vibrant and active.
- Including gender-sensitive metrics in monitoring and evaluating infrastructure changes is also important. These metrics help assess how different demographics are impacted by the improvements, ensuring that the benefits are equitably distributed across the community.

LU2 Protection and restoration of valuable green areas

Timescale
2025–2030

CapEx € 32,749,200
OpEx € 102,700

Action type
Investment – upgrade/retrofit

Action description

This action aims to enhance the natural environment and urban biodiversity by ensuring efficient landscape processes, protecting and restoring critical habitats such as wetlands and forests (green corridors or orbital urban forests) and implementing sustainable land use practices. Key investments include:

Land acquisition: Valuable natural lands will be acquired or leased to protect and restore key areas, including forests and wetlands, while preserving biodiversity and native species.

Watercourse renaturalisation pilot programmes: for example restorations of canalised streams in the (industrial part) of Vilkpedė neighborhood. The hydrographic system will be protected and aquatic ecosystems will be renaturalised.

Wetland protection: Wetlands, which are crucial for biodiversity, will be safeguarded from urbanisation and pollution. This includes implementing legislative measures and investing in restoration. The Vilnia River needs to be cleaned up.

Public access: Public access to chosen green areas will be increased and coupled with educational activities to promote their protection (for example in Karoliniškių draustinis and Vilnia river area).

Legal framework: Establish a mandatory law to protect areas with rich biodiversity and encompass the needs and standards for their restoration. The plan takes into account the city's current state of biodiversity and aims to enhance these natural assets for the benefit of residents and local wildlife. It integrates ecological, social, cultural, and other sustainable uses.

Part of this action should be establishing a standards for nature and biodiversity monitoring. Environmental monitoring (qualitative and quantitative), carried out in a five-year cycle, should cover both fauna: habitats and presence of mammals, amphibians, reptiles, birds, and flora: plants, fungi, lichens, plant communities and the area / number of valuable natural areas. As part of the monitoring, the naturalists will carry out a field analysis and report on the research. The results of these inventories should be documented on a unified website, potentially as an extension of the existing GIS portal. This would offer a centralised and accessible platform for all stakeholders to access and comprehend the data.

The protection and restoration of valuable green spaces should be further supported through the creation of a climate emergency fund.

Targeted results of the action and costs (CapEx)

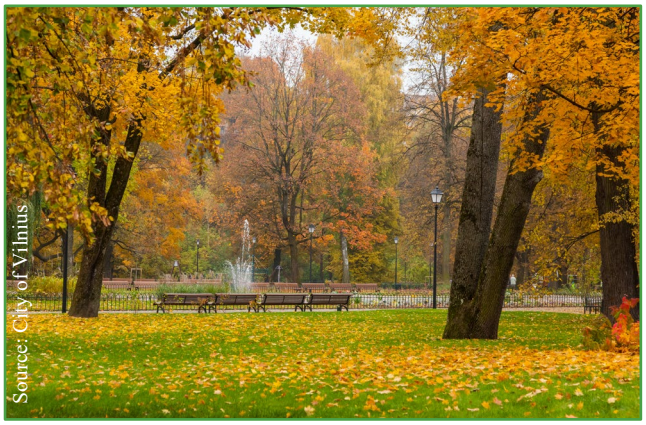
Legal framework development study	€80,000
Pilot land redevelopment program	€50,800
Development of a multi-branch technical concept for the implementation of the restoration project for selected sites	€347,900
Acquisition of urban land for municipality ownership to protect and restore it	€32,150,500
Monitoring of designated areas of natural value in the Vilnius	€120,000

Operational Costs (OpEx)

Climate Emergency Fund:
- Costs of personnel – €38,160
- Costs of subcontracting – €55,000
- Indirect costs – €9,540

Potential action location

Karoliniškių draustinis, Vilnia river, Vilkpedė neighborhood



Implementing body

Vilniaus miesto savivaldybės administracija, VMSA

Key supporting actors

Žemės tvarkymo ir administravimo skyrius as the Implementing partner

Miesto aplinkos skyrius as the Implementing partner

Supporting & relevant actions

W1 Strengthen the city's resilience to surface water run-off

LU1 Green streets and heat island – investment programme for decreasing perceptible temperature in summer

LU3 Development of local plans and land use standards

LU5 Strengthening of the Public Participation in urban planning

Potential sources of financing

- Municipal Budget,
- Climate Change Program,
- LIFE Programme Nature and Biodiversity subprogramme,
- Private financing – crowdfunding,
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.),
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc.

City's strategy / policy / plans

- Comprehensive Plan of Vilnius
- Strategy for Sustainable Development of Vilnius 2024–2029

LU2 Protection and restoration of valuable green areas

Related Challenges

1. Difficulty implementing complex urban renewal projects.
2. Inconsistent planning of residential areas and fragmented housing policies result in uncoordinated urban development.

Directly addressed Strategic Goals

1. SGE2 Ensuring high quality ecosystems and urban spaces by involving external stakeholders in the transparent process of strengthening and integrating urban and environmental policies.
2. SGE4 Preserving and enriching urban biodiversity and green spaces by raising awareness and educating citizens and business.

Supported Targets

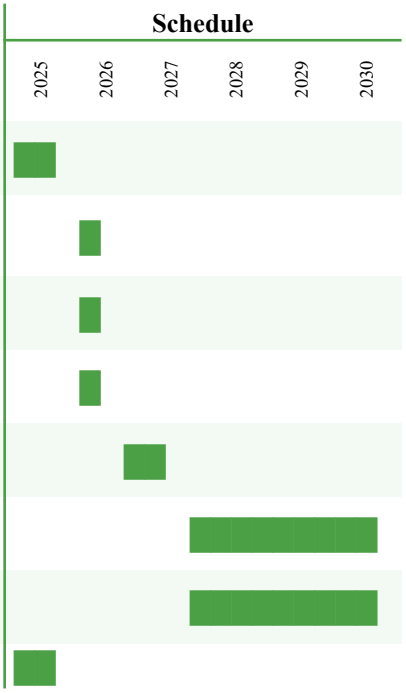
1. ID 7.4 Connectivity of natural areas – over 60% of natural areas
2. ID 6.2 Share of population living within 400m of open green space of at least 0.5ha – over 70% of population

Projected benefits

✓ **Job creation potential: 1–5**

- ✓ Improved green space
- ✓ Compact city / walkable neighbourhood
- ✓ Biodiversity and habitat preservation
- ✓ Environmental sustainability and climate resilience
- ✓ Community well-being through accessible green spaces

Milestones



1	Conduct a legal framework development study to establish guidelines for land redevelopment, restoration, and protection efforts.
2	Design and initiate a pilot land redevelopment programme to test and refine strategies for sustainable land use and restoration.
3	Develop a multi-branch technical concept for implementing restoration projects at selected sites, incorporating environmental, urban planning, and community needs.
4	Identify and prioritise areas of urban land for acquisition by the municipality, focusing on sites of high natural and ecological value.
5	Acquire targeted urban land parcels for municipal ownership to protect and restore them as part of the city's long-term sustainability goals.
6	Implement restoration projects based on the developed technical concept, coordinating with relevant stakeholders and experts.
7	Establish a monitoring system to track the ecological health and natural value of designated areas, ensuring ongoing protection and management.
8	Creation of a Climate Emergency Fund

Smart City Potential

- The use of remote sensing and drones can enable the capture of high-resolution imagery and data from vast areas, facilitating the monitoring of remote and inaccessible locations. These technologies can be used to track changes in land cover, habitat fragmentation and species distribution, providing valuable data for use in biodiversity monitoring.
- The city's platform https://paslaugos.vilnius.lt/ should be upgraded to include a reporting tool with geolocation.
- The use of satellite-based tree coverage technology will ensure the monitoring and valuation of each tree planted. The action could include the creation of a database of biodiversity objects that the city protects. A similar project is being carried out nationally with a map of protected areas and species all being mapped: https://stvk.lt/map.
- Additionally, the city already has a platform for the green city and its visualisation, mainly in maps.vilnius.lt and zalias.vilnius.lt.

Gender Equality and Social Inclusion

- To ensure that new and restored green areas are accessible to everyone and to design these spaces with the needs of children, the elderly, other vulnerable groups, and people with disabilities in mind. This includes providing safe and easy access routes and facilities that accommodate diverse needs, making green areas welcoming and usable for all.
- Ensuring equal engagement of employees and community members in the planning and implementation stages of biodiversity actions. This can be achieved by holding focus groups or workshops to gather input on how best to design and manage green spaces and educational programmes. When documenting and reporting on biodiversity monitoring, it is important to include gender-disaggregated data where possible. This helps to understand how different demographics are impacted by the biodiversity initiatives and ensures that the benefits are equitably distributed.

LU3 Development of local plans and land use standards

Timescale
2025–2029

CapEx € 811,400
OpEx € –

Action type
Regulation

Action description

This action involves the creation of a set of guidelines, prepared by the municipality, outlining local plans for local neighbourhoods.

The local plans should include setting policy standards for areas being analysed - the development of comprehensive standards for sustainable development, building regulations, land use and public amenities is essential. These standards will guide future development and ensure consistency and quality across all projects. Complex background analysis of the area is analysed: urban (urban structure, density, land use and spatial organisation), legal (existing framework and identification of necessary changes), social (community needs, demographics, social dynamics), economic (assessment of conditions, growth potential, investment opportunities), environmental (sustainability, green spaces, environmental impact), cultural (preservation and integration of cultural heritage), and transport (current infrastructure and mobility patterns). The implementation of regulations related to groundwater (infiltration), the mandatory use of NBS solutions and blue-green infrastructure and embankments are also recommended. Guidelines should also include appropriate neighbourhood management plans and a greening plan.

The development of a local plan should allow for efficient and standardised land use in the future, although it should always be supported by feasibility studies to assess the practicality and potential impacts of proposed developments. These studies help to understand the viability of projects and make informed decisions and conceptual designs – to ensure that development plans are coherent, sustainable and in line with the city's vision. This includes detailed plans for land use, infrastructure and public spaces, legal considerations – to address all legal aspects related to urban planning, including land use laws, property rights and regulatory compliance, preparatory work (site formation, complex area formation), stakeholder engagement and management – actively involving citizens, private landowners and developers in the planning process to ensure that the needs and concerns of all stakeholders are considered and addressed. Regular consultations, public meetings and collaborative workshops will be organised to facilitate this engagement.

In order to test the standards and guidelines, a pilot project should be carried out in the area of Šeškinė, Fabijoniškės, Pašilaičiai, Vilkpėdė, focusing on the redevelopment of existing sites in the area of Soviet buildings. The proposed locations for the action in brownfield areas earmarked for revitalisation in the districts of Vilkpėdė, Naujoji Vilnia, Rasos (Markučiai).

Furthermore, the education campaigns will aim to raise awareness among citizens about the importance of greening streets, protecting local flora, biodiversity and natural habitats. Through engaging workshops, informative brochures, and community events, residents will learn about the benefits of urban greenery, such as improved air quality, reduced heat islands, and enhanced biodiversity.

Targeted results of the action and costs (CapEx)

Preparation of guidelines and local plans for neighbourhoods and areas within the city	€200,000
Preparation of six local plans, including conducting research and analysis of current state required for conducting the local plans in the selected city areas (83.10 km^2 of area)	€91,400
Publicity and education campaign	€520,000

Potential action location

To be identified

Implementing body

Vilniaus miesto savivaldybės administracija, VMSA

Key supporting actors

Žemės tvarkymo ir administravimo skyrius as the Implementing partner

Miesto aplinkos skyrius as the Implementing partner

Supporting & relevant actions

B4 Promoting quarterly modernisation of residential buildings

T3 Expanding and integrating cycling infrastructure and pedestrian pathways

T4 Development of infrastructure for multimodal points

LU4 Redeveloping existing urban land to increase liveability

Potential sources of financing

- Municipal Budget,
- Climate Change Program,
- LIFE Programme Nature and Biodiversity subprogramme,
- Private financing – crowdfunding,
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)

City's strategy / policy / plans

- Comprehensive Plan of Vilnius
- Strategy for Sustainable Development of Vilnius 2024–2029

LU3 Development of local plans and land use standards

Related Challenges

1. Inconsistent planning of residential areas and fragmented housing policies result in uncoordinated urban development.
2. Overambitious spatial planning documents.

Directly addressed Strategic Goals

1. SGE2 Ensuring high quality ecosystems and urban spaces by involving external stakeholders in the transparent process of strengthening and integrating urban and environmental policies.
2. SGE3 Establishing infrastructure resilience and implementing city adaptation measures to effectively respond to climate change impacts and urban sprawl pressure.

Supported Targets

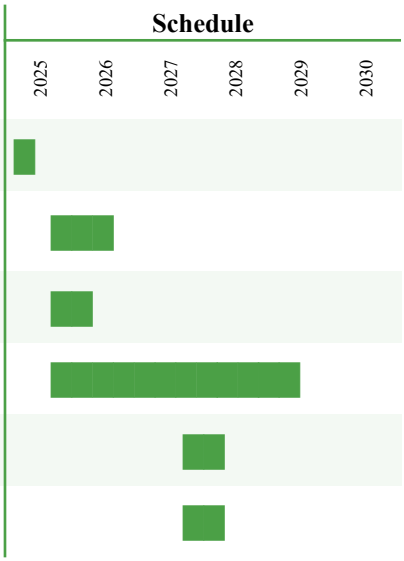
1. ID 7.4 Connectivity of natural areas – over 60% of natural areas
2. ID 6.2 Share of population living within 400m of open green space of at least 0.5ha – over 70% of population

Projected benefits

✓ **Job creation potential: 1–5**

- ✓ Informed and inclusive decision-making with a holistic understanding of key urban factors
- ✓ Consistent and high-quality development across all projects
- ✓ Increased project success rate by ensuring viability
- ✓ Legal compliance and reduced risk of disputes
- ✓ Enhanced community trust and balanced outcomes

Milestones



1	Conduct an initial assessment of the city's current landscape and identify key areas requiring protection and development.
2	Develop a comprehensive strategic plan for city landscape protection and development, aligning with environmental, cultural, and urban planning goals.
3	Engage with stakeholders, including local communities, experts, and policymakers, to gather input and refine the strategic plan.
4	Prepare detailed local plans for each of the six selected areas, focusing on sustainable development, landscape preservation, and community needs.
5	Integrate the local plans with the overall strategic plan to ensure a cohesive approach to landscape protection across the city.
6	Implement the local plans, coordinating with relevant city departments and stakeholders to ensure effective execution.

Smart City Potential

- The building permit and land planning process should be digitised to improve efficiency. The systems currently used for these processes are maintained by the national government, and there may be an opportunity to develop projects with these agencies. Following recent land-use reform, all land-use services are now under the control of municipalities rather than central government.
- The GIS portal should be updated with new adopted local plans to ensure easy public access to its regulations and tracking of changes in urban development. GIS-based tracking systems and mapping should be used to ensure updated information on undertaken activities and implemented projects.

Gender Equality and Social Inclusion

- To ensure that building regulations and public amenities accommodate diverse needs and to design these spaces with considerations for safety, accessibility, and usability. This includes addressing the needs of different genders, families, elderly residents, and people with disabilities, making public spaces and buildings welcoming and functional for all.
- Public spaces and amenities should be designed with the needs of all in mind. This means providing safe and accessible spaces for women, children, and other vulnerable groups. Incorporating playgrounds, childcare facilities, and other amenities that support families and single parents with young children. Ensuring equal engagement in the planning process is another key strategy. Organising focus groups, surveys, and consultations specifically targeting these groups can help gather their input and address their concerns.

LU4 Redeveloping existing urban land to increase liveability

Timescale
2025–2027

CapEx € 15,403,000
OpEx € 2,310,000

Action type
Investment – upgrade/retrofit

Action description

The action aims to improve local neighbourhoods, making them more attractive and liveable in line with modern urban development principles such as the 15-minute city concept.

The aim is to create mixed-use developments that offer residents easy access to essential services, public transport and social amenities within a short walk or bike ride of their homes, while ensuring user safety. The action emphasises transit-oriented development to increase population density in well-connected areas, optimise the use of existing urban land and reduce urban sprawl.

All actions taken should be in line with the 10 rules of urban planning and architecture, which concern: respecting and adapting to the urban context when planning new buildings or public spaces; separating public from private spaces; designing streets taking into account the needs of society and the environment; innovative infrastructure design; using local building materials, trying to rebuild rather than build from scratch; protecting and preserving heritage sites (for example, by creating strategies or guidelines for upgrades); trying to introduce greenery and nature-based solutions wherever possible; organising architectural competitions; choosing projects that will be socially useful. The action will be carried out in small steps to bring about gradual changes in whole areas and will include:

1. Implementing a pilot project to develop a network of local community centres in newly regenerated areas. An area will be selected for the pilot project in one of the following areas: brownfield site, Soviet-era building area, suburban area. Each area will be transformed to ensure the implementation of mixed-use development rules, ensuring that residents have easy access to various services in close proximity and transforming the surroundings into more liveable and service-providing spaces. These spaces will, include community hubs which will serve as centres for essential services such as municipal offices, healthcare, libraries and cultural activities;

2. Redeveloping selected green and recreational areas, with a focus on blue and green infrastructure and NBS in underserved urban areas, especially brownfield sites and regions with poor access to green spaces.

