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Climate City Contract

2030 Climate Neutrality Action Plan

2030 Climate Neutrality Action Plan of the City of Ljubljana

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Summary

An abstract **summarizes the content** of the 2030 Climate Neutrality Action Plan (CCC Action Plan) that is developed jointly by local authorities, local businesses, and other stakeholders.

Textual element
Ljubljana, the vibrant capital of Slovenia, has embarked on an ambitious journey to become a pioneer in climate policy not only regionally, but across Europe. This commitment is testament to the city's dedication to sustainable development and reflects a deep-rooted awareness of environmental responsibility and a proactive approach to tackling global climate challenges. Ljubljana was recognised as the European Green Capital 2016 for its remarkable progress in improving the quality of urban life and its visionary approach to environmental protection. This honour, awarded by the European Commission, puts Ljubljana at the forefront of European cities actively tackling climate change. The city's involvement in climate policy is an essential aspect of its identity and demonstrates its commitment to sustainable practices and innovative solutions. Achieving climate neutrality by 2030 is an ambitious goal that requires a multi-faceted approach. The city itself plays a central role by taking the lead through strategic planning, policy implementation and the promotion of a culture of sustainability. The city's transition team, including the city administration and public enterprises and institutions, is an integral part of achieving the climate goals and contributes significantly to the reduction of greenhouse gas emissions. The citizens of Ljubljana are also important actors on this journey. Their involvement in sustainable practices, be it by using public transport, supporting local green initiatives, or adopting energy-efficient habits, is essential to the success of the city's climate goals. Ljubljana faces several challenges in its pursuit of climate neutrality, which it addresses in the 2030 City Neutral Climate Action Plan as areas in which it has no or only partial implementation competence and can therefore only implement in multi-level governance and deep stakeholder and citizen engagement. In drawing up the CCC with the entire urban community, Ljubljana is building on existing plans and strategies and systematically developing them further based on scientific data, as has already been recognised as an A List city by CDP/ICLEI. The design of the Action Portfolio was based on the interlinking of different actions with consideration of the Levers of Change. To achieve climate neutrality in 2030, annual emissions must be reduced by 80% compared to the estimated 2018 figure to reach 460,316 tonnes of CO_2e emissions in 2030. The main measures to achieve this target are the energy renovation of the building stock, phasing out the use of fossil fuels in the DHS and the natural gas network, electrification of road transport (cars and lorries), increasing the production of renewable energy (biogas, hydrogen) and reducing residual emissions (CCU technologies, conservation of carbon sinks). The action plan consists of 5 main fields of action (energy systems, mobility & transport, waste & circular economy, green infrastructure & nature-based solutions, and built environment) and 2 additional (digitalization, engaging and collaborating with stakeholders) that are related to the main fields of action. The list of measures together comprises 118 individual measures. At a regional and national level, Ljubljana's efforts are supported by policies and initiatives that promote environmental sustainability. The Slovenian government's commitment to the European Green Deal and its own national climate targets provides a supportive framework for Ljubljana's ambitions. In addition, the European Union's policies and funding opportunities support the city's ability to effectively implement its climate action plans. The high political willingness and ambition to achieve climate neutrality is reflected in Ljubljana's proactive measures defined in the 2030 City Neutral Climate Action Plan.

List of figures

The list of figures **identifies the titles and locations** (page numbers) of **all visual elements:** figures, drawings, photos, maps, etc. used in the CCC Action Plan.

List of tables

The list of tables **identifies the titles and locations** (page numbers) of **all tables** used in the CCC Action Plan.

Abbreviations and acronyms

The list of abbreviations and acronyms **identifies the abbreviations** (a shortened form of a word used in place of the full word) **and acronyms** (a word formed from the first letters of each of the words in a phrase of name) used in the CCC Action Plan.

Abbreviations and acronyms	Definition
AFOLU	Agriculture, forestry and other land use
AP	Action plan
BAU	Business-As-Usual
BEB	Battery electric buses
BECCS	Biomass Energy with Carbon Capture and Storage
BEV	Battery Electric Vehicle
BIO	Biennial of Design
BREEAM	Building Research Establishment Environmental Assessment Method
BTC	Goods and transport center
CAD	Computer-aided design
CAP	Common agricultural policy
CAPEX	Capital expenditure
CCC	Climate City Contract
CCS	Carbon capture and storage
CCT	Core City Team
CCU	Carbon Capture and Utilisation
CDP	Carbon Disclosure Project
CHP	Combined heat and power
CIVITAS	City-Vitality-Sustainability
CNG	Compressed natural gas
CNSC	Climate-Neutral and Smart Cities
COL	City of Ljubljana
CoM	Covenant of Mayors
CTT	City Transitional Team
DACCS	Direct Air Carbon Capture and Storage
DGNB	German Sustainable Building Council
DHS	District heating system
DNSH	Do No Significant Harm
EC	European Commission
EEA	European Environment Agency
EF	Emission factor
EIA	Environmental impact assessment
ELES	Slovenia's combined transmission and distribution system operator
ENSVET	Energy consulting office
ESCO	Energy service companie
EU ETS	EU Emissions Trading Scheme

EV	Electric vehicle
EZ	Energy Act
FCEB	Fuel cell electric buses
FOD	First Order Decay
GDP	Gross domestic product
GHG	Greenhouse gases
GIS	Geographic Information System
GPC	Global Protocol for Community-Scale Greenhouse Gas Inventories
GWP	Global Warming Potential
HFC	Hydrofluorocarbon
HR	Human resources
HVAC	Heating, Ventilation, and Air Conditioning
ICLEI	International Council for Local Environmental Initiatives
ICT	Information and Communications Technology
IE	Included elsewhere
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IPOP	Institute for Spatial Policies,
IPPU	Industrial processes and product use
ISG	Interested Stakeholder Group
ISO	International Organization for Standardization
IT	Information technology
ITI	Integrated Territorial Investment
JHL	Public holding Ljubljana
JP LPP	Public company Ljubljana passenger traffic
JP LPT	Public company Ljubljana parking lots and markets
JP VOKA SNAGA	Public company water supply sewerage SNAGA
JTM	The just transition mechanism
KGZS	Department for agricultural consultancy
KPI	Key performance indicator
LEC	Local Energy Concept
LED	Light-emitting diode Description
LEED	Leadership in Energy and Environmental Design
LiDAR	Light Detection and Ranging
LPG	Liquefied petroleum gas
LTT	Local Transition Team
LULUCF	Land Use, Land-Use Change and Forestry
LUR	Ljubljana Urban Region
MRE	Monitoring, Reporting and Evaluation
NECP	National Energy and Climate plan
NGO	non-governmental organisation
NO	Not occurring
NZC	Net Zero Cities
NZEB	Nearly zero-emission building
ODS	Ozone-Depleting Substances
OECD	Organisation for EconomicCo-operation and Development