3. It is recommended that a natural framework be established to ensure the legal protection of green corridors and to require the preservation of green space on developed sites.

The first areas to be revitalised in this way have been identified by the City Municipality: Bendorių/Raisteniškių g. square (Tarandė); square at S. Žukausko; public space between Karaliaučiaus and Varnės; public space at Perkūnkiemio; public space at V. Maciulevičiaus; space near Afindevičių (beach); square nearby Naujosios Vilnios eldership and the Kultūros Centre; Vilkpėdės square between Gerosios Vilties; Joensū square at L. Asanavičiūtė Street and Sausio 13-osios Street; public space with the fountain sculpture “Pumpuras”; Ugnijos square and Čikagos aleja; Vėtrungės square and Tbilisio square.

Targeted results of the action and costs (CapEx)

Revitalisation of 13 public spaces in the identified sites, covering an area of around 44 ha	€15,403,000

Operational Costs (OpEx)

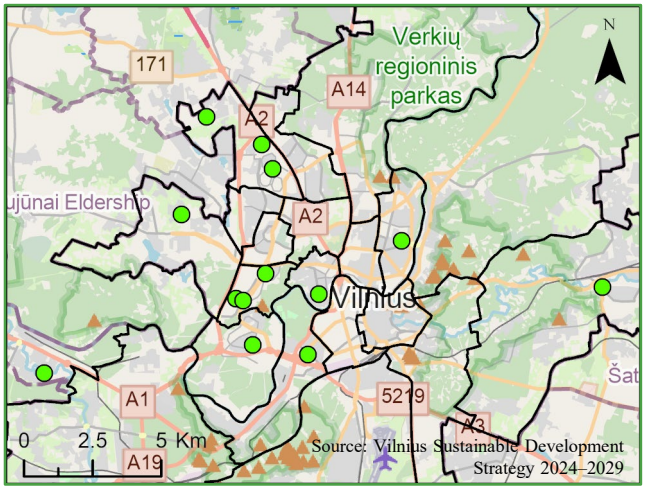
- Greenery maintenance – €2,310,000

City’s strategy / policy / plans

- Comprehensive Plan of Vilnius
- Sustainable Energy and Climate Change Action Plan 2030

Potential action location

Multiple locations



Implementing body

Vilniaus miesto savivaldybės administracija, VMSA

Key supporting actors

- Žemės tvarkymo ir administravimo skyrius as the Technical advisor
- Miesto aplinkos skyrius as the Technical advisor

Supporting & relevant actions

- B4 Promoting quarterly modernisation of residential buildings
- LU1 Green streets and heat island – investment programme for decreasing perceptible temperature in summer
- LU3 Development of local plans and land use standards
- LU5 Strengthening of the Public Participation in urban planning

Potential sources of financing

- Municipal Budget,
- Programme for the European Union funds’ investments in 2021–2027 (Policy objective 2. A greener Lithuania, Action 2.1 Promote energy efficiency and reduce greenhouse gas emissions (92€m),
- Climate Change Program,
- LIFE Programme Nature and Biodiversity subprogramme,
- Private financing – crowdfunding,
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.),
- Private sources through partnership with the city in form of BOO, BOT, DBO, etc.

LU4 Redeveloping existing urban land to increase liveability

Related Challenges

1. Inconsistent planning of residential areas and fragmented housing policies result in uncoordinated urban development.
2. Increased demand on public services and infrastructure due to rising population density in some areas and underutilisation in others.

Directly addressed Strategic Goals

1. SGE3 Establishing infrastructure resilience and implementing city adaptation measures to effectively respond to climate change impacts and urban sprawl pressure.
2. SGE4 Preserving and enriching urban biodiversity and green spaces by raising awareness and educating citizens and business.

Supported Targets

1. ID 7.4 Connectivity of natural area – over 60% of natural area
2. ID 6.2 Share of population living within 400m of open green space of at least 0.5ha – over 70% of population

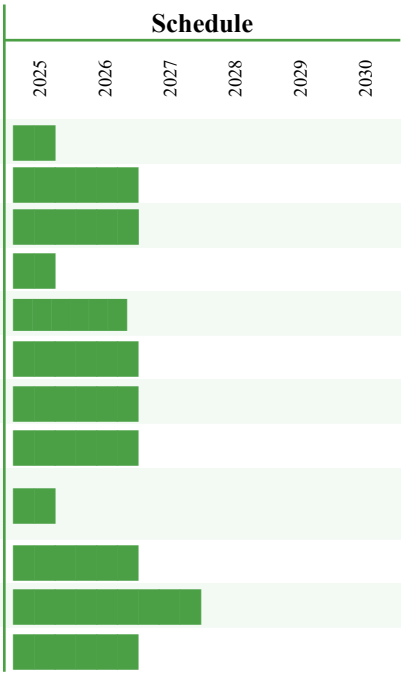
Projected benefits

✓ **Reduction of 865.41 tCO_2**
Green City Action Plan Estimations

✓ **Job creation potential: 50–100**

- ✓ Improved green space
- ✓ Compact city / walkable neighbourhood
- ✓ Social cohesion and neighborhood interaction
- ✓ Habitat protection and pollution reduction
- ✓ Promotion of physical activity and mental well-being
- ✓ Climate mitigation

Milestones



1. Revitalisation of the territory of Bendorių/Raisteniškių g. square (Tarandė)
2. Revitalisation of the territory of Square at S. Žukausko
3. Revitalisation of the territory of Public space between Karaliaučiaus and Varnės
4. Revitalisation of the territory of Public space at Perkūnkiemio
5. Revitalisation of the territory of Public space at V. Maciulevičiaus
6. Revitalisation of the territory of Space near Afindevičių (beach)
7. Revitalisation of the territory of Square nearby Naujosios Vilnios eldership and Kultūros Centre
8. Revitalisation of the territory of Vilkpėdės square between Gerosios Vilties
9. Revitalisation of the territory of Joensū square at L. Asanavičiūtės g. Sausio Street and Sausio 13-osios Street
10. Revitalisation of the territory of Public space with the fountain sculpture “Pumpuras”
11. Revitalisation of the territory of Ugnijos square and Čikagos aleja
12. Revitalisation of the territory of Vėtrungės square and Tbilisio square.

Smart City Potential

- The use of sensors (soil moisture sensors, air quality sensors, temperature and humidity sensors, remote sensing technologies – drones and satellites equipped with multispectral and thermal imaging, smart irrigation systems and water quality sensors), to monitor newly established green spaces and the potential to create a comprehensive database on their condition.
- The collection and sharing of data on green spaces utilising the GIS platform and other technologies. The collected data and information should be integrated into the city’s open platform.
- The GIS upgrade should be an opportunity to capture, integrate and make available data that goes beyond blue-green infrastructure and NBS. This should integrate cadastral information to facilitate the identification of actions and requirements, as well as opportunities to integrate data generated from other actions, such as data from systems proposed in the water and transport sector.

Gender Equality and Social Inclusion

- Provide a range of services that cater to different life stages and responsibilities. This includes incorporating childcare centres, women’s health clinics, and safe public spaces into the design.
- Designing well-lit, safe public spaces with considerations for personal safety, particularly for women and marginalised groups. Public transport options must be accessible to everyone, including those with mobility challenges. Safety concerns for women traveling alone should be addressed by implementing measures like well-lit and safe transport hubs.
- Enhancing connectivity to key services such as healthcare, schools, and shopping areas is also important. Focusing on reducing travel time for individuals who may have multiple responsibilities can make daily tasks more manageable and improve overall quality of life.
- The design of community centres should include features that support all users, such as breastfeeding rooms, childcare facilities, and gender-inclusive amenities.
- Parks and recreational areas should be accessible and welcoming, featuring playgrounds, sports facilities, and safe walking paths for everyone to enjoy.

LU5 Strengthening of the Public Participation in urban planning

Timescale
2025–2030

CapEx € 9,891,000
OpEx € 109,000

Action type
Capacity building

Action description

The main objective of this action is to implement solutions that strengthen public participation in urban planning processes.

1. Establishment of community engagement process standards. This will standardise the community engagement process in urban planning and establish a method to facilitate communication between the municipality, citizens and NGOs. This will enable more joint discussions on problematic planning issues and provide tools to ensure effective engagement both online and in person (by using deep participatory methods such as citizens' assemblies, citizens' juries and participatory budgeting).

2. Development of a digital platform for public participation. This platform will support the whole process, helping to engage the community and keep them informed. It will create map-based questionnaires, collect, analyse and visualise data, facilitate collaboration, organise online workshops, and arrange participatory budgets.

3. Carry out education and information campaigns. These will focus on urban planning, ecology, the environment and sustainable development. One of the elements of these campaigns will be a standard for new sustainable developments, combining nature-friendly and sustainable investments with educational materials and workshops to increase understanding and visibility of these elements.

4. Establish a collaborative learning initiative with NGOs and experts. The city will work with environmental NGOs, universities and experts to offer specialised courses, lectures and webinars. These sessions will cover topics such as urban ecology, renewable energy technologies, sustainable architecture and the social dimensions of climate change.

In addition, the Municipality has identified two locations that can serve as pilot projects in joint urban planning: Šeškinės centre / central square, Šeškinė and Public space near Naugarduko.

Targeted results of the action and costs (CapEx)

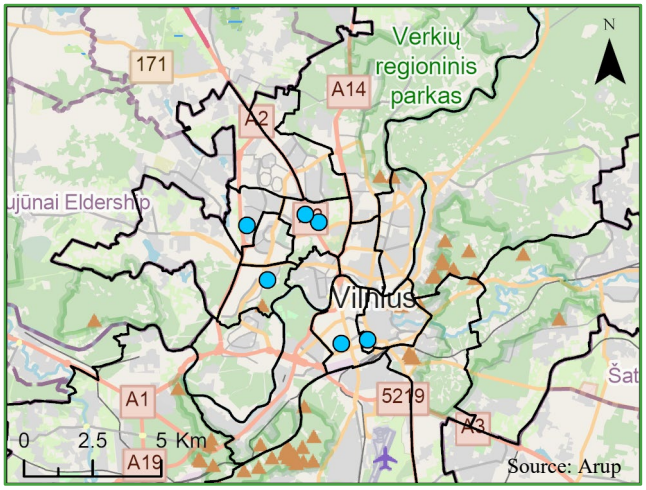
Development of standards for the process of community engagement in urban planning in accordance with national standards and regulations	€10,000
Setting-up and management of a citizen engagement website	€80,000
Increasing access to education for children (also for children with special needs and disabilities):	
1. Creating environments for inclusive education in Vilnius Vyturys Primary School using universal design principles	€1,462,600
2. Creating environments for inclusive education and all-day school activities by applying universal design principles at Vilnius Šeškinė Primary School	€2,231,800
3. Creating environments for inclusive education and full-day school activities by applying universal design principles at Vilnius Adam Mickiewicz Lyceum	€4,748,600
4. Adapting educational environments for disabled and special needs learners using universal design principles at Vilnius Vilties Special School	€630,000
Renovation of two identified locations of approximately 1.5 ha (Renovation of Šeškinė centre / central square, Šeškinė and public space near Naugarduko street)	€728,000

Operational Costs (OpEx)

- Greenery maintenance – €109,000

Potential action location

Multiple locations



Implementing body

Vilniaus miesto savivaldybės administracija, VMSA

Key supporting actors

Žemės tvarkymo ir administravimo skyrius as the Consultant

Miesto aplinkos skyrius as the Consultant

Supporting & relevant actions

B4 Promoting quarterly modernisation of residential buildings

LU1 Green streets and heat island – investment programme for decreasing perceptible temperature in summer

LU3 Development of local plans and land use standards

LU4 Redeveloping existing urban land to increase liveability

Potential sources of financing

- Municipal Budget,
- Climate Change Program,
- LIFE Programme Nature and Biodiversity subprogramme,
- Private financing – crowdfunding,
- Sovereign (or non-sovereign) lending (EBRD, World Bank Group, EIB, IMF, Council of Europe Development Bank, etc.)

City's strategy / policy / plans

- Comprehensive Plan of Vilnius

LU5 Strengthening of the Public Participation in urban planning

Related Challenges

1. Inconsistent planning of residential areas and fragmented housing policies result in uncoordinated urban development.
2. Overambitious spatial planning documents.

Directly addressed Strategic Goals

1. SGE2 Ensuring high quality ecosystems and urban spaces by involving external stakeholders in the transparent process of strengthening and integrating urban and environmental policies.
2. SGLU1 Balancing city development while emphasising diversity and inclusivity, ensuring equal access to high-quality services through an effective land management system and legal framework.

Supported Targets

1. ID 6.2 Share of population living within 400m of open green space of at least 0.5ha – over 70% of population
2. ID 7.4 Connectivity of natural area – over 60% of natural area

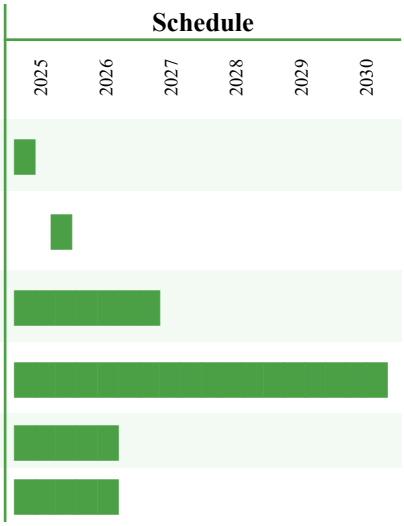
Projected benefits

✓ **Reduction of 27.89 tCO_2**
Green City Action Plan Estimations

✓ **Job creation potential: 5–10**

- ✓ Stronger sense of community, compliance, improved decision-making, streamlined processes
- ✓ Enhanced accessibility, increased participation, promoted transparency
- ✓ Inclusive learning environments, holistic education, tailored support for special needs

Milestones



1	Develop standards for community engagement in urban planning, ensuring alignment with national regulations and best practices.
2	Establish a citizen engagement website to facilitate transparent communication and participation in urban planning processes.
3	Apply universal design principles to create inclusive educational environments in Vilnius Schools, focusing on accessibility and inclusivity.
4	Engage with the community through the citizen engagement website and other channels to gather feedback and improve the inclusivity and effectiveness of the educational environments.
5	Renovation of the area of Šeškinės centre / central square, Šeškinė
6	Renovation of the area of Public space near Naugarduko.

Smart City Potential

- The main challenge in engaging in productive dialogue with numerous NGOs is the lack of awareness about urban planning in general and its common issues. This results in a restricted quality of discussion, with minimal comprehension. This could be improved in two ways:
  1. The creation and popularisation of content on urban challenges, based on the experience of cities in Lithuania and abroad, should be considered. This could be integrated into familiar learning platforms or new activities for education.
  2. The simplification of urban planning processes, making them more accessible and transparent, should be explored. This could be achieved through the use of open data, dashboards and other types of tools that would allow citizens to understand what is happening, why and how to interact.

Gender Equality and Social Inclusion

- To facilitate participation from underrepresented gender groups and to develop values and standards such as providing childcare during meetings and ensuring venues are accessible to people with disabilities.
- Designing the digital platform with features that support diverse gender needs. This includes options for anonymous feedback and accessibility features for those with disabilities, ensuring that the platform is user-friendly and accessible to all.
- Using targeted outreach strategies to engage vulnerable groups and gender minorities who might otherwise be excluded from digital platforms is another key strategy. These efforts ensure that all voices are heard and included in the conversation.
- Including gender-specific content in educational materials and campaigns is vital. Addressing issues like gender-based violence, equal opportunities, and women's rights helps raise awareness and promote equality. These campaigns can empower individuals with the knowledge and resources they need to advocate for their rights and contribute to a more inclusive society.

7.9 Financing route of the GCAP

The total amount of investment up to 2030 (total CapEx) related to the GCAP actions is **€2,716,865,900**.[3] The total annual operating expenditure (OpEx) associated with the planned investments is **€34,180,950**. The buildings sector represents the largest share of investment costs (43.8% of the total). However, it should be borne in mind that the list of actions is only a set of proposals that the city can follow in order to accelerate the achievement of the climate neutrality. In contrast, the annual savings from the implementation of all planned actions could be as high as **€101,207,000.** Assuming full implementation of these actions, emissions will be reduced by **598,868.89 tCO_{2e}**. This represents a 20% reduction in CO_2 compared to the city's total emissions in 2021 (2,942,967 tCO_2). In addition, it is estimated that the implementation of these investments could create between **1,463–3,190** new jobs.