OP ECP	Operational Programme for the Implementation of the European Cohesion Policy
PCL	Ljubljana Passenger Centre
PCS	Participatory-Communication Strategy
PPA	Power purchase agreement
PURES	Regulations on efficient use of energy in buildings
PV	Photovoltaics
QR	Quick-response
RCERO	Ljubljana Regional Waste Management Centre
RDP	Regional Development Programme
RE	Renewable energy
RES	Renewable Energy Sources
RRA	Regional Development Agency
RS	Republic of Slovenia
SCIS	Smart Cities Information System
SEAP	Sustainable Energy Action Plan
SECAP	Sustainable Energy Climate Action Plan
SFT	specialised focus teams
SMS	Short Message Service
SOE	State-owned enterprises
SuDS	Sustainable drainage systems
SUMP	Sustainable Urban Mobility Plan
TE-TOL	Ljubljana Thermal Power Plant
UKC	University Clinical Center
WtE	Waste-to-energy

1 Introduction

The introduction outlines the local geographic and policy context in which the city´s 2030 Climate Neutrality Action Plan is being developed and describes the gap it addresses in broad terms.

Introduction

THE OVERALL 2030 CLIMATE NEUTRALITY ACTION PLANNING STRATEGY AND FRAMEWORKS

The City of Ljubljana's decision to join the Climate City Contract (CCC) is an important milestone in its long-standing commitment to environmental sustainability. This step is a natural consequence of being recognised as the "Green Capital" in 2016, which acknowledged Ljubljana's achievements to date in the field of sustainable development and set the course for future efforts. The city's involvement in the CCC is not only a continuation of its journey towards sustainability, but a strategic step that aligns its historic efforts with its ambitious 2030 goals. By combining its experiences and lessons learnt from the past with its aspirations for a climate-neutral future, Ljubljana is strengthening its role as a pioneer in creating a greener, safer, and more inclusive urban environment. The CCC offers Ljubljana the opportunity to collaborate, share knowledge and build partnerships to strengthen its reputation on the international stage as a city committed to improving the quality of life of its inhabitants while tackling the urgent challenges of climate change. This initiative emphasises Ljubljana's holistic approach to sustainability and demonstrates the city's unwavering commitment to environmental excellence and creating a sustainable path for future generations.

Ljubljana's strategic alignment with the Climate City Contract (CCC) demonstrates that the city's journey towards sustainability and carbon neutrality is deeply rooted in its development vision. In 2007, Ljubljana adopted the forward-looking Vision Ljubljana 2025, laying the foundations for a sustainable future. This vision, which the city is still actively realising today, is anchored in the fundamental task of improving the quality of life for citizens and visitors. Even then, Ljubljana had set itself the goal of becoming a carbon-neutral city by 2050 - not only an ambitious goal, but also a clear sign of the city's commitment to the environment. The vision set out 93 specific development projects that have already been realised or are currently being implemented. The inspiration and guidance gained from the Green Capital award and the strategic foresight of the city's Vision 2025 have significantly improved the living standards of the city's population. In addition, the city has implemented more than 2,400 other projects to improve the quality of life.

To tackle new challenges and raise its ambitions, Ljubljana has introduced Vision Ljubljana 2045 and set itself the ambitious goal of becoming carbon neutral by 2040. The development guidelines set out in Vision 2045 focus on resilience, innovation and improving the city's visibility and reputation. These guidelines are not only ambitious but are embedded in the city's spatial planning and sectoral strategies. This visionary document also underlines the city's proactive stance in promoting cooperation between citizens, businesses, universities, research institutions, non-governmental organisations, neighbouring municipalities, and other stakeholders to achieve the set goals.

The City of Ljubljana's commitment to the Climate City Contract (CCC) is a strategic step that coherently embodies its commitment to sustainability and resilience. This focus includes an additional range of initiatives to introduce renewable energy and energy efficiency, promote sustainable transport, enhance urban green spaces, apply circular economy principles, actively engage stakeholders, etc., demonstrating the city's increased commitment to environmental protection.

Ljubljana's current climate planning is strengthened by plans and strategies that form a coherent mosaic on the road to sustainability.

These include the Local Energy Concept - LEC and the Sustainable Energy Climate Action Plan - SECAP (2022-2030) - the only action plans in the areas of energy efficiency, renewable energy, mobility with assessed emissions and climate risk vulnerability assessment, the Programme for Protection against Natural and Other Disasters (2023-2030), the Sustainable Urban Mobility Plan - SUMP (2022-2027), Ljubljana's Strategy for Circular Potentials (2021-2027), the Urban Digital Platform, the Environmental Action Programme, the Urban Forest Development Strategy and the Rural Development and Urban Agriculture Strategy (2021-2027). This tandem work between CCC and the city's existing climate measures and initiatives related to CO_2e emissions is further visualised, see Figure 1.

The development trajectory of the city's key strategies from 2007 to 2024 shows the commitment to reducing emissions, as evidenced by the 20% reduction in CO_2e emissions in 2020 from a 2008 baseline (highlighted in blue) and the planned 80% reduction in CO_2e emissions by 2030 from a 2018 baseline (highlighted in orange). It is important to note that the adoption of these strategies is not directly correlated with the emissions data unless explicitly stated (in blue and orange).

This holistic approach shows the compatibility and synergies between the 2030 Climate Neutrality Action Plan and the current efforts or programmes that the city is already implementing. Ljubljana's determination not only to set ambitious climate targets, but also to effectively integrate and execute multiple strategies to achieve them.