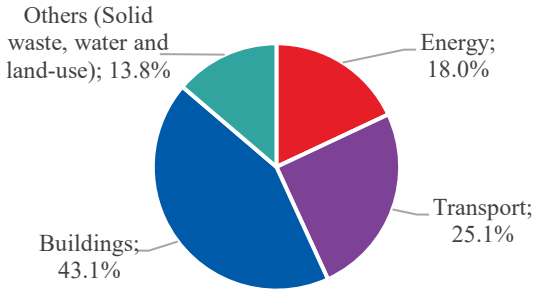


Figure 22 Distribution of GCAP Action Costs (CapEx)

As a result of the implementation of actions in all of the sectors identified and included in the GCAP, the quality of life of residents will be significantly improved. In addition, the implementation of these actions will lead to a number of additional environmental benefits, such as improving the condition of green spaces throughout the city, ensuring the protection and development of blue-green infrastructure and its integration into urban spaces.

The assumptions presented in the document are intended to guide the city in making decisions on the implementation of the presented investments, including those related to potential sources of funding, monitoring the implementation of actions and mitigating risks that may arise during the implementation or exploitation of the results of the given investments.

It should be remembered that the GCAP is an investment roadmap presenting actions that can help transform the city into a greener and more liveable place. The cost estimates presented in the document are intended to show the scale of investment required and the financial consequences will not be borne by local government alone. The proposed actions and investments illustrate the scale of the city's challenges and the investment need in order to prevent or adapt to climate change.

This roadmap is intended to help the city identify alternative and potential sources of funding to implement the activities identified.

The stated objectives and conditions will help to identify and find new sources of funding, while at the same time helping the local government budget to obtain investment funding from other external sources.

7.10 Identification of barriers to the implementation of GCAP actions

The implementation of actions is associated with various types of challenges. The nature and relevance of barriers to investment vary between economic sectors and between mitigation and adaptation activities. Barriers are also strongly influenced by other factors affecting the investment environment in a country or region, and by the technologies involved. Different financial instruments – such as grants, concessional loans or guarantees – have specific characteristics that can address these different barriers.

Four main types of barriers related to GCAP investment were identified:

Financial Investment Barriers: These hurdles involve the difficulties investors encounter in securing the necessary capital. Causes include inadequate returns on investment, high entry costs, and limited access to funding. These challenges often restrict smaller investors' participation, limit investment opportunities, and discourage potential investors from entering a market or investing in an asset.

Regulatory Investment Barriers: These obstacles stem from government-imposed rules

[3] The estimates of costs presented in the document are intended to show the scale of the economic challenge facing the city. The proposed actions and investments illustrate the extent of the city's shortages and needs. It should also be kept in mind that it is not only local government entities that will bear the financial consequences. Also, private entities will need to contribute to financial outlays to prevent or adapt to climate change.

and regulations that restrict or limit investment activities. Examples include restrictions on foreign investment, licensing requirements, and capital flow restrictions. Such barriers impact investment opportunities, increase compliance costs, and may deter investors from investing in a specific region or asset.

Legal Investment Barriers: These arise from issues related to property rights, such as land use regulations and zoning laws. They restrict investment opportunities, limit the entry of new market players, and reduce competition.

Informational Investment Barriers: These challenges emerge due to opaque market systems, unclear investment opportunities, and manipulated data within the market. They can lead to a lack of knowledge among investors about the investment process, limited understanding of market dynamics, and the potential for poor investment decisions that result in significant losses.

7.11 Potential funding options

First of all, it is important to distinguish between funding and financing term.

Funding refers to the provision of financial resources to support a specific project, business, or initiative. It often implies that the money is provided without the expectation of repayment or with very lenient repayment terms (grants, donations, equity investment, crowdfunding).

Financing refers to the act of providing funds for business activities, making purchases, or investing. It usually involves borrowing money with the expectation of repayment over time, often with interest (loans, bonds, lines of credit, leasing).

The objectives and stipulations of this analysis will help to identify and find new funding prospects, while assisting the local government budget in obtaining investment funding from other external sources such as:

- financing from national resources,
- International Financial Institutions (e.g., EBRD, EIB),
- EU grants (NextGenerationEU, e.g., under the Recovery and Resilience Facility Fund and the European Green Deal),
- Public-private partnerships,
- Energy Services company's (ESCO) formula.

External financing sources are however secondary to city's own source revenue, which should be considered as priority for climate actions with city's ownership.

Within the identified actions, a distinction can be made between actions that will generate revenue in the future and those that will not. The vast majority of the identified actions have no revenue generating potential or it is very limited / not direct.

Revenue generating actions include i.a.:

- E1 Enhancing the use of renewable energy sources (RES) in district heating,
- B1 Upgrading municipal buildings and their systems,
- T5 Expansion of the network of public charging stations and charging points for electric cars,
- W3 Resilience of water supply system,
- SW4 Upgrade of the local MBT facility.

Investments that will generate revenue in the future can be financed via private sources through partnership with the city in form of BOO, BOT, DBO, etc.

The solutions presented in the actions will also be a strong asset and advantage for the local government in obtaining financial support from currently planned and future funding mechanisms related to the implementation of EU regulations and requirements resulting from the Community's pursuit of climate neutrality.

In managing the financial affairs of a city, it becomes clear that not all expenditures can be feasibly covered by the allocated city budget alone. As municipalities strive to meet the diverse needs and demands of their citizens, it is often necessary to seek external sources of funding to bridge the gap between budgetary constraints and essential investments. Faced with this imperative, city administrators carefully navigate the various funding programmes and align their goals, objectives and policies with specific funding opportunities. This strategic approach enables cities to match required investments with appropriate external funding sources, ensuring the realisation of key projects and initiatives for the betterment of the environment and the community.

As a result, seeking external funding becomes a necessity to support essential investments.

Firstly, internal sources were examined, including allocations from the local municipal budget as well as the financial resources of

municipal entities. These internal channels served as foundational pillars, providing an initial source of funds for the proposed projects.

At the national level, the state budget emerged as a significant source, providing access to various national programmes and projects tailored to support infrastructure and development efforts.

External sources of finance have been extensively explored. International financial institutions, including the European Bank for Reconstruction and Development (EBRD) and the European Investment Bank (EIB), and private commercial entities were key channels for securing financial support.

In addition, the potential for public-private partnerships (PPPs) was carefully explored, recognising the collaborative synergies between public and private actors.

European Union funding mechanisms and programmes were identified as another important channel for financial support. Given Vilnius' strategic position within the European Union, careful efforts were made to align the proposed projects with the strict criteria and objectives of EU funding opportunities.

In the context of international funding institutions and EU funding mechanisms, strategic alignment between proposed investments and their pre-defined objectives and targets was paramount. This alignment not only streamlined the allocation process, but also increased the prospects of securing financial support from these bodies. In addition, alternative funding opportunities for smaller actions such as crowdfunding and sponsorship have been explored, underlining a proactive attitude towards innovative funding strategies.

7.12 The impact of GCAP on GHG emissions reduction

Furthermore, Vilnius' emissions are projected to increase from 4.2 tCO_{2e} per capita in 2019 to 4.5 tCO_{2e} per capita in 2050 under a business-as-usual emissions scenario.

Based on its GHG emissions and national income status in 2019, Vilnius was assigned the Paris-compliant "steady decrease" trajectory in the emissions reduction pathway modelling completed for the GCAP. This trajectory calls for a 62% reduction from 2019 baseline emissions by 2030 before full decarbonisation in 2050.

GCAP actions are expected to save 598,868.89 tCO_{2e} per annum assuming they are all implemented in full. It represents 29% of the required emissions reduction between business-as-usual and Paris alignment pathways. GCAP actions in the energy sector contribute the largest total carbon savings, with a total value of 386,041.8 tCO_{2e} per year.

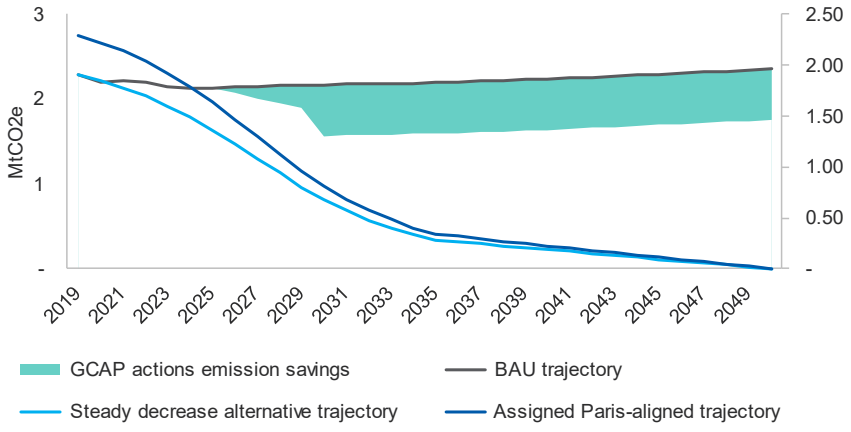


Figure 23 Summary GHG trajectories [4]

[4] The purpose of developing a Business-as-Usual trajectory and Paris-aligned trajectory to 2050 for individual cities is to compare them with the achieved emissions savings from actions included in the city GCAPs. GCAPs represent an important opportunity for cities to consider how they can decarbonise their infrastructure and urban systems in line with the goals of the Paris Agreement. This report presents a business-as-usual and "Paris aligned" emissions trajectory between 2019 and 2050 for Vilnius, alongside the contribution from the city's GCAP climate actions that aim to reduce emissions. The purpose of these results is to emphasise the level of ambition required to keep within a global 1.5 ºC temperature rise above pre-industrial levels. The assigned Paris-aligned trajectory for Vilnius is based on an assessment of the fair share contribution that Vilnius should aim to make towards long-term emissions reductions.

In addition, Vilnius is participating in the Net Zero Cities programme, where the city is developing an action plan that sets even higher targets for the city's GHG emissions reduction. By implementing the actions included in the NZC Action Plan, this target could be increased to up to 80% reduction by 2030 (relative to 2021).

The simultaneous development of the GCAP and the CCC Action Plan will significantly boost the city's chances of successfully implementing all proposed initiatives and achieving climate neutrality by 2030. The synergy created between these two programs will play a crucial role in this process. By working in tandem, they will not only raise awareness among local residents and key decision-makers but also enhance the city's capacity to secure additional funding and investment. Moreover, this collaboration will fortify the city's position within the EU, showcasing its commitment to sustainability and strengthening its resilience in meeting climate-related challenges.

MONITORING AND REPORTING

8. Monitoring and reporting

The purpose of monitoring and evaluating progress in implementing the GCAP is to check whether the actions and decisions taken are producing the expected results and what impact they are having on the sectoral challenges identified. Monitoring reports will be published to ensure that residents and other stakeholders have access to information and can monitor progress. The following sections describe the framework for monitoring and reporting on progress in implementing the GCAP.

8.1 Monitoring of implementation and results

The monitoring process will have two components:

- **Monitoring the progress of implementation**, reviewing the progress of implementation of actions developed within the Vilnius GCAP.
- **Monitoring the results**, checking whether the implemented actions and steps of implementation are bringing the expected positive changes in the city and whether they will lead to the achievement of the vision and goals of the document.

The VšĮ "Neutralus klimatui Vilnius" will be responsible for the monitoring process and the preparation of evaluation reports.

To ensure consistency and cooperation, the four main components that determine the effectiveness of the process are presented in Table 11.

Table 11 Components of the monitoring progress

Reporting and monitoring framework	The unit responsible for the monitoring process will define the reporting framework and monitor the implementation of the GCAP. This will mainly include actions taken by other departments and units identified as responsible for the action and cooperation with stakeholders.
The responsibilities of coordinating entities and cooperating stakeholders	Each action identifies the bodies responsible for a given action. These units will be responsible for coordinating the work with the stakeholders involved in the implementation of the actions according to the timetable and for monitoring their implementation.
Financing of actions	The units responsible for the actions, in collaboration with the other city departments, obtain a budget for the actions from both external and internal funds. To optimise this process, each action provides estimates of capital and operating costs and identifies possible sources of funding for the action.
Review and evaluation	The entities responsible for the implementation of the actions will collect data on the progress of their application. The information collected will be sent to the VšĮ "Neutralus klimatui Vilnius" on a regular basis (at least once a year). This unit, together with the entities responsible for a given action, will be able to adjust the period and steps for the implementation of the action to ensure an efficient process.

8.2 Reporting process

A crucial element of reporting will be the continuous observation of the results of the actions implemented in the city. This will allow an objective look at the results of the implementation of the GCAP and possibly to review the initial assumptions if the observed progress is not satisfactory. In the "Targeted results of the action and costs" section of each action, the indicators for the implementation of the action are defined, which will allow the progress of the developed actions to be determined in a measurable way. As a tool to support the monitoring process, it is recommended to use the database of indicators developed in the project, which contains assessments of the pressure-state-response indicators used to analyse the existing state of the city. Data for indicators related to a given action should be collected and updated on a regular basis. The unit responsible for the monitoring process will supervise the process of data collection in this respect and the cooperation with the units responsible for the actions in the area of results monitoring. The tasks of the units responsible for a given action include following up contacts with stakeholders, collecting and verifying data and providing information that includes an actual assessment of the impact of actions, resources and budget on their implementation. This information should be provided to the unit responsible for monitoring on a regular basis according to agreed reporting periods. It is recommended that the method and indicators for monitoring results should be reviewed annually and revised if necessary. It is recommended to provide an annual report to the EBRD.