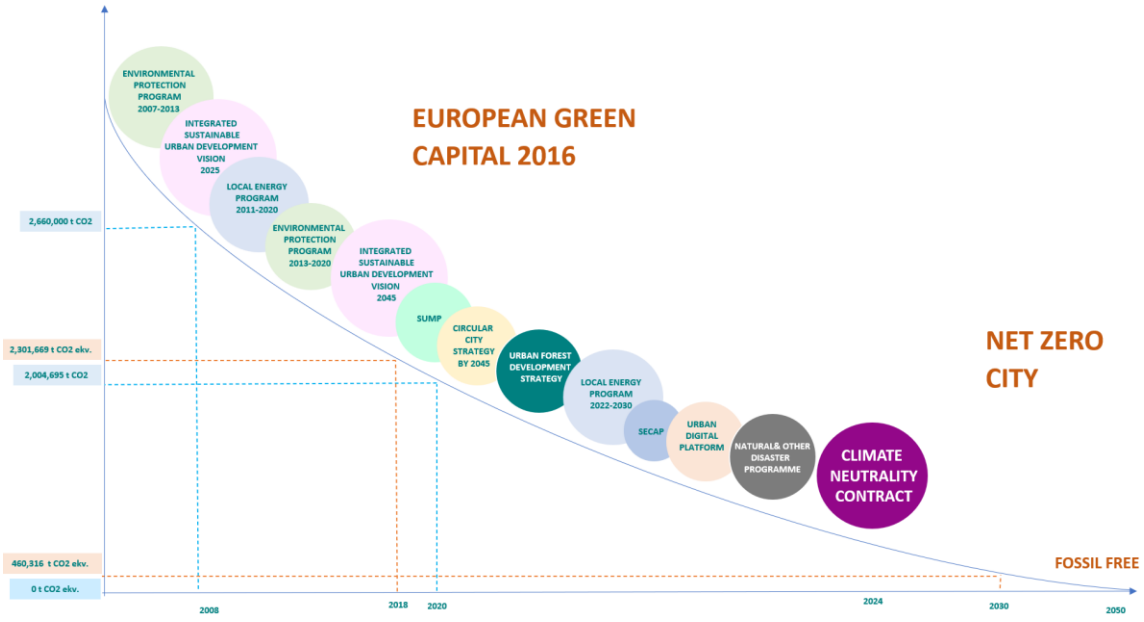

Figure 1: Ljubljana's current climate planning.

The Figure represents the development path of key city's strategies between 2007-2024. The emissions (highlighted on the left with blue colour) include CO_2e emissions in 2008 and their reduction in 2020 (20 %). The emissions (highlighted on the left with orange colour) include CO_2e emissions in 2018 and planned CO_2e emissions reduction till 2030 (80%). Adoption of strategies is not directly related to the shown emissions, except where emissions are highlighted (blue and orange colour).

To ensure that the 2030 Climate Neutrality Action Plan is aligned with the city's formal and established procedures and frameworks for climate action, the city used the CCC as a strategic tool for a comprehensive review and integration of its various strategies and programmes.

This process involved a detailed, cross-sectoral analysis of all existing and relevant plans with a strong focus on their synergistic potential to advance the city's overarching goal of climate neutrality while promoting resilience and sustainability.

Key to this approach was the assessment and integration of measures from existing strategies, e.g. SUMP, LEC, etc. rather than a blanket adoption of these programmes, the CCC strategically integrated elements that contribute significantly to the city's ambitious climate neutrality targets, while also considering other indirect yet impactful aspects.

During the preparation of the CCC, the additional measures in the individual sectors were discussed in depth with stakeholders from various perspectives. The city prides itself on its collaborative approach to strategy development, involving a wide range of stakeholders, as the city has a long history of best practice. Considerations such as accountability, funding sources and feasibility, direct and indirect, social, environmental, and organisational aspects have been carefully considered for each measure.

The methodology fosters a sense of shared responsibility and commitment among stakeholders. This inclusive process ensures that all voices are heard and that the resulting strategies reflect a comprehensive and shared vision for the future of Ljubljana. This forward-looking approach ensures that these new measures are seamlessly integrated into future revisions of Ljubljana's strategies and programmes and are continuously enriched with new and innovative measures that are in line with the city's goals. Furthermore, this ensures that the CCC is not just a static framework, but a dynamic, evolving, relevant and effective plan that responds to evolving needs and opportunities. Furthermore, it provides both the mandate and the framework for action.

The Climate City Contract (CCC) commitments, together with the 2030 Climate Neutrality Action Plan and the 2030 Climate Neutrality Investment Plan, will form a comprehensive policy framework. This framework will further on guide the city's administration, public organisations, and institutions to include principles of climate neutrality into all decision-making processes. In areas as environment, energy, circular economy, waste management and climate change, Ljubljana has consistently pursued a harmonised policy, prior to CCC. This coherent approach ensures that all these sectors work in line with the common goal of sustainability.

The CCC will play a central role in Ljubljana's long-term strategic planning. It will play an important role in revising existing strategies, especially in areas where the CCC has identified measures that are currently not included in the current strategies. The CCC will also play a crucial role in setting and monitoring indicators and understanding the linkages between different sectors. This holistic view is important to ensure that all city measures are aligned and contribute effectively to the overall goal of climate neutrality.

Ljubljana's commitment to the CCC is a comprehensive and forward-looking approach that integrates climate protection into the structure of the city's administrative and operational structures. This commitment not only reflects Ljubljana's climate endeavours, but also creates a solid framework for sustainable climate neutral urban development now and in the future.

Achieving the set goals will require significant financial resources, as further detailed in the city's Investment plan. Therefore, a key focus is on creating a strong, structured framework at various levels to support financing and gain the support of politicians and decision-makers.

The development of Ljubljana's CCC has been carefully aligned with the Net Zero Cities (NZC) Climate Transitional Map to ensure a coherent and strategic approach to climate action.

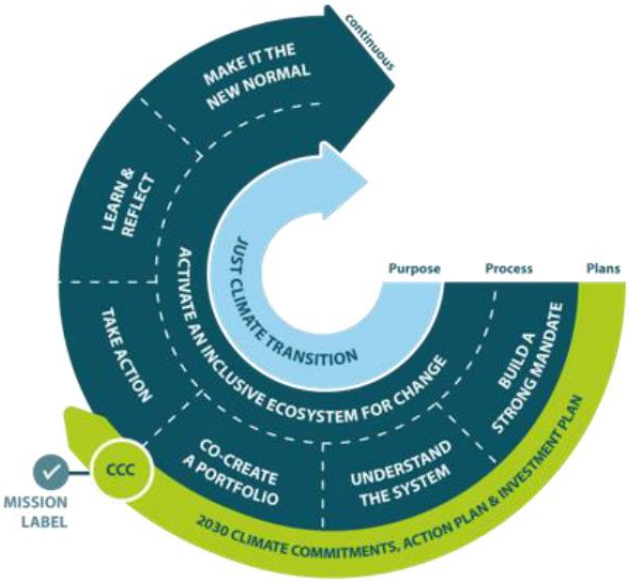

Figure 2: NZC Transition Map.

BUILD A STRONG MANDATE

In Ljubljana, the commitment to climate neutrality by 2030 is a top priority, supported by the city leadership and deeply embedded in the organisational structure. Led by the mayor and supported by six deputy mayors, each responsible for specific areas (one specifically for environmental protection, climate change and spatial planning), the City of Ljubljana uses a broad-based committee approach to decision-making. This co-operative structure ensures comprehensive planning and implementation of strategies that are formally adopted by the City Council.

The Ljubljana city family, united under the umbrella of Public Holding Ljubljana, consists of employees from the administration, public companies, and institutions. This holding connects important public services such as energy, waste and wastewater treatment and public transport, thus ensuring seamless service provision.

The city has legal authority in critical areas such as construction, waste management, water resources, public health, energy management, urban land use and green infrastructure, and underpins its efforts with a strong legislative focus.

Responsibility for the Climate City contract has been assigned to the head of the city's Environmental Protection Department. This person is accountable to the Deputy Mayor and oversees the various aspects and initiatives of the CCC. This streamlined organisational structure promotes effective collaboration and the integration of content essential to climate action.

In early 2023, the mayor appointed a project manager for the city's climate initiatives and established a Core City Team (CCT) made up of the heads of the various public administration departments. This strategic step, combined with the formation of the City Transitional Team (CTT), which is made up of 23 representatives from the public administration and public city companies and organisations, illustrates Ljubljana's integrative approach to climate neutrality. The composition of the CTT reflects a holistic strategy that incorporates different perspectives and expertise.

In addition, Ljubljana invited various stakeholders, including experts and non-governmental organisations, to form the stakeholder group (ISG) in order to broaden the range of contributions to the city's climate strategy. Building on this, the Local Transition Team (LTT) was established, comprising specialised focus teams (SFT) for seven key areas. These teams play a central role in

steering Ljubljana's efforts towards a sustainable future and ensuring alignment with the city's ambitious climate goals.

In addition, the newly formed Ljubljana City Climate Change Council (a mix of CTT, ISG and SFT representatives) will be formed to advise the city on planning and implementing measures and closely monitor the impact of the implementation of the Action and Investment Plan.

UNDERSTANDING THE SYSTEM

In 2018 (base year), most GHG emissions in the city of Ljubljana were caused by energy consumption in buildings, which accounted for 61.8% of total emissions in the city. Transport in the city of Ljubljana is responsible for 34.4% of total GHG emissions, while waste management and wastewater treatment contribute 2.1%. The agriculture, forestry, and other land use (AFOLU) sector accounts for a smaller share of 1.0% and the industrial processes and product use (IPPU) sector for 0.6%.

Ljubljana's approach to understanding and managing its systems is both comprehensive and data driven. The city's robust monitoring tradition is illustrated by the launch of the Energy Climate Atlas in 2018. This innovative software tool contains a wealth of spatial, climate and environmental data and provides automatic updates and reports for decision making. This tool not only improves the city's ability to respond quickly to environmental challenges, but also supports strategic planning and policy development.

In addition to the Energy-Climate Atlas, Ljubljana has been meticulously compiling its annual Greenhouse Gas (GHG) Emissions Inventory since 2013. This important document is prepared in accordance with the OECD/IEA methodology. This practice emphasises Ljubljana's commitment to maintaining a clear, comprehensive, and accurate understanding of its energy consumption and related emissions.

In addition, Ljubljana has been continuously reporting to CDP/ICLEI since 2017 and achieved an impressive A- score in 2021. This CDP reporting is a testament to the city's transparent and progressive approach to achieving climate neutrality. It reflects Ljubljana's commitment to not only setting ambitious targets, but also methodically tracking and reporting on its progress. The city places great importance on collecting and analysing the necessary data annually so that it can effectively adapt and refine its strategies.

Through these measures, Ljubljana ensures that its climate strategies are based on a deep and evolving understanding of its systems. This systematic approach is crucial for the city to tackle the complex challenges of climate change and continue its journey towards sustainability and climate resilience.

BACKGROUND CITY INFORMATION

In 2022, the city of Ljubljana had 293,845 inhabitants, with a population density of 1,068.5 inhabitants/km^2. The main settlement, Ljubljana, has a majority of 284,293 inhabitants. The administrative area covered by the climate neutrality targets for 2030 includes the entire administrative area of the city of Ljubljana (larger urban area). The entire administrative area of the City of Ljubljana is 275 km^2, with the urban settlement of Ljubljana covering 164 km^2. In terms of land use within the city, forests predominate with 41% of the area, followed by built-up areas with 25%, permanent grassland with 13% and arable land with 10%.

The city has a temperate continental climate (warm summers and moderately cold winters). Urbanisation and global warming have caused the average annual temperature to rise from 11.4°C (1991-2020) to 12.2°C (2013-2022). There are up to 120 foggy days a year in the city. The monthly precipitation peaks occur in autumn and summer, with pronounced summer peaks in most areas. Natural hazards (floods, landslides, drought) are influenced by deviations from the long-term average values, with extreme precipitation events exceeding the average values by 200 to 400%. Snow cover

has decreased in recent decades and amounts to around 50 days per year in the city. The sunshine duration is between 1,890 and 2,000 hours per year.

Ljubljana is the largest employment centre in Slovenia. In addition to the inhabitants of Ljubljana, around 130,000 people from the surrounding municipalities and other regions commute to work or school in Ljubljana every day.

The city is part of the pan-European transport network with ten corridors, including Corridor V and Corridor X. As these are corridors, a significant part of the traffic is transit traffic. The location of the city of Ljubljana at the intersection of the two corridors contributes to its favourable traffic situation.

The city of Ljubljana is characterised by a high concentration of secondary schools, universities, and institutes, which makes it the largest educational centre in Slovenia. The City of Ljubljana is the founder of the Ljubljana Health Centre, the largest public primary health care facility in Slovenia. The City of Ljubljana is the founder of the Ljubljana Public Pharmacy (Lekarna Ljubljana), the largest pharmacy centre in Slovenia.

STAKEHOLDER INVOLVEMENT

Ljubljana attaches great importance to involving all relevant stakeholders in the process, from planning to implementation. In January 2023, the city developed the CCC Participatory-Communication Strategy (CCC-PCS), the strategy for participatory communication of the CCC. This strategy, which aims to promote a structured, transparent, and inclusive process, is based on a variety of initiatives, events, and activities. It reflects a broad range of perspectives, needs, and interests and focuses on key areas that are critical to the transformation of the city (more in sections A-3.3 and C-1.1 of the Action Plan).

A stakeholder analysis was carried out to assess the critical stakeholders. Stakeholders were categorised into four groups based on the importance and power dynamics of each stakeholder group and their level of interest.