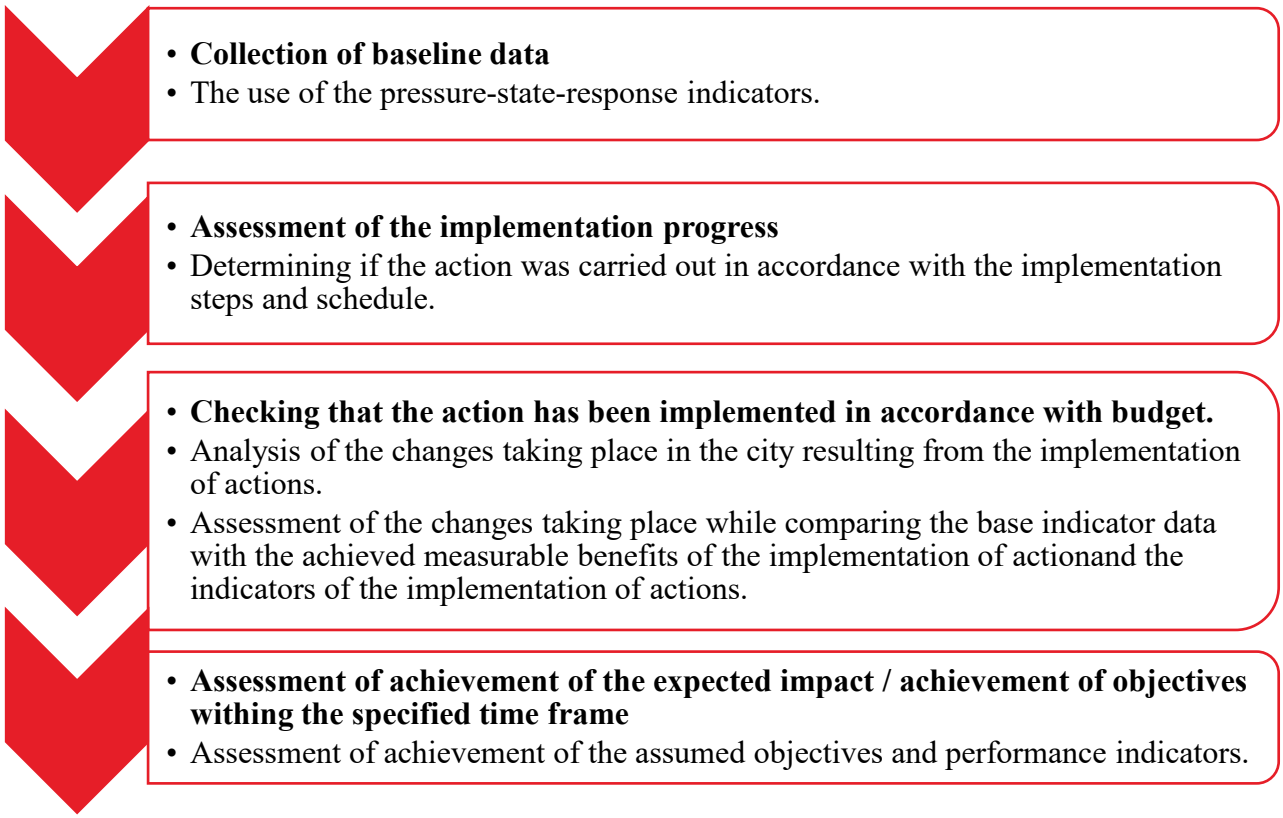


Figure 24 Diagram of the monitoring

Appendix A

Appendix A – Abbreviations & glossary

Abbreviations		
Abbr.	Term	Definition
AB	(lt. Akcinė bendrovė) – joint-stock company (JSC)	N/A
AHP	Air Source Heat Pump	An air source heat pump is a heat pump that can absorb heat from air outside a building and release it inside; it uses the same vapor-compression refrigeration process and much the same equipment as an air conditioner, but in the opposite direction.
BAU	Business as usual	A term used in the context of business and policy that signifies the continuation of current actions, strategies, or practices without making significant changes. In the context of climate change or sustainable development, it refers to a situation where no actions are taken to reduce negative environmental impacts, and all processes and operations are conducted as they have been.
BIM	Building Information Modelling	Building information modelling is a process involving the generation and management of digital representations of the physical and functional characteristics of buildings and other physical assets.
BOD	Biochemical oxygen demand	An analytical parameter representing the amount of dissolved oxygen consumed by aerobic bacteria growing on the organic material present in a water sample at a specific temperature over a specific time period. The BOD value is most commonly expressed in milligrams of oxygen consumed per litre of sample during five days of incubation at 20°C and is often used as a surrogate of the degree of organic water pollution.
BOO	build–own–operate	BOO means a Build-Own-Operate contract to build, operate, and maintain a facility; after the completion of the facility, the investor shall own and have the right to commercially operate such facility in perpetuity unless by mutual agreement the Government decides to purchase the asset at the end of a specified period of time.
BOT	build–operate–transfer	A build, operate and transfer contract is a project delivery model that is typically used for large projects developed through Public Private Partnerships (PPPs).
ca.	circa	N/A
CapEx	Capital expenditure	Capital expenditure or capital expense is the money an organisation or corporate entity spends to buy, maintain, or improve its fixed assets, such as buildings, vehicles, equipment, or land.
CCC	Climate Change Contract	The Cities Mission Climate City Contract (CCC) is a governance innovation tool to help cities collaboratively address their barriers to reaching climate neutrality by 2030. The CCC is one process and document with three interlinked components: Commitments, Actions, and Investments.
CHP	Combined Heat and Power	Combined heat and power is the use of a heat engine or power station to generate electricity and useful heat at the same time.
CNG	Compressed natural gas	CNG is natural gas compressed to a pressure of 20–25 MPa, used to power motor vehicles with both spark-ignition and compression-ignition engines.
CO_2	Carbon dioxide	N/A
CTO	Chief Technology Officer	N/A

DBO	design-build-operate	A design build operate contract is a project delivery model in which a single contractor is appointed to design and build a project and then to operate it for a period of time.
DĖK'UI		DĖK'UI stations are drop-off and exchange points where residents can leave their unused items.
DGASA	(lt. Didelių gabaritų atliekų surinkimo aikštelės) - bulky waste collection sites	Areas designated for the disposal of bulky waste, household-generated textiles, hazardous waste arising from construction and municipal waste streams, and other waste generated from municipal waste streams, separated from mixed municipal waste.
DT	Digital transformation	The process of adoption and implementation of digital technology by an organisation in order to create new or modify existing products, services and operations by the means of translating business processes into a digital format.
EBRD	European Bank for Reconstruction and Development	An international financial institution founded in 1991. As a multilateral development investment bank, it uses investment as a tool to build market economies.
EIB	European Investment Bank	EIB is the European Union's investment bank and is owned by the 27 member states. It is the largest multilateral financial institution in the world. The EIB finances and invests both through equity and debt solutions companies and projects that achieve the policy aims of the European Union through loans, equity and guarantees.
EPA	Environmental Project Management Agency	A professional organisation operating under the Ministry of Environment of the Republic of Lithuania, responsible for managing projects funded by the European Union and national funds in the environmental and climate change sector, providing services to project promoters to ensure efficient and compliant implementation of environmental protection initiatives and climate change projects.
EPR	Extended Producer Responsibility for Packaging	Extended Producer Responsibility is a policy tool that extends the producer's financial and/or operational responsibility for a product to include the management of the post-consumer stage, in order to help meet national or EU recycling and recovery targets.
ESCO	Energy Service Company	An ESCO is a company that offers energy services which may include implementing energy-efficiency projects (and also renewable energy projects) and in many case on a turn-key basis.
ESO	(lt. Energijos skirstymo operatorius) – Energy distribution operator	An electricity and gas distribution company in Lithuania.
EU	European Union	Is a supranational political and economic union of 27 member states that are located primarily in Europe.
EUR	Euro (€)	It is the common currency for the eurozone countries.
EV	Electric Vehicle	Is a passenger automobile that is propelled by an electric traction motor, using electrical energy as the primary source of propulsion.
FDI	Foreign direct investment	A foreign direct investment refers to purchase of an asset in another country, such that it gives direct control to the purchaser over the asset (e.g. purchase of land and building).
FTEs	Full-Time Equivalents	A unit of measurement that indicates the workload of an employed person in a way that makes workloads or class loads comparable across various contexts.
GBVH	Gender-Based Violence and Harassment	Is an umbrella term that covers a range of behaviours, including sexual, physical, psychological, and economic abuse.
GCAP	Green City Action Plan	Defines the actions that can be implemented by the city to become a green and sustainable for the citizens
GDP	Gross Domestic Product	Gross domestic product is a monetary measure of the market value of all the final goods and services produced and rendered in a specific time period by a country or countries.

GHG	Greenhouse Gas	Gases that have little or no interaction with solar radiation but absorb infrared radiation in the wavelength range emitted by the Earth's surface.
GWh	Gigawatt hour	A unit for measuring energy. It is used to express the quantity of energy produced or consumed by a piece of equipment with power of one gigawatt for one hour.
H_2	Hydrogen	In the context of H_2 buses, it refers to hydrogen-powered buses that use fuel cells to generate electricity from hydrogen.
HICP	Harmonised Index of Consumer Prices	The HICP is an indicator of inflation and price stability for the European Central Bank (ECB). It is a consumer price index which is compiled according to a methodology that has been harmonised across EU countries.
HR	human resources	N/A
HWRC	Household Waste Recycling Centre	A facility where the public can dispose of household waste and also often containing recycling points.
ICT	Information and Communication Technologies	ICT is an expanded term for information technology (IT) that highlights the integration of telecommunications and computers, along with the necessary software, storage, and audiovisual systems, enabling users to access, store, transmit, and manipulate information. It also refers to the convergence of audiovisual and telephone networks with computer networks through a single cabling system.
IMF	International Monetary Fund	An international organisation within the UN that deals with issues of global economic stabilisation. It provides financial assistance to member countries in debt, which are required to implement economic reforms and other stabilising actions in return.
INRIX		A traffic and mobility data analysis company.
ITS	Intelligent Transportation Systems	ITS is an advanced application that aims to provide innovative services relating to different modes of transport and traffic management and enable users to be better informed and make safer, more coordinated, and "smarter" use of transport networks.
JSC	Joint-Stock Company	N/A
JUDU		JUDU is a team of traffic management and organisation professionals that ensures the harmonious movement of the city of Vilnius.
KTU	Kaunas University of Technology	N/A
kWh	Kilowatt hour	A unit for measuring energy. It is used to express the quantity of energy produced or consumed by a piece of equipment with a power of one kilowatt for one hour.
kWp	Kilowatt peak	kWp is a unit of measurement that indicates the maximum output of a photovoltaic (PV) system, representing the highest amount of electrical power, measured in kilowatts, that the system can produce under optimal sunlight conditions.
LNG	Liquefied natural gas	Liquefied natural gas is natural gas (predominantly methane with some mixture of ethane) that has been cooled down to liquid form for ease and safety of non-pressurised storage or transport.
LPG	Liquefied petroleum gas	Liquefied petroleum gas is a fuel gas composed of a flammable mixture of hydrocarbons, mainly propane, n-butane, and isobutane. It is used in heating appliances, cooking equipment, and vehicles, where it is often called autogas or simply gas.
MBT	Mechanical Biological Treatment Plant	Type of waste processing facility that combines a sorting facility with a form of biological treatment such as composting or anaerobic digestion. MBT plants are designed to process mixed household waste as well as commercial and industrial wastes.
MSW	Municipal Solid Waste	Municipal waste generated by households.
MW	Megawatt	A unit of power equal to one million watts. It is used to measure large amounts of power, for example in power plants, wind turbines, or large energy installations.

MWh	Megawatt hour	A unit of energy equal to one megawatt of power sustained for one hour. It is used to measure large quantities of energy consumption or production, for example in power plants, wind farms, or large energy installations.
NBS	Nature-Based Solutions	Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience.
NGOs	Non-Governmental Organisations	A non-governmental organisation is a nonprofit entity that operates independently from the government, often focusing on humanitarian or social issues.
NO_2	Nitrogen dioxide	N/A
NO_X	Nitrogen oxides	N/A
NREL	National Renewable Energy Laboratory	The NREL in the United States specialises in the research and development of renewable energy, energy efficiency, energy systems integration, and sustainable transportation.
NZC	NetZeroCities	NetZeroCities is part of the Horizon 2020 Research and Innovation Programme in support of European Union's Green Deal. NetZeroCities has been designed to help cities overcome the current structural, institutional and cultural barriers they face in order to achieve climate neutrality by 2030.
OpEx	operating expense	An operating expense is an ongoing cost for running a product, business, or system.
pcs	pieces	N/A
PM	Particular Matter	A mixture of solid particles and liquid droplets found in the air.
PM_{10}	Particular Matter	Particulate matter less than 10 µm in size.
$PM_{2,5}$	Particular Matter	Particulate matter less than 2,5 µm in size.
PPP	Public Private Partnerships	A public–private partnership is a long-term arrangement between a government and private sector institutions.
PVC	Polyvinyl chloride	A synthetic polymer from the vinyl polymer group, obtained through the polymerisation of vinyl chloride. It is used in the production of plastics, has thermoplastic properties, high mechanical strength, and is resistant to many solvents.
RES	Renewable energy sources	RES include wind, solar, aerothermal, geothermal, hydro, ocean energy sources, biomass and the biodegradable fraction of waste.
res.	residents	N/A
RVA	Risk and Vulnerability Assessment	This is a process that evaluates the risk of climate-related impacts, resulting from the interaction of climate-related hazards (including hazardous events and trends) with the vulnerability and exposure of human and natural systems. It considers changes in both the climate system and socioeconomic processes, including adaptation and mitigation, as drivers of hazards, exposure, and vulnerability.
SEA	Strategic Environmental Assessment	The process of assessing the impact of policies, plans, and programs on the environment.
SEP	Stakeholder Engagement Plan	Documents how involved and influential your project stakeholders are.
SI	Smart integration	N/A
SO_2	Sulphur dioxide	N/A
SPSC	(lt. Statybos produkcijos sertifikavimo centras) – Building Product Certification Centre	N/A
sq.	square	Refers to the area in square meters.
St.	Street	Refers to a specific road or thoroughfare, typically as part of an address.

SUMP	Sustainable Urban Mobility Plan	It is a planning concept used by local and regional authorities for strategic mobility planning. It encourages a shift towards more sustainable transport modes and supports the integration and balanced development of all transport modes.
tCO_{2e}	tonnes of CO_2 equivalent	It is a unit of measurement used to estimate the impact of various greenhouse gases on the greenhouse effect compared to carbon dioxide (CO_2).
TJ	Terajoule	A unit of measurement for energy, used to quantify large amounts of energy.
UAB	(lt. Uždaroji akcinė bendrovė) – Limited Liability Company (LLC)	N/A
UHI	Urban heat island	Urban areas usually experience the urban heat island effect, that is, they are significantly warmer than surrounding rural areas.
V2G	Vehicle-to-Grid	A technology that enables bidirectional flow of electrical energy between a vehicle connected to a charging station and the electricity grid.
VAATC	(lt. Vilniaus apskrities atliekų tvarkymo centras) – Vilnius Region Waste Management Centre)	A company responsible for operating a waste management system in areas designated by partners in the Vilnius region.
VASA	(lt. Vilniaus atliekų sistemos administratorius) – Administrator of the City Waste management systems	N/A
VMSA	(lt. Vilniaus miesto savivaldybės administracija) – Vilnius City Municipality Administration	N/A
VŠT	(lt. Vilniaus šilumos tinklai) – Vilnius heating network	N/A
VVT	(lt. Vilniaus viešasis transportas) – Vilnius Public Transport	N/A
WFD	Water Framework Directive	Setting out rules to halt deterioration in the status of EU water bodies and achieve good status for Europe's rivers, lakes and groundwater.
WM	Waste management	N/A
WMS	Waste Management System	N/A
yty	year-to-year	N/A

Glossary - general

Term	Definition
Fossil fuel	Hydrocarbon-containing material formed naturally in the Earth's crust from the remains of dead plants and animals that is extracted and burned as a fuel. The main fossil fuels are coal, oil, and natural gas.
Green City baseline	A summary of the situation of the city based on a technical assessment of the city's environment and urban systems together with a review of the policy, governance and economic context and assessments of the city's resilience, vulnerability, and smart maturity
Kick-off	An inaugural meeting that marks the formal start of a project.

Natura 2000	The network of nature protection areas in the territory of the European Union. It is made up of Special Areas of Conservation and Special Protection Areas designated under the Habitats Directive and the Birds Directive, respectively. The network includes both terrestrial and Marine Protected Areas.
NER 300	NER 300 is a funding programme pooling together about EUR 2 billion for innovative low-carbon technology, focusing on the demonstration of environmentally safe Carbon Capture and Storage (CCS) and innovative renewable energy technologies on a commercial scale within the EU.
Pressure Indicators	Pressure indicators describe the city's infrastructure and other physical systems and their effect on the environment.
REPowerEU	REPowerEU is a European Commission proposal to end reliance on Russian fossil fuels before 2030 in response to the 2022 Russian invasion of Ukraine.
Response Indicators	Response indicators describe the presence and effectiveness of relevant city and other government action (policy, regulation etc.) to reduce or mitigate the effect of the city's pressures on its environment.
Risk	The potential for consequences where something of value is at stake and where the outcome is uncertain, recognising the diversity of values. As part of a Risk and Vulnerability Assessment, risk is often represented as the probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur.
Smart City	A smart city is an innovative city which uses ICT and other digital tools across all sectors to make optimal use of city services and urban functions and improve quality of life within the city.
Solid fuel	Refers to various forms of solid material that can be burnt to release energy, providing heat and light through the process of combustion.
State Indicators	State indicators describe the quality of environmental assets, the availability of natural resources and the city's effect upon and exposure to climate change.
Vulnerability	The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt, as well as the structural conditions, (including physical, social, cultural, economic, and political. systems) that render people and communities susceptible to the impacts of hazards, and which make it possible for a hazard to become a disaster.

Glossary – action cards

Term	Definition
Action type	Specification of the type/scope of action, broken down into capital investments, operational actions, and enabling actions.
Addressed Strategic Goals	Key strategic goals that the action aims to help the city achieve.
Benefits	Benefits related to improving the quality of environment and life in the city and strengthening the city's climate resilience.
City's strategy / policy / plans	Documents where the description of this action is compatible with those contained in the strategy, plan or policy.
Implementing body	The unit responsible for the preparation, implementation and monitoring of actions under the GCAP of Vilnius.
Inclusivity and Social Aspects	Opportunities to implement solutions to increase inclusivity, social diversity and accessibility in the implementation of the action.
Key supporting actors	Organisations or individuals with a direct interest in consulting on the implementation of the action and the results of its implementation.
Milestones	Key stages and project progress in the schedule.
Operational Costs (OpEx)	Expenses associated with maintaining a product, business or system.
Potential action location	Sites affected by the action.

Potential sources of financing	The way in which a company, organisation or programme receives the funding it needs to continue operating.
Related Challenges	Related challenges for which the action was created, aimed at supporting the improvement of environmental quality and life in the city.
Smart City Potential	Opportunities to implement digital technologies, oriented towards smart, innovative solutions in the implementation of the action (not included in the CapEx).
Supported Targets	Measurable impact resulting from the implementation of the action.
Supporting & relevant actions	Other activities that are connected and relevant to this action.
Targeted results of the action and costs (CapEx)	Expenditure related to the cost of constructing the facility, purchasing equipment, making the investment.
Timescale	Range of years in which the action will be implemented.