Critical stakeholders were identified as those whose involvement, influence and interests are crucial to the success and impact of a project or policy, whether as an individual organisation or as a group: European Union and Slovenian government authorities, municipal, state, or private companies and industry leaders, academia and research, citizens, non-governmental organisations (NGOs) and environmental associations as watchdogs holding stakeholders accountable and advocating for sustainable practices.

The critical stakeholders represent such well-educated groups as: The City Transition Team (CTT), the Interested Stakeholder Group (ISG), the Specialised Focus Teams (SFT), the Ljubljana City Climate Change Council, the City Council. Neighbouring municipalities, international strategic partnerships such as the Euro Cities Network, ICLEI Circular Cities, Ellen MacArthur Foundation's CE100, Zero Waste Network (Detailed in Commitments, section 3. Strategic priorities).

CLIMATE NEUTRALITY TARGET AND AMBITION

The analysis of baseline GHG emissions and reduction targets refers to the entire administrative territory of the City of Ljubljana (larger urban area), and no parts of the sectors, territories, sources, and gases were excluded.

As proposed in the Mission Info Kit for Cities, emissions from industrial facilities within the city boundaries that are registered under the EU Emissions Trading Scheme (EU ETS) were excluded from the GHG emissions inventory.

Solid waste generated in the city of Ljubljana is disposed of in a landfill within the city limits. Therefore, there are no emissions from waste that is generated within the city limits but disposed of in landfills outside the city limits (Scope 3). On the contrary, waste from other (mostly neighbouring) municipalities is also disposed of at the landfill site within the city. Therefore, methane emissions from

waste from other municipalities deposited at the landfill within the city limits are excluded from the regulation.

The City of Ljubljana used the methodology of the Global Protocol for Community-Scale Greenhouse Gas Inventories (GPC), which is based on the IPCC guidelines, to estimate its greenhouse gas emissions. A combination of the GPC methodology and the Covenant of Mayors (CoM) methodology was used to calculate the local emission factor for grid-supplied electricity, as recommended in the Mission's Info Kit for Cities.

In 2018, Ljubljana emitted 2,301,669 tonnes of CO_2e. As some GHG sources cannot be fully reduced by 2030 due to constraints, the mission proposes (in the Info Kit for Cities V2.0 and in the CCC AP template) to target "residual emissions" within 20% of this baseline and to provide offsets for hard-to-reduce sources. Ljubljana plans to reduce emissions by 80%, i.e. by a total of 1,841,353 tonnes of CO_2e, with residual emissions of 460,316 tonnes (20%).

The most important measures for achieving this target are the energy-efficient refurbishment of the building stock, the gradual phasing out of fossil fuels in the DHS and the natural gas network, the electrification of road transport (cars and lorries), the increase in the production of renewable energies (biogas, hydrogen) and the reduction of residual emissions (CCU technologies, conservation of carbon sinks). The highlighted measures are also measures with a higher financial outlay, which is recognised in the urban investment plan.

Regarding "residual emissions", the city will focus on CCU technologies (no suitable geology for CCS). The main energy plant, fuelled by biogas and biomass, is expected to sequester significant amounts of CO_2, resulting in negative emissions. A new waste co-incineration plant will also use carbon capture to neutralise all emissions. It is expected to capture 394,616 tonnes of CO_2 annually, with the captured CO_2 to be reused in local industry. The city's carbon sinks, including forests and urban green spaces, contributed 49,900 tonnes in 2018, with a target of 65,700 tonnes of CO_2. The planned measures will strengthen these natural sinks and promote the sustainable management of urban areas.

PLAN EVOLUTION SUMMARY

The 2030 Climate Neutrality Action Plan includes a portfolio of measures across all sectors and mandatory indicators based on the identification of gaps within the sector to achieve GHG emission neutrality from a technological/infrastructural, institutional/regulatory, organisational, financial, political, social, and behavioural perspective. The 2030 Climate Neutrality Action Plan thus ensures comprehensive and cross-sectoral impact pathways by engaging stakeholders at multiple levels of governance.

For future iterations, the cities plan to refine these areas by expanding the range of indicators used for monitoring and reporting.

This includes not only greenhouse gas emissions data, but also additional indicators for co-benefits such as biodiversity, economy, environment/public health, resource efficiency and social inclusion. The aim is to create a more streamlined and interconnected data management and reporting system to increase the effectiveness of the 2030 Climate Neutrality Action Plan.

These evolving aspects of the 2030 Climate Neutrality Action Plan reflect a dynamic approach that adapts to new data, insights, and the evolving needs of the city.

Building on the knowledge and experience gained during the preparation of the CCC and building on past successful practices, the focus will be on maintaining momentum, creating even more robust frameworks, gaining the support of policy makers, and strengthening stakeholder teams that demonstrate exemplary commitment.

The City Transition Team (CTT) will be responsible for producing an annual report detailing the progress made in implementing the CCC. A key element will be the establishment of a Climate Change Council in the City of Ljubljana (a mix of representatives from the CTT, ISG and SFT), which will advise on the planning and implementation of measures and closely monitor impacts, playing an important advisory role. The report will also be assessed annually by the City Council, enabling informed decision making and annual strategic adjustments to the plan.

Transparency and public accountability are also important components of the plan. By making the annual report publicly available, supported by the Info Point on climate change (one stop shop) and numerous other social innovations, Ljubljana will foster an environment of openness that encourages wider community engagement and support for its climate initiatives (see C section).

From 2024, an updated CCC will be uploaded to 100 CNSC Mission Platform every two years. An update will also include a report on the status and progress of the measures implemented in the organisations that have committed to the CCC (signatories to the CCC) in the areas they have identified or implemented that address the climate neutrality targets. This approach enables the evaluation of signatories' effectiveness and commitment, informs investment, and encourages further progress and improvements in the CCC processes (see signatories of the city's climate neutral commitment).

Table I-1.1: Climate Neutrality Target by 2030

Sectors	Scope 1	Scope 2	Scope 3
Stationary energy	In scope 1, the following sub-sectors are covered: residential buildings, commercial buildings and facilities, institutional buildings and facilities, manufacturing industries and construction, and energy industries; including the following energy sources: natural gas, extra light fuel oil, liquefied petroleum gas, wood biomass, biogas, diesel fuel, and gasoline.	In scope 2, the following sub-sectors are covered: residential buildings, commercial buildings and facilities, institutional buildings and facilities, manufacturing industries and construction, energy industries, and public lighting; including the following energy sources: grid-supplied district heating and electricity.	Not applicable.
	Excluded EU ETS registered industrial facilities.	Without exclusion.	Not applicable.
Transport	Scope 1 includes on-road transportation, railways, off-road transportation, and the following energy sources: diesel, gasoline, natural gas, liquefied petroleum gas, and biodiesel.	Scope 2 includes the use of electricity for on-road transportation and railways.	Not included, recommended by 2030.
	Without exclusion.	Without exclusion.	Not applicable.
Waste/ Waste water	Scope 1 includes GHG emissions from solid waste disposal and wastewater management.	Not applicable.	Solid waste generated in the City of Ljubljana is disposed of at a landfill within the city boundary, so there are no

			emissions from waste generated within the city boundary but sent to landfill outside the city boundary.
	Emissions from waste generated in other municipalities but disposed within the city boundary are excluded.	Not applicable.	Not applicable.
IPPU	Refrigerant gas emissions (HFCs), employed as substitutes for ODS and categorized in the IPPU sector, are calculated for mobile air conditioning and mobile refrigeration. These and other emissions in the IPPU sector are not significant.	Not applicable.	Not applicable.
	The City of Ljubljana does not have industrial facilities that produce CO_2 and other greenhouse gas emissions through processes like mineral, chemical, or metal production; hence, these emissions are not accounted for.	Not applicable.	Not applicable.
AFOLU	In this sector, scope 1 includes emissions from energy use for agricultural and forestry machinery (gasoline and diesel), as well as non-energy emissions in agriculture, encompassing livestock (enteric fermentation, manure management), and agricultural land management (liming, urea application, fertilization, and cultivation of agricultural land). The sector also includes CO_2 emissions and sinks resulting from land use and land use changes.	Not applicable.	Not applicable.
	Without exclusion.	Not applicable.	Not applicable.
Other	All considered emissions are already categorized in the above-mentioned sectors.	All considered emissions are already categorized in the above-mentioned sectors.	Not applicable.
Geographical boundary	**Same as city administrative boundary**	**Smaller than city administrative boundary**	**Larger than city**

			administrative boundary
(Tick correct option)	✓	-	-
Specify excluded/additional areas	Without exclusion.	-	-

Map

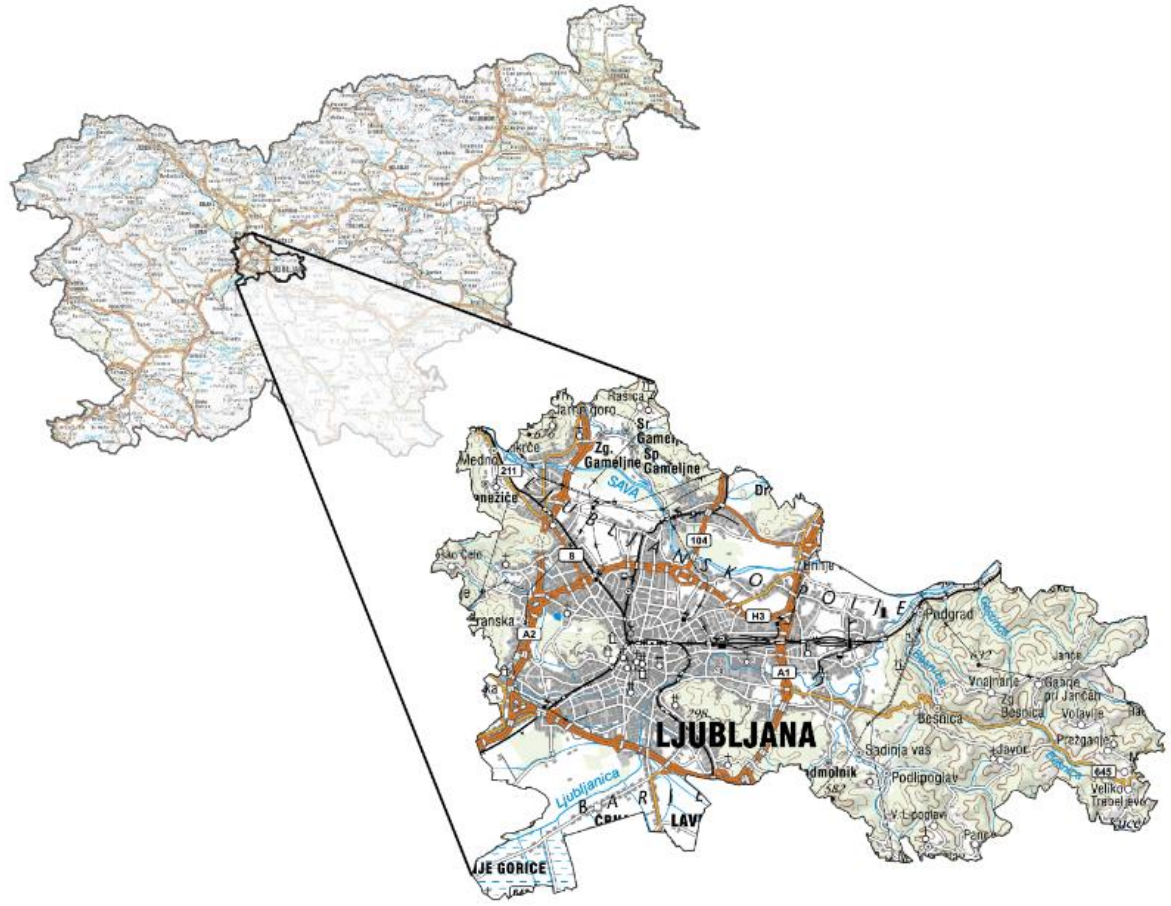

Figure 3: Map of the City of Ljubljana and its location in Slovenia.
Source: GURS (Surveying and Mapping Authority of the Republic of Slovenia).

2 Part A – Current State of Climate Action

Part A "Current State of Climate Action" describes the point of departure of the city towards climate neutrality, including commitments and strategies of key local businesses, and informs the subsequent modules and the outlined pathways to accelerated climate action.

2.1 Module A-1 Greenhouse Gas Emissions Baseline Inventory

GHG Emissions Baseline inventory

GEOGRAPHIC BOUNDARY OF THE GHG EMISSIONS INVENTORY

The analysis of baseline GHG emissions and reduction targets applies to the entire administrative area of the City of Ljubljana, without any exclusions for specific parts of the city. The total area of the City's administrative territory is 275 km².