Appendix A.1

Appendix A.1 – List of entity names (LT-ENG)

Entity name	
Lithuanian	English
AB “Ambergrid”	JSC “Amber Grid”
AB “Civinity”	JSC “Civinity”
AB “Litgrid”	JSC “Litgrid”
AB “Energijos skirstymo operatorius, ESO”	JSC “Energijos skirstymo operatorius” (ESO)
AB “Swedbank”	JSC “Swedbank”
AB “Šiaulių bankas”	JSC “Šiauliai Bank”
AB “Vilniaus šilumos tinklai, VŠT”	JSC “Vilnius heating network” (VŠT)
Aplinkos projektų valdymo agentūra	Environmental Project Management Agency of the Ministry of the Environment of the Republic of Lithuania
Dzūkijos - Suvalkijos saugomų teritorijų direkcija	Dzūkija - Suvalkija Directorate of Protected Areas
Eksploatuoti netinkamų transporto priemonių tvarkytojų asociacija	Association of End-of-Life Vehicle Operators
GNLD Neolife	NEOLIFE International LLC
Kraštovaizdžio dendrologas	Landscape dendrologist
Lietuvos architektų sąjungos (LAS) Vilniaus skyrius	Vilnius Branch of the Lithuanian Union of Architects
Lietuvos bankas	Bank of Lithuania
Lietuvos dviratininkų bendrija	Lithuanian Cyclists Community
Lietuvos energetikos agentūra	Public Institution “Lithuanian Energy Agency”
Lietuvos geografų draugija	Lithuanian Geographical Society
Lietuvos kraštovaizdžio architektų sąjunga	Lithuanian Union of Landscape Architects
Lietuvos mokslo taryba	Research Council of Lithuania
Lietuvos pėsčiųjų asociacija	Lithuanian Pedestrians’ Association
Lietuvos Respublikos Aplinkos Ministerija	Ministry of Environment of the Republic of Lithuania

Lietuvos Respublikos Seimas	Seimas of the Republic of Lithuania
Lietuvos žmonių su negalia sąjunga	Lithuanian Union of People with Disabilities
MB “Studio Space/Time”	Small Partnership “Studio Space/Time”
MB “BLUMA Collective”	Small Partnership “BLUMA Collective”
Miesto aplinkos skyrius	Urban Environment Department
Nacionalinė vartotojų federacija	Lithuanian National Consumers Federation
Pavilnių Verkių regioninis parkas	Municipal budget institution “Pavilnių ir Verkių regioninių parkų direkcija”
Pelkiu atkurimo ir apsaugos fondas	Public Institution “Foundation for Peatland Restoration and Conservation”
S/B, “Troleibusas”	Trolleybus Gardeners’ Association
Sakalaičių seniūnaitija, Naujininkų seniūnijoje	Sakalaičiai Eldership, in Naujininkai Eldership
Salininkų bendruomenės asociacija	Association of Salininkai Community
SĮ “Susisiekimo paslaugos, JUDU”	Municipal enterprise “Susisiekimo paslaugos” (JUDU)
SĮ “Vilniaus atliekų sistemos administratorius, VASA”	Municipal enterprise “Administrator of the City Waste management systems” (VASA)
Šiaurės ministrų tarybos biuras Lietuvoje	Nordic Council of Ministers Office in Lithuania
Susisiekimo ministerija	Ministry of Transport and Communications
Talino technikos universitetas (TalTech)	Tallinn University of Technology
UAB “313 architects”	313 architects LLC
UAB “Ecoservice”	Ecoservice LLC
UAB “Eika”	Eika LLC
UAB „Ekonominės konsultacijos ir tyrimai”	Ekonominės konsultacijos ir tyrimai LLC
UAB “Ekonovus”	Ekonovus LLC
UAB “Energesman”	Energesman LLC
UAB “Gaučė ir Ko”	Gaučė ir Ko LLC
UAB “Grinda”	Grinda LLC

UAB “ID Vilnius”	ID Vilnius LLC
UAB “Idea prima”	Idea prima LLC
UAB “Technologinių paslaugų sprendimai”	Technologinių paslaugų sprendimai LLC
UAB „Tolimojo keleivinio transporto kompanija”	Tolimojo keleivinio transporto kompanija LLC
UAB “Vesta Consulting”	Vesta Consulting LLC
UAB “Vilniaus apskrities atliekų tvarkymo centras, VAATC”	VAATC (Vilnius Region Waste Management Centre) LLC
UAB “Vilniaus apšvietimas”	Vilnius apšvietimas LLC
UAB “Vilniaus vandenys”	Vilnius waters LLC
UAB “ZABolis Partners”	Žabolis ir partneriai kapitalo valdymas LLC
UAB “Vilniaus kogeneracinė jėgainė”	Vilnius Combined Heat and Power Plant (Vilnius CHP) LLC
UAB “Vilniaus viešasis transportas, VVT”	Vilniaus viešasis transportas LLC
UAB “Vilniaus vystymo kompanija, VVK”	Vilnius Development Company LLC
Valstybinės Kultūros Paveldo Komisija	National Commission for Cultural Heritage of the Republic of Lithuania
Vartotojų aljansas	Lithuanian Consumers Alliance
Vilniaus Gedimino technikos universitetas	Vilnius Gediminas technical university (VILNIUS TECH)
Vilniaus kolegija	Vilniaus kolegija | Higher education institution
Vilniaus miesto savivaldybė	Vilnius City Municipality
Vilniaus miesto savivaldybės administracija, VMSA	Vilnius City Municipality Administration
Vilniaus universitetas	Vilnius University
Vokės bendruomenė	Association of Vokė Community
VšĮ “Gyvi gali”	Public Institution “Gyvi gali”
VšĮ “Žaliasis taškas”	Public Institution “The Green Dot”
VšĮ CPO LT	Public Institution “CPO LT”
VšĮ Kurk Lietuvai	The Young Professionals Program “Create Lithuania”

VšĮ Mes Darom	Public Institution “Mes Darom”
VšĮ “Atnaujinkime miestą”	Public Institution “Let’s renovate the city”
VšĮ “Neutralus klimatui Vilnius”	Public Insitution “Climate Neutral Vilnius”
VšĮ “Vilniaus miesto parkai"	Public institution “Vilnius city parks”
Žaliųjų finansų institutas / ILTE	Institute of Green Finance / “ILTE” LLC
Žemės tvarkymo ir administravimo skyrius	The National Land Service under the Ministry of Environment of the Republic of Lithuania
Žirmūnų Tuskulėnų bendruomenė, asociacija	Association of Žirmūnai Tuskulėnai Community

Appendix B

Appendix B – Stakeholder engagement

Engagement consisted of stakeholder participation through meetings with the city, internal and external engagement events, a survey and online meetings and at all stages of the project.

A comprehensive list of completed engagements, along with additional details, is provided in Table 12.

Consultations and workshops were organised to involve both the public and the city's stakeholders. Various sectors representing different interests and social groups at local and national levels were considered. The selection of stakeholders was influenced by the importance attached to social diversity and the inclusion of vulnerable groups.

Table 12 Stakeholder engagement process

Engagement	Term	Location	Participants	Results	Links
Kick off meeting	16th October 2023	Online	12 attendees (7 females, 5 males)	Formal start of the GCAP process, introduction to the EBRD Green Cities Programme – GCAP and the associated processes and methodology.	
Launch Event	1st February 2024	On site	54 attendees (28 females, 26 males)	The official public launch event with the municipality, the EBRD and the donor. Followed by a presentation of the project by the consultant and a short discussion with the participants on the main challenges and priorities of the city.	Link 1
1st Stakeholder Engagement	1st February 2024	On site	29 attendees (16 females, 13 males)	Post-launch workshops, which provided an opportunity to validate and refine the priorities and key challenges previously discussed at the launch event.	
Sectoral meetings	2nd February 2024	On site	37 attendees (21 females, 16 males)	A series of 6 sectoral meetings with experts to discuss and define the environmental and sectoral challenges facing the city.	
CCC, SEP and Baseline Reports Event	27th March 2024	Online	29 attendees (17 females, 12 males)	Meeting with city stakeholders to present the 2030 Climate Action Plan, Stakeholder Engagement Plan, the structure of GCAP reports and the main findings.	
Sectoral meetings	April – May 2024	Online	74 attendees (41 females, 33 males)	A series of 10 sectoral expert meetings to discuss the results of the baseline assessment and confirm the priority challenges.	
Public survey	10–24 April 2024	Online	514 respondents (257 females, 242 males, 15 preferred not to disclose)	City-wide survey on the state and challenges of Vilnius' environmental quality, urban planning and infrastructure.	
Vision and Strategic Goals Engagement	3rd July 2024	On site	52 attendees (36 females, 16 males)	Selection of the city's vision and key strategic goals of the GCAP.	Link 1 Link 2 Link 3
Action Stakeholder Engagement Events	4th July	On site	43 attendees (30 females, 13 males)	Develop a list of actions that the city will implement to become a Green City.	Link 1 Link 2 Link 3
Sectoral meetings	23–30 July 2024	Online	33 attendees (19 females, 14 males)	A series of 7 sectoral meetings with experts to discuss the results of the workshop for actions and to confirm initial actions for the city of Vilnius.	
Introduction to the GCAP	26th September 2024	On site	73 attendees (38 females, 35 males)	Meeting with external stakeholders to introduce them to the GCAP, communicate its results and progress, and facilitate networking with city representatives and experts.	Link 1 Link 2
Developing the GCAP actions	17th October 2024	On site	65 attendees (40 females, 25 males)	Consultation with external stakeholders on GCAP actions.	Link 1 Link 2 Link 3 Link 4
Adoption of the GCAP	2025	On site / Online		Adoption of GCAP by Steering Committee and City Council.	

Figure 25 Launch Event

Figure 26 Panel discussion at the Launch Event

Figure 27 Workshop – City State Assessment session

Figure 28 Results of the City State Assessment session

Figure 29 Workshop – Vision & Goals

Figure 30 Workshop – Action Development

Figure 31 External stakeholder engagement

Figure 32 External stakeholder engagement

Appendix C

Appendix C – Sectoral findings: key indicators of concern

Table 13 Key transport-related indicators of concern

STATE INDICATORS		
Current state	Desired state	Indicator
0.5 mg/kg	<0.3 mg/kg	ID 4.1.a. concentration of mercury in soil (2023)
17.8 %	>20%	ID 7.2. natural areas (2023)
PRESSURE INDICATORS		
Current state	Desired state	Indicator
15.83 years	<5 years	ID 10. average age of total car fleet (2023)
47.97 %	<20%	ID 10.1. percentage of diesel cars in total vehicle fleet (2023)
1.411 %	>3%	ID 10.3. share of total passenger car fleet run by electric, hybrid, LPG and CNG cars (2023)
43.6 %	<30%	ID 11. transport modal share in commuting (2022)
50.98 %	<30%	ID 11.1. transport modal share in total trips (2023)
0.514 vehicles per capita	<0.3 vehicles per capita	ID 11.2. motorisation rate (2023)
1.1 vehicles per household	<0.5 vehicles per household	ID 11.3. average number of vehicles cars and motorbikes per household (2023)
7.532 km	>40km	ID 11.4. kilometres of road dedicated exclusively to public transit per 100000 population (2023)
17.1 avg. number of services at station per hour, in total bus network	>30 avg. number of services at station per hour, in total bus network	ID 11.7. frequency of bus services (2023)
23.00 km/h	>30km/h	ID 12. average travel speed on primary throughfares during peak hour (2018)
21.97 km/h	>25km/h	ID 12.1. travel speed of bus services on major thoroughfares daily average (2018)
Bus and rail transit systems are able to run in case of disaster, but with reduced efficiency	bus and rail transit systems are able to run normally in case of disaster	ID 13. interruption of public transport systems in case of disaster (2023)
Emergency transport systems are able to run in case of disaster, but limited efficiency	emergency transport systems are able to run normally in case of disaster	ID 13.1. efficiency of transport emergency systems in case of disaster (2023)
RESPONSE INDICATORS		
Current state	Desired state	Indicator
Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	existing and well implemented, and there is no significant need to further expand this type of response	ID 36. high-polluting vehicles are regulated
		ID 37. extension and improvement of public and non-motorised transport is planned and supported through investment in place
		ID 39. traffic demand is managed congestion charges smart technologies
		ID 40. public transport emergency management in publicly and or privately run networks is planned and tested
		ID 41. system integration is sought and supported (integrated ticketing, user information, open data, and traffic control)

Table 14 Key buildings-related indicators of concern

STATE INDICATORS		
Current state	Desired state	Indicator
3.548 mg/L	<2 mg/L	ID 2. Biochemical Oxygen Demand BOD in rivers and lakes (2023)
0.5 mg/kg	<0.3mg/kg	ID 4.1a. concentration of mercury in soil (2023)
60.1%	>70%	ID 6.2. share of population living within 400m of open green space of at least 0.5ha (2021)
17.79%	>20%	ID 7.2. natural areas (2023)
47.52 %	>50%	ID 7.3. tree canopy cover (2022)
30 %	>60%	ID 7.4. connectivity of natural area (2020)
PRESSURE INDICATORS		
Current state	Desired state	Indicator
78.45 kWh/m^2	<47 kWh/m^2	ID 14. electricity consumption in buildings (2019)
32.90 kWh/m^2	<21 kWh/m^2	ID 14.1. electricity consumption in residential buildings (2018)
124.00 kWh/m^2	<122 kWh/m^2	ID 14.2. electricity consumption in non-residential buildings (2019)
146.95 kWh/m^2	<104 kWh/m^2	ID. 15. heating (fossil fuels) and cooling consumption in buildings (2020)
158.73 kWh/m^2	<96 kWh/m^2	ID 15.1. heating (fossil fuels) and cooling consumption in residential buildings (2019)
164.97 kWh/m^2	<127 kWh/m^2	ID 15.2. heating (fossil fuels) and cooling consumption in non-residential buildings (2020)
RESPONSE INDICATORS		
Current state	Desired state	Indicator
Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	existing and well implemented, and there is no significant need to further expand this type of response	ID 42. green building is promoted through standards and fiscal incentives
		ID 43. Public and private investment in energy efficiency in buildings
		ID 44. metering and billing for personal energy use is regulated
		ID 45. support schemes for building renovation established
		ID 46. building inspectors employed and trained

Table 15 Key land use-related indicators of concern

STATE INDICATORS		
Current state	Desired state	Indicator
3.548 mg/L	<2 mg/L	ID 2. Biochemical Oxygen Demand BOD in rivers and lakes (2023)
17.79%	>20%	ID 7.2. natural areas (2023)
47.52 %	>50%	ID 7.3. tree canopy cover (2022)
30 %	>60%	ID 7.4. connectivity of natural area (2020)
1 %	<0.50%	ID 9. estimated economic damage from natural disasters as a share of GDP (2022)
PRESSURE INDICATORS		
Current state	Desired state	Indicator
1450.06 res./km^2	7000–20000 res./km^2	ID 33. population density on urban land (2023)
7.81 km	<5km	ID 33.1. average commuting distance (2023)
2.21 %	>40%	ID 34.1. percentage of urban development that occurs on existing urban land rather than on greenfield land (2015)
6.80 %	<6%	ID 35. vacancy rates of offices (2022)
13.50 %	<6%	ID 35.2. vacancy rates of residential buildings (2021)
RESPONSE INDICATORS		
Current state	Desired state	Indicator
Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	existing and well implemented, and there is no significant need to further expand this type of response	ID 71. density is regulated
		ID 72 transit-Oriented Development is promoted
		ID 73 mixed-use development is promoted through zoning regulations or incentives

Table 16 Key energy-related indicators of concern

STATE INDICATORS		
Current state	Desired state	Indicator
3.548 mg/L	<2 mg/L	ID 2. Biochemical Oxygen Demand BOD in rivers and lakes (2023)
0.5 mg/kg	<0.3mg/kg	ID 4.1.a. concentration of mercury in soil (2023)
PRESSURE INDICATORS		
Current state	Desired state	Indicator
5.07 %	<5%	ID 21.2. percentage of network line losses (2023)
31.94 %	<10%	ID 22.2. share of district heating from carbon intensive sources (2023)
RESPONSE INDICATORS		
Current state	Desired state	Indicator
Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	existing and well implemented, and there is no significant need to further expand this type of response	ID 51. coverage and quality of electricity and heat supply is improved through investment
		ID 52. renewable energy facilities in private buildings are incentivised through fiscal instruments
		ID 53. renewable energy technologies are developed and supported through public and private investment
		ID 54. renewable energy facilities are incentivised through awareness campaigns
		ID 55. the resilience of electricity networks in case of disaster is tested and enhanced through investment