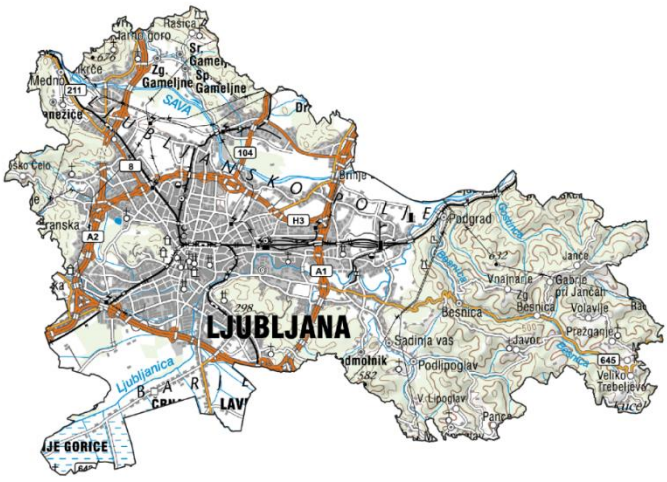

Figure 4: Geographic boundary of the City of Ljubljana.
Source: GURS (Surveying and Mapping Authority of the Republic of Slovenia).

METHODOLOGY USED

A detailed inventory of energy consumption and GHG emissions by sectors for the City of Ljubljana was initially established for the base year 2018, and it has been updated annually using the same methodology since then, with the inclusion of new and improved data over the years. When better data is acquired at the city level, calculations are also retroactively adjusted for previous years. The most recent data on energy use and greenhouse gas emissions is available for the year 2022.

The primary methodology used for emissions estimation is the GHG Protocol for Cities (GPC), which is derived from the IPCC Guidelines for National Greenhouse Gas Inventories.

Additionally, the emission inventory is also produced in parallel using the methodology outlined in the Covenant of Mayors SECAP Guidebook, which is similar but excludes certain sectors (e.g., emissions reported under the IPPU sector, non-energy related emissions/removals in the AFOLU sector due to changes in carbon stocks, and other emissions in agriculture).

However, since the Mission's Info Kit for Cities guidelines specify sectors and emissions that are not covered by the Covenant of Mayors methodology, emissions data for the purposes of this reporting is primarily generated using the GPC/IPCC methodology. Emission factors for grid-supplied electricity and heat consumption are calculated by combining the GPC and CoM methodologies, as suggested in the Mission's Info Kit for Cities guidelines.

Greenhouse gas emissions are expressed in CO_2 equivalent (tons CO_2e). Use of CO_2e makes the emissions of different greenhouse gases comparable to each other and therefore can be summed together. When quantifying greenhouse gas emissions, it's necessary to consider at least three of the seven types of greenhouse gases: CO_2, N_2O, CH_4, F-gases (PFCs, HFCs), NF_3 and SF_6. The City of Ljubljana is currently calculating CO_2e emissions, which in addition to CO_2 also include CH_4, N_2O, and HFCs, while other gases will be additionally included when more reliable data will be available.

The greenhouse gas emissions inventory includes direct and indirect emissions from energy use, direct emissions in agriculture (enteric fermentation, manure management, fertilizer application, etc.), emissions from solid waste management, and wastewater management. Some F-gases emissions from air conditioning and refrigeration are also included.

Emissions of refrigerant gases (HFCs), used as substitutes for ODS and included in the IPPU sector, are estimated for mobile air conditioning and transport refrigeration. However, for other uses (e.g., commercial refrigeration, industrial refrigeration), data is only available at the national level and cannot currently be disaggregated to the level of the City of Ljubljana from existing data sources. Emissions of F-gases, NF_3, and SF_6 at the national level represent less than 5% of the total CO_2e emissions, so they can be considered as insignificant. Nevertheless, we will include in the inventory those for which data will be available or can be indirectly estimated. Within the City of Ljubljana, there are no industrial facilities that would generate emissions of CO_2 and other greenhouse gases from industrial processes such as mineral industry, chemical industry or metal production, so these emissions are not included.

Emissions and sinks resulting from land use and land use changes have also been considered. Calculations and estimates specific to the City of Ljubljana, following the IPCC methodology, have been made by the Slovenian Forestry Institute.

Emissions and removals resulting from land use and land use change were estimated using the stock-change method, utilizing specific local data. In line with best practice guidelines (IPCC, 2006; IPCC, 2019), three approaches can be used to assess land use. The highest level is approach 3, where spatial data is explicit, detailing both the extent and location of changes. For the LULUCF sector, spatial data must cover six main land use categories: forest land, cropland, grassland, wetlands, settlements, and other land. Using approach 3 (IPCC, 2006), we compared land use sample points between 2012-2016 and 2016-2020 to develop land use change matrices. For all land use categories, changes in carbon stocks were assessed in living biomass, deadwood and litter, as well as in mineral and organic soils. Emission factors were determined following IPCC guidelines (2006, 2019), with data mainly sourced for the City of Ljubljana. Timber stock data for forests came from the Slovenian Forestry Institute's permanent plots, while dead wood data were obtained from the national forest inventory database.

IPCC guidelines for assessing greenhouse gas emissions from the agricultural sector include various emission sources or processes that cause emissions. Relevant emissions for the City of Ljubljana include N_2O emissions from all cultivated lands, CO_2 emissions associated with liming and urea application on cultivated lands, CO_2 and N_2O emissions from cultivated organic soils, methane (CH_4)

emissions from livestock (enteric fermentation), and CH_4 and N_2O emissions from manure management systems.

For estimating emissions in agriculture, several methodologies can be used. Tier 1 involves the use of default IPCC data, while Tiers 2 and 3 require the use of country-specific data. Methane emissions from livestock were calculated at Tier 2 according to IPCC methodology, while emissions from other animal husbandry (such as horses, pigs, and small ruminants), methane emissions from manure management, as well as direct and indirect nitrous oxide emissions from both manure management and managed soils, along with emissions from fertilization and liming, were estimated using Tier 1 methodology.

The IPCC methodology was used to estimate greenhouse gas emissions in the waste sector. The IPCC employs the First Order Decay (FOD) method to estimate CH_4 emissions from solid waste disposal sites. This approach operates under the assumption that the degradable organic component (known as degradable organic carbon, DOC) in waste decays slowly over several decades, leading to the formation of CH_4 and CO_2. Assuming constant conditions, the rate of CH_4 production is solely dependent on the remaining carbon content in the waste. Consequently, CH_4 emissions from waste deposited in disposal sites peak in the initial years after deposition, gradually decreasing as the degradable carbon in the waste is consumed by decay-causing bacteria.