Table 17 Key solid waste-related indicators of concern

STATE INDICATORS		
Current state	Desired state	Indicator
3.548 mg/L	<2 mg/L	ID 2. Biochemical Oxygen Demand BOD in rivers and lakes (2023)
0.5 mg/kg	<0.3mg/kg	ID 4,1a. concentration of mercury in soil (2023)
PRESSURE INDICATORS		
Current state	Desired state	Indicator
340 kg/year/capita	<300 kg/year/capita	ID 29. total solid waste generation per capita (2022)
1.21 USD/kg	<1 USD/kg	ID 29.2. GDP per domestic material consumption (2022)
26 %	>35%	ID 30.1. proportion of dry recyclables (2022)
0.0004 %	>20%	ID 30.2. proportion of organic waste (2021)
RESPONSE INDICATORS		
Current state	Desired state	Indicator
Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	existing and well implemented, and there is no significant need to further expand this type of response	ID 66. coverage of solid waste collection system is improved through plans and investment
		ID 68. composting recycling and waste-to-energy facilities are developed through plans and investment
		ID 69. solid waste reuse sorting and recycling is promoted through information and awareness campaigns

Table 18 Key water-related indicators of concern

STATE INDICATORS		
Current state	Desired state	Indicator
3.548 mg/L	<2 mg/L	ID 2. Biochemical Oxygen Demand BOD in rivers and lakes (2023)
0.5 mg/kg	<0.3mg/kg	ID 4,1a. concentration of mercury in soil (2023)
60%	>70%	ID 6.2. share of population living within 400m of open green space of at least 0.5ha (2021)
17.79%	>20%	ID 7.2. natural areas (2023)
1 %	<0.50%	ID 9. estimated economic damage from natural disasters (floods, droughts etc.) as a share of GDP (2022)
PRESSURE INDICATORS		
Current state	Desired state	Indicator
67.0 L/day/capita	>120–200 l/day/capita	ID 25. water consumption per capita (2022)
0.488 kWh/m^3	<0.35kWh/m^3	ID 26.2 energy used for urban water production and supply (2022)
4.78 %	>60%	ID 27. percentage of residential and commercial wastewater that is treated according to applicable national standards (2022)
0 %	>80%	ID 27.1. percentage of non-industrial buildings equipped to reuse grey water (2022)
1.1 kWh/m^3	<0.75kWh/m^3	ID 27.4. energy used for wastewater collection and treatment (2022)
Citizens are aware of natural disaster risk but do not have resilient attitudes	citizens are well aware of natural disaster risk & know how to react	ID 28.2. awareness and preparedness to natural disasters (2022)
RESPONSE INDICATORS		
Current state	Desired state	Indicator
Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	existing and well implemented, and there is no significant need to further expand this type of response	ID 57. water saving reuse is encouraged through awareness campaigns
		ID 59. buildings access to wastewater collection and treatment system is improved through plans and investments,
		ID 62. drinking water pre-treatment is enhanced through plans and investment
		ID 64. business and community resilience is encouraged through awareness campaigns

Table 19 Key industry-related indicators of concern

STATE INDICATORS		
Current state	Desired state	Indicator
3.548 mg/L	<2 mg/L	ID 2. Biochemical Oxygen Demand BOD in rivers and lakes (2023)
0.5 mg/kg	<0.3mg/kg	ID 4.1a. concentration of mercury in soil (2023)
PRESSURE INDICATORS		
Current state	Desired state	Indicator
32 %	>95% (90%)	ID 19. share of industrial waste recycled as a share of total industrial waste produced (2018)
4.78 %	>60%	ID 20. percentage of industrial wastewater that is treated according to applicable national standards (2022)
RESPONSE INDICATORS		
Current state	Desired state	Indicator
Existing, but implementation challenges have been observed, and/or existing policies are not sufficient to solve the issue at stake	existing and well implemented, and there is no significant need to further expand this type of response	ID 47. energy efficient industrial machinery is regulated and incentivised through fiscal instruments electricity heat industrial processes
		ID 48. energy efficient industrial technologies electricity heat industrial processes are supported through private investment
		ID 49. material efficiency of new built industrial facilities and waste recycling is regulated and incentivised through fiscal instruments

Appendix D

Appendix D – Action cost and benefits calculation methodology

Action cost calculation methodology – introduction

The following appendix provides a detailed description of the methodology used to calculate the costs and benefits associated with the actions presented in the GCAP. To estimate the costs of specific actions, Consultant utilised internal benchmarks, along with publicly available documentation from international financial institutions, tenders, strategic documents from the city of Vilnius, annual reports of Vilnius municipal companies, information from the Vilnius state level, various ministries, and scientific articles. Additionally, a portion of the information was directly obtained from representatives of the different management units within the city of Vilnius.

All presented cost estimates have been quoted in euro and indexed to 2022 by the HICP – annual data provided by Eurostat and World Bank[5]. The GCAP was prepared on the basis of up-to-date data obtained during its development and internal expert analyses.

The estimates of costs presented in the document are intended to show the scale of the economic challenge facing the city. The proposed actions and investments illustrate the extent of the city's shortages and needs. It should also be kept in mind that it is not only local government entities that will bear the financial consequences. Also, private entities will need to contribute to financial outlays in order to prevent or adapt to climate change.

Estimates of potential new jobs are based on industry expertise and lessons learned from analysing comparable investments in similar contexts. These estimates are derived from a combination of quantitative and qualitative approaches, incorporating assumptions developed by experts with extensive experience in the relevant industries. Key factors influencing these projections include the size, type and nature of the investments, particularly in local infrastructure and broader economic activities. It is important to note that job creation is a potential outcome rather than a guaranteed commitment associated with the investments. Job creation may vary depending on the effectiveness of implementation, local economic conditions, and the absorptive capacity of the labour market.

The city units designated as responsible for implementing the proposed actions will play a key role in influencing job creation, both directly and indirectly. Direct impacts may result from their operational activities, such as hiring in the construction, services or manufacturing sectors. Indirect impacts may result from the multiplier effects generated by the investment, such as increased demand for local suppliers, services and related economic activities.

Table 20 HICP annual data (average index and rate of change)

Country	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Austria	2.1%	1.5%	0.8%	1.0%	2.2%	2.1%	1.5%	1.4%	2.8%	8.6%
Lithuania	1.2%	0.2%	-0.7%	0.7%	3.7%	2.5%	2.2%	1.1%	4.6%	18.9%

[5] Eurostat, https://www.ons.gov.uk/economy/inflationandpriceindices/timeseries/d7g7/mm23, https://data.bls.gov/pdq/SurveyOutputServlet, https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?end=2022&locations=UA&start=2013, https://www.worlddata.info/europe/belarus/inflation-rates.php, https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?end=2022&locations=AZ&start=2013, https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?end=2022&locations=JO&start=2013, https://data.worldbank.org/indicator/NY.GDP.DEFL.KD.ZG?end=2022&locations=KZ&start=2013.

Country	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Poland	0.8%	0.1%	-0.7%	-0.2%	1.6%	1.2%	2.1%	3.7%	5.2%	13.2%
United Kingdom*	2.6%	1.5%	0.0%	0.7%	2.7%	2.5%	1.8%	1.0%	2.5%	7.9%
United States*	1.2%	1.3%	-0.8%	0.6%	1.8%	2.2%	1.4%	0.8%	5.3%	8.7%
Denmark	0.5%	0.4%	0.2%	0.0%	1.1%	0.7%	0.7%	0.3%	1.9%	8.5%
Serbia	7.7%	2.3%	1.5%	1.3%	3.3%	2.0%	1.9%	1.8%	4.0%	11.7%

Table 21 Average Exchange Rates in 2022[6]

Exchange Rate	Value
GBP/EUR	1.17
USD/EUR	0.95
PLN/EUR	4.45

Action cost calculation methodology – limitations

It is expected that this Plan will form a solid foundation for the continued work on climate actions. However, based on current market prices and relevant benchmarks, it should be recognised that the estimates of capital expenditures presented in this document represent only a high-level financial outlay needed to deliver the proposed actions. Detailed cost estimations will follow on the stage of targeted feasibility studies and design works. Moreover, a contingency should be applied to macroeconomic challenges – the current geo-political situation, the energy crisis and the associated economic impact can cause significant fluctuations in prices and exchange rates in global markets. For some actions, only unit costs have been presented, due to the need for more in-depth research and analysis of the city's needs. Potential funding mechanisms have also been suggested for each action. The provisions contained in the individual actions have been systematically shared and consulted with all affected city departments.

At the same time, the GCAP provides a valuable framework for supporting the sustainable development of the city in the long term. This document will form the basis for the implementation of the investment, helping the city to respond to the needs of citizens and environment.

[6] https://www.exchangerates.org.uk/GBP-EUR-spot-exchange-rates-history-2022.html, https://www.exchangerates.org.uk/USD-EUR-spot-exchange-rates-history-2022.html, https://www.ecb.europa.eu/stats/policy_and_exchange_rates/euro_reference_exchange_rates/html/eurofxref-graph-pln.en.html

Table 22 Description of the methodology used to estimate the costs and benefits of the GCAP actions

Fields of Action	GCAP Action	Methodology for cost and benefit estimation	Source
Energy	E1 Enhancing the use of renewable energy sources (RES) in district heating	**CapEx:** Other CapEx costs were estimated based on an VŠT, where an average value was used: Construction of the RK-8 boiler plant – from €20,000,000 to €60,000,000. Construction of the RK-2 CHP plant – from €17,000,000€ to €20,000,000 The capital costs of the district heating points have been estimated based on the VŠT information and amount to €26.07 per 1kWh of heat energy. The estimated total capacity of the 349 heat points is 115,255 kWh. **OpEx:** OpEx costs were estimated based on the IRENA report – Renewable Energy Technologies: Cost Analysis. Series Biomass for power generation. The cost includes costs of labour, scheduled maintenance, routine component/equipment replacement (for boilers, gasifiers, feedstock handling equipment, etc.), insurance, etc. These account for 6% of CapEx annually. Annually operating and maintenance cost of 1 district heating point has been estimated based on "Cost analysis of district heating compared to its competing technologies" report and amount to €171. Operating costs were estimated based on the report "Assessment of Hydrogen Production Costs from Electrolysis: United States and Europe' and represent 3% of CapEx. **Benefits:** Currently, in the decentralised segment of households in Lithuania, pollution emissions from all old heat production facilities used to produce heat energy cause annually €232,000,000 in socio-economic damages to Lithuania (mainly due to pollution from inefficient biofuel boilers and fossil fuel boilers). €3,539,000 has been allocated to Vilnius and this value is proportionally related to the whole programme – €90,440,000.	1. VŠT 2. https://taryba.palanga.lt/fileadmin/Docs/2022/2022-04-07/29/29-PROJEKTAS.pdf 3. https://www.checkatrade.com/blog/cost-guides/heat-pump-servicing-and-repair-cost/ 4.VŠT 5. https://www.witpress.com/Secure/elibrary/papers/ESUS13/ESUS13009FU1.pdf\ 6. Vilnius Municipality 7. https://www.ena.lt/inpa-katilokeita/ 8. https://2014.esinvesticijos.lt/lt/finansavimas/paraiskos_ir_projektai/kogeneracines-elektrines-visagino-miesto-cst-sistemoje-statyba 9. NZC Action Plan
	E2 Enhancing the use of renewable energy sources (RES) in non-centralised heating systems	**CapEx:** 1. Household consumers – the cost of the state and municipal subsidy for the purchase of biofuel boilers and heat pumps was estimated based on Vilnius City Sustainable Energy and Climate Change Action Plan and the cost of the manufacturer – €5,500 for 1 biofuel boiler and €5,000 for 1 heat pump (50kW). There are 32,430 dwellings not connected to DH in the city. It is assumed that biofuel boilers will be purchased in 10% of them, while the remaining 90% will have per 1 heat pump. The municipality will subsidise 10% and the state 50% of the purchase cost.	1. Vilnius City Sustainable Energy and Climate Change Action Plan 2. VŠT

Fields of Action	GCAP Action	Methodology for cost and benefit estimation	Source
		2. Non-centralised heating service sector – the cost of the state and municipal subsidy for the purchase of biofuel boilers and heat pumps was estimated based on Vilnius City Sustainable Energy and Climate Change Action Plan and the cost of the manufacturer – €30,000 for 1 boiler and €25.000 for 1 heat pump (50kW). There are 1,709 service sector buildings not connected to DH in the city. It is assumed that biofuel boilers will be purchased in 10% of them, while the remaining 90% will have per 4 heat pumps. The municipality will subsidise 10% and the state 25% of the purchase cost. 3. Non-centralised heating industry sector – the cost of the state and municipal subsidy for the purchase of biofuel boilers and heat pumps was estimated based on Vilnius City Sustainable Energy and Climate Change Action Plan and the cost of the manufacturer – €30,000 for 1 boiler and €25,000 for 1 heat pump (50kW). There are 1,932 industry buildings not connected to DH in the city. It is assumed that biofuel boilers will be purchased in 80% of them, while the remaining 20% will have per 3 heat pumps. The municipality will subsidise 10% of the purchase cost. The costs of installing heat pumps and solar panels were estimated based on the Special Plan for Heat Management in the city of Palanga. The total budget of the state programme: "Replacement of inefficient boilers using biomass or fossil fuels with more efficient technologies using renewable resources for heat generation in individual dwellings not connected to a central heat supply system" is €90,440,000 from state funds (including €14,000,000 from European Funds). The programme will support the replacement of inefficient biomass or fossil fuel boilers in single-family houses with class 5 biofuel boilers or ground-water, water-water and air-water heat pumps. €3,539,000 has been allocated to Vilnius. **OpEx:** Maintenance costs for heat pump installation were estimated at €200 per service.	
	E3 Reconstruction of heating networks	**CapEx:** It is assumed that 10km of district heating network will be reconstructed annually until 2030 (70km in total). Reconstruction costs were provided by the city based on previously completed projects. The unit cost is €2,000,000 per 1km of network reconstruction. The maintenance costs of the district heating network have been estimated based on the Assessment of the Costs, Performance, and Characteristics of UK Heat Networks report and amount to €0.85 per 1MWh of energy delivered to the network. The total amount of energy delivered to the network in 2021 in Vilnius was 3.189GWh, while the new networks will represent 9.23% of the total networks in the city. The costs of developing the digital twin were estimated on the basis of the VŠT information.	1. https://assets.publishing.service.gov.uk/media/5a802b44e5 2. https://cordis.europa.eu/article/id/413462-smart-application-promotes-energy-efficiency-and-savings-for-households/pl 3. https://www.vv.lt/2021/11/22/skaitikliu-nurasymas-tampa-praeitimi-vilniaus-vandenys-jau-idiege-beveik-8-tukst-nuotolinio-nuskaitymo-skaitikliu/ 4. https://www.cityofmoore.com/sites/default/files

Fields of Action	GCAP Action	Methodology for cost and benefit estimation	Source
		The costs of installing 64,320 smart hot water meters were estimated on the basis of an ongoing project by UAB "Vilniaus vandenys". The unit cost of one smart meter is €238. **OpEx:** The operating costs for digital twin amount to 1% of the CapEx costs and are related to employment and the purchase of the relevant digital licences. Maintenance costs for the smart water meter were estimated on the basis of Benefit/Cost Analysis Smart Water Meter System report, where the unit cost is €2.09 per 1 smart meter. After 2030, the upgrade of heat networks will prevent the loss of more than 76,536 MWh of heat energy distributed to the network annually. The average cost per 1MWh of heat energy in 2023 was €72.81. **Benefits:** Heat losses on the grid in 2023 reached 11.8%. The reconstruction of the network will prevent heat losses and save €5,572,000. By replacing manual physical checks of meter readings in buildings with a digitised system, more than €400,000 could be saved annually on handling requests for readings, billing, and recalculations. In addition, the implementation of smart hot water meters will digitise the process and avoid undisciplined accounting practices, fraud, abuse and other network-related incidents, saving an additional €1,000,000.	/docs/benefit-cost-analysis-smart-water-meter-system.pdf 5. https://www.vert.lt/siluma/Puslapiai/statistika.aspx 6. NZC Action Plan 7.VŠT
	E4 Building Renewable Energy Community	**CapEx:** Development of RES in the Vilnius area (includes grants €78,500,000, loans €95,900,000, coverage of ineligible VAT values €36,600,000) it is planned to develop 155 MW of RES for electricity generation. Specific implementation plans are set out in The National Energy and Climate Action Plan. The action aims to promote the national programme and raise public awareness – €10,000 has been secured for marketing and public awareness purposes. The costs of publicity and education campaigns were estimated on the basis of the VAATC similar activites. **OpEx:** Operating costs represent the cost of employing 5 staff as energy technical advisors. An amount of €2,000 per employee per month has been allocated for this purpose. Operating costs of Climate Fund are based on Climate Funding 4 Cities - Turbocharching citizen engagement and climate actions in EU-Mission Cities Klagenfurt, Vilnius and Gozo and represent the cost of personnel – €38,160, subcontracting – €55,000, indirect costs – €9,540	1. https://take-profit.org/en/statistics/wages/lithuania/ 2. The National Energy and Climate Action Plan 3. NZC Action Plan 4. VAATC

Fields of Action	GCAP Action	Methodology for cost and benefit estimation	Source
	E5 Developing a flexible energy storage system	**CapEx:** The cost of preparing a feasibility study for the construction of energy storage facilities for new RES projects has been estimated on the basis of internal benchmarks and amounts to €200,000. Capital costs associated with the construction of an energy storage facility with a capacity of 10 MW and 40 MWh have been estimated on the basis of planned projects: Columbus Energy, modular energy storage project with a capacity of 200 MW and 820 MWh – PGE, industrial energy storage project with a capacity of 110 MW – Green Capital S.A., large-scale energy storage project with a capacity of 202.44 MW and 810.18 MWh – Columbus Energy, industrial energy storage project with a capacity of 62.7 MW and 250.8 MWh – Columbus Energy, where the value of these projects per MW of energy storage ranged from €1,200,000 to €1,800,000. **OpEx:** Operating costs have been estimated based on the NREL report – Cost Projections for Utility-Scale Battery Storage: 2023 Update and are 2.5% of capital expenditure. **Benefits:** The savings were estimated from the report Energy Storage Benefit-Cost Analysis A Framework for State Energy Programs, prepared for the Clean Energy States Alliance by the Applied Economics Clinic, and represent a cost saving associated with electricity producers that can reduce the cost of maintaining sufficient generation capacity to meet peak demand (plus a reserve margin) by discharging batteries during periods of high demand and charging them during periods of low demand, and charging during periods of low demand, which amounts to €143 per kW of energy storage. The CO_2 reduction was estimated from the report Energy Storage Benefit-Cost Analysis A Framework for State Energy Programs, prepared for the Clean Energy States Alliance by the Applied Economics Clinic, which found that battery storage charged with wind and solar energy emits zero emissions and can serve the grid during peak demand, reducing CO_2 by 105.7 tCO_2 per MW per year.	1. https://www.cire.pl/artykuly/serwis-informacyjny-cire-24/columbus-planuje-budowe-magazynu-energii-o-mocy-133-mw-za-ok-1-mld-zl 2. https://www.cire.pl/artykuly/serwis-informacyjny-cire-24/182462-pge-szacuje-koszt-duzego-magazynu-energii-na-900-mln-zl 3. https://www.teraz-srodowisko.pl/aktualnosci/magazynowanie-energii-nowe-inwestycje-12410.html 4. https://group.columbusenergy.com/trzeci-wielkoskalowy-magazyn-energii-od-columbusa-to-juz-400-mw-mocy-i-1600-mwh-pojemnosci/ 5. https://group.columbusenergy.com/columbus-postawi-magazyn-energii-o-mocy-63-mw/ 6. https://www.nrel.gov/docs/fy23osti/85332.pdf 7. https://www.cesa.org/wp-content/uploads/Energy-Storage-Benefit-Cost-Analysis.pdf
Buildings	B1 Upgrading municipal buildings and their systems	**CapEx:** By 2030, Vilnius city plans to modernise all municipal buildings below energy efficiency class B. Currently, the area of municipal buildings to be renovated is 972,731 m², according to information provided by Vilnius Municipality Services Application. The municipality estimates that renovating a building to class B or higher will cost €600/m². **Benefits:**	1. Vilnius City Sustainable Energy and Climate Change Action Plan 2. NZC Action Plan

Fields of Action	GCAP Action	Methodology for cost and benefit estimation	Source
		By renovating buildings, energy consumption can be reduced by 40%. City buildings in 2021 consumed 126 GWh of energy. Renovations can save more than 50 GWh of energy annually. The average cost per 1 MWh of heat energy in 2023 was €72.81.	
	B2 Promoting the modernisation of multi-apartment buildings	**CapEx:** The Municipality has projected a total budget of €3,920,000,000 for renovation 2,400 multi-apartment building by 2030 (at least 300 per year). Distribution of costs: - Private: €1,885,520,000, - National: €1,642,480,000, - Municipality: €392,000,000. CapEx costs were estimated based on Vilnius City Sustainable Energy and Climate Change Action Plan. The costs of multi-apartment renovation are: - 30-flat apartment building – €1,100,000, - 60-flat multi-apartment – €1,700,000, - 90-flat multi-apartment – €2,100,000. Renovation cost of an average multi-apartment building was estimated on €1,633,000. Cost of a publicity and education campaign, marketing and promotion activities to help implement the existing multi-apartment modernisation programme was estimated based on information from the municipality. **OpEx:** 20 FTEs to run VšĮ "Atnaujinkime miestą", which is administrating the process of multiapartment buildings' refurbishment – €480,000 (average monthly wage in Lithuania in 2023 – €2,000) **Benefits:** By renovating buildings, energy consumption can be reduced by 40%. Residential buildings in 2021 consumed 2,227 GWh of energy. Renovations can save more than 890 GWh of energy annually. The average cost per 1 MWh of heat energy in 2023 was €72.81.	1. Vilnius City Sustainable Energy and Climate Change Action Plan 2. NZC Action Plan
	B3 Integrate and enhance building condition and energy efficiency data	**CapEx:** The cost of installing a centralised automatic system for reading and analysing building meters and readings was estimated by Mid-Atlantic Controls Corp. to range from €2.3 to	1. https://info.midatlanticcontrols.com/blog/how-much-does-a-building-automation-system-cost

Fields of Action	GCAP Action	Methodology for cost and benefit estimation	Source
		€6.9 per m^2 of building. It was decided to use an average of €4.6 per m^2. The area of municipal buildings to be renovated and the system installed is 972,731 m^2. **OpEx:** 4 FTEs to manage and maintain the new system – €96,000 (average monthly wage in Lituhania in 2023 – €2,000)	
	B4 Promoting quarterly modernisation of residential buildings	**CapEx:** The Municipality has projected a total budget of €100,000,000 to run out Neighbourhood Programme. The municipality awards grants in the amount up to €70 per 1 sq. of meter renewed territories for those renovate the yards of apartment blocks. **OpEx:** OpEx costs were estimated based on the budgets of two Polish cities, Wroclaw and Gdansk. These costs include maintenance of the trash can in the road lane (€28.99 per month), annually cleaning up the housing estate field (€800 per year) and maintenance of existing plantations (€1,100 per ha). Operating costs are estimated to €2,122,000.	1. https://vilnius.lt/lt/kaimynijos/ 2. https://www.e-tar.lt/portal/lt/legalAct/4a7b43908a4911eb9fecb5ecd3bd711c/asr 3. https://www.wroclaw.pl/budzet-wroclawia/2023/ 4. https://www.gdansk.pl/cennik-miejski-gdansk
	B5 Promoting panel modernisation of multi-apartment buildings	**CapEx:** The capital costs of the pilot projects for the implementation of the panel (modular) modernisation project were estimated by the VšĮ "Atnaujinkime miestą". The cost per modernisation is €2,000,000.	1. VšĮ "Atnaujinkime miestą".
Transport	T1 Renewal and modernisation of public transport fleet and related infrastructure	**CapEx:** The cost of purchasing new low-emission vehicles has been estimated on the basis of Vilnius City Sustainable Energy and Climate Change Action Plan and amounts to €574,990 for one trolleybus, €516,725 for an electric bus and €387,200 for a hydrogen-powered bus. 25% of the purchase cost of the new vehicles will be covered by the state budget. The cost of purchasing the electric ships was provided by the city. The cost per one ship is €500,000. The costs of installing vehicle charging stations were estimated on the basis of the "Analysis of Costs and Benefits of the Use of Zeroemission Vehicles for Municipal Communication Services" and are as follows: Installation of 50–100 kW charging stations – €22,500. The installation of a 3 MW electrolyser on the site of the Vilnius district heating network, together with a hydrogen storage facility, was estimated on the basis of a project implemented by the Ministry of Energy of the Republic of Lithuania.	1. Vilnius City Sustainable Energy and Climate Change Action Plan and internal city's calculation 2. Analysis Of Costs and Benefits of the Use of Zeroemission Vehicles For Municipal Communication Services (Arup internal) 3. https://www.statista.com/statistics/1314546/lithuania-monthly-wholesale-electricity-price/ 4. https://autotraveler.ru/en/lithuania/trend-price-fuel-lithuania.html 5. https://www.e-petrol.pl/wiedza-i-porady/lpg/wlasciwosci-i-przeliczanie

Fields of Action	GCAP Action	Methodology for cost and benefit estimation	Source
		The Ministry of Energy will finance 70% of the project implementation costs, the rest – will be financed from the Municipal Budget). **OpEx:** Operating costs represent the cost of purchasing fuel to power the vehicle. They were estimated on the basis of benchmarks and data from statistical companies. The total distance travelled by public transport in the city was 39,000,000 km annually (in order to estimate the number of km travelled by a specific mode of transport, total travelled distance was related proportionally to the number of newly purchased vehicles). The average consumption of the power source of vehicle has been estimated on the basis of "Analysis of Costs and Benefits of the Use of Zeroemission Vehicles for Municipal Communication Services" and scientific articles. It is assumed that • trolleybuses will travel 11,693,000 km in a year and their average energy consumption is 1.56 kWh/km, the price for energy is €0.16/kWh. • e-bus 26,166,000 km and their average energy consumption is 1.45 kWh/km, the price for energy is €0.16/kWh. • hydrogen buses 1,141,000 km and their average consumption is 0.08 kg H_2/km. the price for H_2 is €8/kg. *The cost of replacing an e-bus battery can account for up to 25% of the initial CapEx, however, the life cycle of the battery is not within the period up to 2030 (life span of up to 15 years). Operating costs of charging stations were estimated from NREL's Critical Elements of Vehicle-to-Grid (V2G) Economics report and amount to 5% of CapEx. Operating costs were estimated based on the report "Assessment of Hydrogen Production Costs from Electrolysis: United States and Europe" and represent 3% of CapEx. **Benefits:** Annually, public transport covers more than 39,000,000 km. Assuming those were to be travelled solely by diesel vehicles the cost would be €22,081,800. The saving is the difference between purchasing alternative vehicle fuels and purchasing diesel. The hydrogen buses are assumed to travel 1,141,000 km per year, with an average consumption of 0.08 kg H_2/km. The price of H2 is €8/kg. The hydrogen produced will fully power the hydrogen vehicle fleet.	6. https://h2v.eu/analysis/statistics/financing/hydrogen-cost-and-sales-prices 7. https://www.statista.com/statistics/1314546/lithuania-monthly-wholesale-electricity-price/ 8. https://www.rhinocarhire.com/World-Fuel-Prices/Europe/Lithuania.aspx 9. https://enmin.lrv.lt/lt/naujienos/vilniuje-pradedami-igyvendinti-zaliojo-vandenilio-gamybos-projektai/ 10. https://theicct.org/wp-content/uploads/2021/06/final_icct2020_assessment_of-_hydrogen_production_costs-v2.pdf 11. UAB „Vilniaus viešasis transportas"

Fields of Action	GCAP Action	Methodology for cost and benefit estimation	Source
	T2 Enhancing public transport routes efficiency	**CapEx:** The cost of extending traffic lanes for public transport (47.9km) was estimated based on the expenditure presented in the Vilnius Sustainability Urban Mobility Plan and the cost of implementing 1km of traffic lane is €642,500. The cost of installing an intelligent traffic light control infrastructure on the Vilnius Public Transport trunk line was estimated on the basis of the SĮ "Susisiekimo paslaugos, JUDU" information. **OpEx:** Road maintenance costs (related to pavement, line renewal) in the period up to 2030 are presented only as a unit cost, as they are not expected to occur in the short term. The costs of maintaining traffic lights were estimated on the basis of the costs incurred by the city of Gdańsk in Poland for this purpose. It is estimated that the maintenance of traffic lights at one intersection is a cost of €550 per month.	1. https://inicjatywa.opole.pl/cennik-miejski 2. Vilnius Sustainability Urban Mobility Plan 3. SĮ "Susisiekimo paslaugos, JUDU" 4. https://www.gdansk.pl/cennik-miejski-gdansk
	T3 Expanding and integrating cycling infrastructure and pedestrian pathways	**CapEx:** The cost of building inter-district cycle routs was estimated on the basis of the Vilnius Sustainable Urban Mobility Plan and averages €708,000 per 1 km. It is estimated that around 320 km of roads will be built/rebuilt. Maintenance costs represent the cost of reconstruction of 1m of cycle rout with bituminous surface. However, no such activities are assumed in the period to 2030. Capital costs were estimated on the basis of the Vilnius Sustainable Urban Mobility Plan. The unit cost for the bicycle storage facility is €57,100 and for the bicycle rack €128.3. The cost of constructing 300 km of new pavement was estimated on the basis of information provided by Vilnius Municipality, with a unit cost of €160 per 1m of new pavement. **OpEx:** Maintenance costs for cleaning around the cycling infrastructure and painting the elements were estimated at 2% of CapEx. Maintenance costs were estimated on the basis of the costs incurred by the city of Częstochowa and amount to €79 per m^2. These costs are not assumed to be incurred until 2030. **Benefits:** Emissions from the construction of new cycle paths (abandoning the use of internal combustion vehicles and using bicycles only) were estimated on the basis of a similar	1. https://inicjatywa.opole.pl/cennik-miejski 2. Vilnius Sustainability Urban Mobility Plan 3. Vilnius Municipality 4. https://czestochowa.budzet-obywatelski.eu/wszystko-o-budzecie/cennik-miejski,36 5. https://eko.zagreb.hr/UserDocsImages/arhiva/dokumenti/secap/City%20of%20Zagreb%20-%20Sustainable%20Energy%20and%20Climate%20Action%20Plan%20(SECAP).pdf

Fields of Action	GCAP Action	Methodology for cost and benefit estimation	Source
		project carried out in Zagreb, where the estimated reduction in CO_2 emissions for 250 km was 62,999 tCO_2e.	
	T4 Development of infrastructure for multimodal points	**CapEx:** The construction costs of the multimodal transport hub have been estimated on the basis of similar investments carried out in Poland (in Łódź, Zabrze, Chorzów, Katowice and Dąbrowa Górnicza). It should be noted that the current state of affairs does not provide precise information on the realisation of the investment, its size and location, and therefore the costs are subject to change. The costs used have been indexed for inflation and range from €11 million to €17 million. An average was used. Costs of a multi-variant concept or location study for a new multimodal transport hub and development of a technical study for the construction of a multimodal interchange were estimated on the basis of similar tenders in Poland. **OpEx:** Multimodal transport hub maintenance costs were estimated at 5% of the initial CapEx, as costs associated with cleaning, pavement repairs, lines and staffing costs.	1. Vilnius Sustainability Urban Mobility Plan 2. https://ccdcboise.com//wp-content/uploads/2016/02/Document-A3-ITDP-The-Bike-share-Planning-Guide.pdf 3. https://judu.lt/wp-content/uploads/2023/10/Vilniaus-miesto-darnaus-judumo-plano-veiksmu-planas-iki-2024-m.-GALUTINIS.pdf 4. https://um.warszawa.pl/documents/57254/8829823/cennik_-_ile_kosztuje_miasto_styczen_2020.pdf/7b78c197-6ee8-7703-ef6b-04aa8028160e?t=1598800531011 5. https://www.vz.lt/nekilnojamasis-turtas-statyba/2018/08/10/prie-vilniaus-antakalnio-ziedo--nauja-stovejimo-aikstele-su-dviraciu-saugykla&template=api_article 6. https://mapadotacji.gov.pl/projekty/1388956/ 7. https://www.transport-publiczny.pl/mobile/w-zabrzu-powstana-dwa-centra-przesiadkowe-wybrano-wykonawcow-70144.html 8. https://mapadotacji.gov.pl/projekty/767993/ 9. https://bip.katowice.eu/ogloszenia/zamowienia/ogloszenie.aspx?ido=5362 10. https://investmap.pl/inwestycja/nowy-uklad-komunikacyjny-i-centrum-przesiadkowe-dabrowa-gornicza-golonog,13762.html 11. https://www.przetargi.egospodarka.pl/76257_Wykonanie-wielowariantowej-koncepcji-wezla-przesiadkowego-Dworzec-Poludniowy-

Fields of Action	GCAP Action	Methodology for cost and benefit estimation	Source
			wraz-z-analizamifunkcjonalna-ekonomiczna-i-prawna-przedsiewziecia_2017_2.html 12. https://ztmwaw.ezamawiajacy.pl/pn/ztmwaw/demand/notice/public/39619/details
	T5 Expansion of the network of public charging stations and charging points for electric cars	**CapEx:** Installation costs of charging stations for medium power (22 kW) electric vehicles was estimated on the basis of the Vilnius Sustainable Urban Mobility Plan and the manufacturer Delfi, where the unit cost was €1,450 per charging point. Installation costs of high power (50kW) charging point for electric vehicles was estimated on the basis of the Vilnius Sustainable Urban Mobility Plan, where the unit cost was €2,800 per charging station point. **OpEx:** Operating costs were estimated from NREL's Critical Elements of Vehicle-to-Grid (V2G) Economics report and amount to 5% of CapEx.	1. Vilnius Sustainability Urban Mobility Plan 2. https://www.nrel.gov/docs/fy17osti/69017.pdf
Water	W1 Strengthen the city's resilience to surface water run-off	**CapEx:** The cost of developing the stormwater network has been estimated on the basis of the Kalvarijų str. project, where the cost of 1 km newly built stormwater network (1200 – 1500 mm diameter) is €2,750,000. Stormwater network expansion needs are estimated by UAB "Grinda" in its long-term activities strategy 2024–2033. The infrastructure cost of improving stormwater management systems in Vilnius was estimated based on "Management of surface sewerage systems in the city of Vilnius" funded by the European Union Cohesion Fund No. 05.1.1-APVA-R-007-01-0002, which amounted to €38,871,733.03. The cost of the feasibility study and technical design for green space using stormwater to water green areas has been estimated based on other similar studies undertaken by Consultant. The cost of constructing green space using stormwater to water green areas has been estimated based on other similar projects in Europe. The cost of preparing a strategy for the emergency prevention and waste water management system was estimated on the basis of internal expertise. **OpEx:** Operating costs represent the annual expenditure associated with the operation and maintenance of the built infrastructure (i.e. repairs, maintenance) and the cost of licences and subscriptions for the use of software. In total, this equates to approximately 0.5% of the initial investment outlay (CapEx).	1. https://www.grinda.lt/uploads/UAB%20%E2%80%9EGrinda%E2%80%9C%20strategija.pdf 2. https://www.grinda.lt/uploads/Dokumentai/0_Ataskaitos_2023-s0405%20su%20visais%20para%C5%A1ais.pdf 3. https://vilnius.lt/naujai-irengiami-ir-tvarkomi-zeldynai/viesoji-erdve-ties-j-rutkausko-g-ir-pilaites-pr/ 4. https://www.grinda.lt/pavirsiniu-nuoteku-sistemu-tvarkymas-vilniaus-mieste/ 5. Update of the Special Plan for the Development of Water Supply and Wastewater Management Infrastructure in Vilniaus District 6. https://www.ebrd.com/work-with-us/projects/psd/54538.html

Fields of Action	GCAP Action	Methodology for cost and benefit estimation	Source
		Benefits: Estimated CO_2 emission reductions were based on projects in Ferizaj and Aktobe, where project implementation resulted in an average reduction of 0.05 tCO_{2e}/1 P.E. A total of 200,000 P.E. were assumed.	7. https://www.ebrd.com/work-with-us/projects/psd/53958.html 8. UAB "Grinda"
	W2 Power generation installations for water and sewage infrastructure facilities	**CapEx:** Investments in photovoltaic power plants (4,000 kW) and reconstruction of thermohydrolysis digester have been estimated on the basis of the planned activities of UAB "Vilniaus vandenys" in the Operational and Development Plan 2023–2027. **OpEx:** Operating costs according to the Wastewater treatment in the Danube region: opportunities and challenges report are estimated to range from €866,700 to €1,622,000. An average of the benchmark was used to estimate annual costs. Operating and maintenance costs of photovoltaic were estimated based on a BloombergNEF report and the lower limit of cost was €7,800 and the upper limit of cost was €14,500 per 1 MW of installed capacity annually. An average cost of €11,150 per 1 MW has been assumed for the estimation. These costs include module cleaning and vegetation management, system control and monitoring, component replacement, module replacement, inverter replacement, administration. **Benefits:** From 1 MW of solar panels, 963.6 MWh of electricity will be generated annually. A total of 4 MW of photovoltaic panels are planned to be installed in the UAB "Vilniaus vandenys", which will generate a total of 12 MWh of energy annually. The average cost of 1 MWh electricity in Lithuania is €88.91. It is assumed that the new mono-incineration of sludge sewage facility will be able to produce 15% (8.25m kWh annually) of the UAB "Vilniaus vandenys" total electricity demand (55m kWh annually).	1. UAB "Vilniaus vandenys" Activity and development plan for 2023-2027 2. https://www.vv.lt/wp-content/uploads/2024/04/Veiklos-ir-pletros-planas-2023-2027.pdf 3. UAB "Vilniaus vandenys" 4. https://publications.jrc.ec.europa.eu/repository/bitstream/JRC115606/sfp_report_final.pdf 5. NZC Action Plan 6. https://www.statista.com/statistics/1314546/lithuania-monthly-wholesale-electricity-price/ 7. https://www.vv.lt/2024/01/17/energija/
	W3 Resilience of water supply system	**CapEx:** Capital expenditures of: emergency response in water supply networks, replacing submersible pumps, repair of wells in water supply networks, renovation of water bodies and wells, water pumps, renovation of water pump stations, installation of waterproofing of water pumping tanks/strengthening of structures, waterproofing of water tanks, installation of a digital network (remote reading invasive flowmeters, valve position sensors, hydrant sensors) were estimated based on UAB "Vilniaus vandenys" Activity and development plan for 2023–2027. The cost of developing the water supply network has been estimated on the basis of the update of the Special Plan for the Development of Water Supply and Wastewater Management Infrastructure in Vilniaus District, where 1 km of newly	1. UAB "Vilniaus Vandenys" Activity and development plan for 2023–2027 2. https://www.vv.lt/wp-content/uploads/2024/04/Veiklos-ir-pletros-planas-2023-2027.pdf 3. Development of water and sewage infrastructure in the central part of Vilnius (White Zones): 4. https://vilnius.lt/lt/2024/01/18/vandentiekio-ir-nuoteku-infrastrukturos-pletrai-vilniaus-

Fields of Action	GCAP Action	Methodology for cost and benefit estimation	Source
		constructed water supply network costs €240,000. Water supply network expansion needs are estimated by UAB "Vilniaus vandenys" in its long-term activities strategy 2024–2033. The costs of publicity and education campaigns were estimated on the basis of the VAATC similar activities. **OpEx:** Operating costs represent the annual expenditure associated with the operation and maintenance of the built infrastructure (i.e. repairs, maintenance) and the cost of licences and subscriptions for the use of software. In total, this equates to approximately 0.5% of the initial investment outlay (CapEx).	miesto-centrineje-dalyje-beveik-10-mln-euru-investiciju/ 5. VAATC
Solid waste	SW1 Preventing waste generation through raising awareness and education	**CapEx:** Cost of establishment of a waste education center sponsored by VAATC was estimated based on provided information by VAATC. The cost of organising large events for all residents was estimated based on internal benchmarks, the cost per event was estimated at €4,500. The cost of organising smaller workshops for all residents was estimated based on the costs incurred by one city in Poland, the cost of organising one workshop was estimated at around €1,100. The costs of publicity and education campaigns were estimated on the basis of the VAATC Annual Report 2020, Waste Prevention and Management Plan 2021–2027 and a similar project "Publicity Campaigns to start and carry out collection of biodegradable waste (including food/kitchen waste) organisation. Organise campaigns to promote reusable products and waste prevention through educational activities, promote the separate collection of various types of waste through publicity campaigns, continue the project to educate the Vilnius region's population on waste sorting, involving direct engagement with residents and dissemination of information through various media, develop a network of public drinking water stations to reduce plastic packaging waste, implement publicity measures to reduce food waste and improve people's food consumption skills were estimated on the basis of the costs indicated in the Vilnius City Municipality Prevention and Management Plan 2021–2027. **OpEx:** Operating costs represent the cost of employing 10 staff for maintenance and service purpose. €2,000 per employee per month has been allocated for this purpose.	1. Vilnius City Municipal Waste Prevention and Management Plan 2021-2027 2. VAATC 3. https://boos.um.ostrowiec.pl/wszystko-o-budzecie/cennik-miejski,36 4. https://www.vaatc.lt/wp-content/uploads/2023/02/TS-1_Vilniaus-regiono-atliek%C5%B3-prevencijos-ir-tvarkymo-2021-2027-planas.pdf 5. https://recyclewits.com/tools-calculators/carbon-footprint-savings/
	SW2 Expanding the network of DĖK'UI stations	**CapEx:** Costs have been estimated based on information from the Municipality of Vilnius. **OpEx:**	1. Municipality of Vilnius

Fields of Action	GCAP Action	Methodology for cost and benefit estimation	Source
		Operating costs represent the cost of employing 11 staff for maintenance and service purpose. €2,000 per employee per month has been allocated for this purpose.	
	SW3 Further introduction of DGASA (lt. Didelių gabaritų atliekų surinkimo aikštelės) – bulky waste collection sites	**CapEx:** The cost of building DGASA points was estimated on the basis of the Vilnius City Municipal Waste Prevention and Management Plan 2021–2027. **OpEx:** The operating costs were based on the recommendations of SWECO, which indicated an amount of PLN 704,000 for the operation of a one very large HWRC (Household Waste Recycling Centre). This amount was updated with the inflation index and amounted to EUR 200,000. A significant part of the operating costs are costs related to the preparation of waste for recycling, its transport and proper management in accordance with legal requirements.	1. Vilnius City Municipal Waste Prevention and Management Plan 2021–2027 2. https://odpady-help.pl/uploads/files/115/rekomendacje_PSZOK.pdf
	SW4 Upgrade of the local MBT facility	**CapEx:** Costs were estimated on the basis of the information provided by VAATC. The cost of the feasibility study documentation and environmental and social due diligence was estimated on the basis of project costs carried out by the EBRD. The cost of the feasibility study to assess the potential for hydrogen production from municipal waste was estimated on the basis of internal analysis. **OpEx:** Operating costs represent the cost of employing 20 staff for maintenance and service purpose. €2,000 per employee per month has been allocated for this purpose.	1. VAATC 2. https://www.ebrd.com/work-with-us/projects/psd/mhp-biogas.html 3. https://www.ebrd.com/work-with-us/projects/psd/modus-biogas-portfolio-phase-ii.html
	SW5 Developing a smart municipal waste management system	**CapEx:** The capital expenditure associated with the design, supply and commissioning of a comprehensive Municipal Waste Management System for multi-apartment housing in Verkiai district in Vilnius was determined based on the costs of implementing a pilot programme of the same scope in Zamość, Poland (€977,000), covering 758 households. Assuming that 1 flat equal 1 household, the programme would cover 10% of households in Verkiai district in Vilnius (5,800), the proportionate cost is estimated at €7,477,000. **OpEx:** The operating costs are estimated on the basis of the costs of operation of the Municipal Individual Waste Management System in Zamość (€134,000) and are related to: training, expenditure on salaries and derivatives of 40 employees involved in the operation of the waste management system, together with other current expenditure in the performance of	1. https://umzamosc.bip.lubelskie.pl/upload/pliki/Informacja_z_otwarcia_ofert_(IM-ZP.272.13.2021.MT).pdf

Fields of Action	GCAP Action	Methodology for cost and benefit estimation	Source
		their duties, including: purchase of consumables, office supplies, equipment, energy charges, telecommunication services, etc. The estimated annual operating cost will be approximately €1,017,000.	
Land use	LU1 Green streets and heat island – investment programme for decreasing perceptible temperature in summer	**CapEx:** CapEx costs of redevelopment of indicated areas were estimated based on the information provided by Vilnius Municipality. The cost for the indicated location was presented by the city: Skveras Jeruzalėje, both sides of Maumedžių – €2,059,000 Public space in Žirmūnuose – €2,231,000 Square at Pelesos and Liepkalnio g sankirta – €2,037,000 Šv. Florijono square between Mortos and T. Ševčenkos – €1,128,000 Šv. Stepono square and Šv. Stepono – €8,997,000 Square in front of Šv. Onos Church – €511,000 Based on the costs indicated, an average cost was estimated for the remaining sites – €3,682,055 per hectare. The size of the remaining area is approximately 7.3 ha. The costs of installing 1 luminaire controller were provided by Vilniaus Apsvietimas. The cost of installing one luminaire controller is €40. **OpEx:** Operating costs of greenery maintenance were estimated as a 15% of CapEx. Estimation based on data from project conducted in Ostrowiec Świętokrzyski in Poland. Operating costs of luminaire controller represent 3% of CapEx. **Benefits:** The carbon sequestration rate for urban parks is estimated at 1.95 $kgCO_{2e}/m^2$/year.	1. Strategy for Sustainable Development of Vilnius 2024–2029 2. Vilnius City Sustainable Energy and Climate Change Action Plan 3. https://boos.um.ostrowiec.pl/wszystko-o-budzecie/cennik-miejski,36 4. NZC Action Plan 5. Vilnius Municipality
	LU2 Protection and restoration of valuable green areas	**CapEx:** Costs of the preparation of the pilot land redevelopment programme was estimated on the basis of the public procurement for the preparation of design documentation for the revitalisation of the Warsaw Gwary Square in 2019. The cost of developing a multi-branch technical concept for the implementation of the restoration project for selected sites has been estimated on the basis of a public tender for the development of a multi-branch technical concept for the implementation of the restoration project for water bodies, together with obtaining decisions and permits for the construction of dams on ditches or	1. https://www.krakow.pl/aktualnosci/252401,29,komunikat,nik_pozytywnie_o_zieleni_w_krakowie.html?_ga=2.145471474.779399599.1630925144-452717252.1630925144 2. http://zzw.waw.pl/zamowienia-publiczne/zamowienia-powyzej-130-000/wycinanie-krzewow-i-samosiewow-drzew-

Fields of Action	GCAP Action	Methodology for cost and benefit estimation	Source
		their adaptation in 2020 in Warsaw. Legal framework development study and cost of environmental monitoring was estimated by Consultant. The cost of acquiring land for protection and restoration was estimated at 0.5% (€6,430,100 per year) of the annual revenue of the municipal budget (2024 – €1,286,010,200) for a period of 5 years (2025–2030).	z-brzegow-wod-w-ramach-utrzymania-efektow-projektu-ochrona-siedlisk-kluczowych-gatunkow-ptakow-2-2/?b=94 3. http://zzw.waw.pl/zamowienia-publiczne/zamowienia-powyzej-130-000/wykonanie-dokumentacji-projektowej-rewitalizacji-skweru-gwary-warszawskiej/?b=94 4. https://vilnius.lt/lt/biudzeto-suvestine/
	LU3 Development of local plans and land use standards	**CapEx:** The cost of preparing guidelines and local plans for neighbourhoods and areas within the city local plans for neighbourhoods and areas within the city. The cost of preparing 6 local plans was estimated on the basis of a similar project carried out in Krynica-Zdrój in Poland (€43,900 for an area of 40.17 km^2 for local plans). As a cost indicator, the cost of preparing a local plan per 1 km^2 was taken as €1,100. The area covered by plans in the 6 selected districts is 83.10 km^2. The costs of publicity and education campaigns were estimated on the basis of the VAATC similar activites.	1. https://platformazakupowa.pl/transakcja/594870 2. VAATC
	LU4 Redeveloping existing urban land to increase liveability	**CapEx:** CapEx costs of redevelopment of indicated areas were estimated based on the information provided by Vilnius Municipality. The cost for the indicated location was presented by the city: Bendorių/Raisteniškių g. skveras (Tarandė) – €550,000 Viešoji erdvė ties Perkūnkiemio – €2,779,000 Viešoji erdvė ties V. Maciulevičiaus – €600,000 Based on the costs indicated, an average cost was estimated for the remaining sites – €553,681 per hectare. The size of the remaining area is approximately 20.1 ha. **OpEx:** Operating costs of greenery maintenance were estimated as a 15% of CapEx. Estimation based on data from project conducted in Ostrowiec Świętokrzyski in Poland. **Benefits:** The carbon sequestration rate for urban parks is estimated at 1.95 $kgCO_{2e}/m^2$/year.	1. Strategy for Sustainable Development of Vilnius 2024–2029 2. https://boos.um.ostrowiec.pl/wszystko-o-budzecie/cennik-miejski,36 3. Vilnius Municipality

Fields of Action	GCAP Action	Methodology for cost and benefit estimation	Source
	LU5 Strengthening of the Public Participation in urban planning	**CapEx:** The costs of developing the platform and standards were estimated on the basis of the consultant's internal data. The costs of education initiatives were estimated in the Strategy for Sustainable Development of Vilnius 2024–2029. CapEx costs of pilot project for indicated areas were estimated based on the information provided by Vilnius Municipality. The cost for the indicated location was presented by the city: Viešoji erdvė ties Naugarduko – €592,000 Based on the costs indicated, an average cost was estimated for the remaining sites - €592,000 per hectare. The size of the remaining area is approximately 1.4 ha. **Benefits:** The carbon sequestration rate for urban parks is estimated at 1.95 $kgCO_{2e}/m^2$/year.	1. Strategy for Sustainable Development of Vilnius 2024–2029 2. Vilnius Municipality

Appendix E

Appendix E – List of sources

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