The emissions inventory covers all the key sectors required by the GPC and CoM methodologies, with data being aggregated for various reporting purposes in different ways, depending on the requirements of each report. Currently, the following sectors and sub-sectors are included in the inventory:

- **Stationary energy (scope 1 and 2)***
  - Residential buildings,
  - Institutional buildings and facilities
    - *City-owned buildings and facilities,*
    - *State-owned buildings and facilities,*
  - Public lighting,
  - Commercial buildings and facilities,
  - Manufacturing industries and construction,
  - Energy industries.
- **Transportation (scope 1 and 2)**
  - On-road transportation
    - *City-owned fleet,*
    - *Public transport,*
    - *Private and commercial transport,*
  - Railways,
  - Off-road transportation.
- **Waste (scope 1)****
  - Solid waste disposal,
  - Wastewater management.
- **Industrial processes and product use (scope 1)**
  - Product use
    - Substitutes for ozone depleting substances.
- **Agriculture, forestry and other land use (scope 1)**
  - Agricultural and forestry machinery,

- Livestock
  - *Enteric fermentation,*
  - *Manure management,*
- Agricultural land management
  - *Liming,*
  - *Urea application,*
  - *Fertilization and cultivation of agricultural land.*

* As suggested by the Missions Info Kit for Cities, emissions from industrial facilities located within the city boundary which are registered under the EU Emissions Trading Scheme (EU ETS) were excluded from the GHG emissions inventory. In the year 2018, four companies were part of the EU ETS. One of them is a public company for the distribution of district heat, which is owned by the city and for which decarbonization measures are planned; hence, these emissions were not excluded. However, emissions from the remaining three industrial facilities were exempted from the inventory (amounting to a total of 67,861 tons of CO_2 in the year 2018).

** Solid waste generated in the City of Ljubljana is disposed of at a landfill within the city boundary, so there are no emissions from waste generated within the city boundary but sent to landfill outside the city boundary (scope 3). On the contrary, at the waste disposal site within the city, waste from other (mostly neighbouring) municipalities is also deposited. Therefore, methane emissions from the waste disposal site were recalculated based on the share of disposed waste generated in the City of Ljubljana (scope 3 emissions belonging to other municipalities were excluded).

ENERGY CONSUMPTION IN THE CITY OF LJUBLJANA

In the year 2018, a total of 7,584,702 MWh of energy was consumed in the City of Ljubljana, while energy consumption in 2022 amounted to 7,488,412 MWh, representing a decrease of 1.3% or 1.9% compared to the previous year when energy consumption was at its highest in the period under review. A significant decrease in energy use is also noticeable in the year 2020 when numerous restrictive measures were in place due to the Coronavirus, particularly affecting transportation, and industry.

In 2018, most of the energy was consumed in buildings (including public lighting), totalling 4,591,738 MWh, which accounts for 60.5% of the total energy consumption in the city (residential buildings dominate with 1,519,111 MWh or 20.0%). Transportation follows with a 39.4% share and a total estimated consumption of 2,984,926 MWh. On-road transportation dominates with 2,968,432 MWh or 39.1%. The energy consumption structure by energy sources is presented in the table in section A-1.1. Electricity and district heating are categorized under scope 2 and together account for 62.8% of energy use in buildings (with district heating at 24.9% and electricity at 37.9%). Natural gas follows in terms of energy consumed, representing 27.0% of energy use in buildings.

Energy and fuel consumption in buildings are no longer monitored at the municipal level in national statistics. Data on electricity consumption, natural gas, and district heat from the district heating system were obtained from distribution companies.

Data on the sale of extra-light heating oil and liquefied petroleum gas within the city were also obtained from suppliers. In addition, the quantities of consumed liquid fuels, wood biomass, and other heat sources for heating and hot water preparation in buildings were estimated using statistical models and machine learning. These estimates were used for those energy sources where there were not enough reliable data on actual consumption.

In transportation, diesel fuel dominates, accounting for 61.1% of total energy consumption in transportation, followed by gasoline at 36.7%. Compressed natural gas (primarily for urban public transport), liquefied petroleum gas, and electricity, which predominates in rail transportation, represent smaller shares. Energy consumption in private and commercial road transportation was estimated based on a traffic model that considers traffic counters (traffic loads) on national and municipal roads, road lengths by category, the average fuel consumption of individual vehicle types, and the number of residents and travel habits of the population. Based on the calculated distances travelled on the road network within the geographical boundary of the city, the consumption of propulsion energy was estimated. Data for city-owned vehicles and public transportation were obtained from the city and the public transport provider.

A-1.1: Final energy use by source sectors			
Base year	**2018**		
Unit	MWh/year		
	Scope 1	Scope 2	Scope 3
Buildings	**1,708,641**	**2,883,097**	**NO**
Electricity	NO	1,738,378	NO
Natural gas	1,240,201	NO	NO
District heat	NO	1,144,719	NO
Liquefied petroleum gas	48,027	NO	NO
Extra light fuel oil	179,682	NO	NO
Wood biomass	132,074	NO	NO
Diesel	33,193	NO	NO
Gasoline	341	NO	NO
Biogas	75,123	NO	NO
Transport	**2,968,336**	**16,590**	**NO**
Electricity	NO	16,590	NO
Natural gas	33,676	NO	NO
Diesel	1,824,060	NO	NO
Gasoline	1,094,392	NO	NO
Liquefied petroleum gas	16,154	NO	NO
Biodiesel	54	NO	NO
Waste	**IE**	**IE**	**NO**
Industrial Process and Product Use (IPPU)	**IE**	**IE**	**NO**
Agriculture, Forestry and Land Use (AFOLU)	**8,038**	**IE**	**NO**
Electricity	NO	IE	NO
Diesel	7,985	NO	NO
Gasoline	54	NO	NO

NO = not occurring
IE = included elsewhere

The following charts illustrate the structure of energy consumption in the base year 2018, disaggregated into more detailed subsectors, and energy consumption over the period 2018-2022.

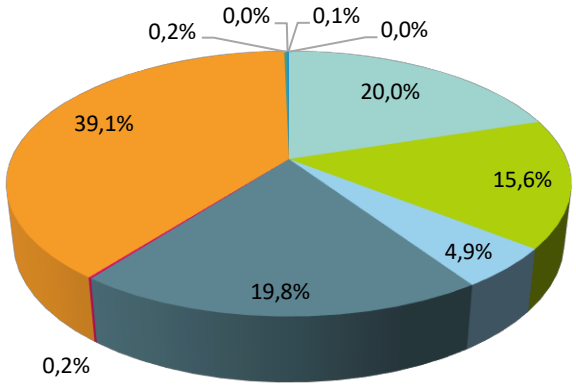

Figure 5: Energy consumption in 2018 by subsector.

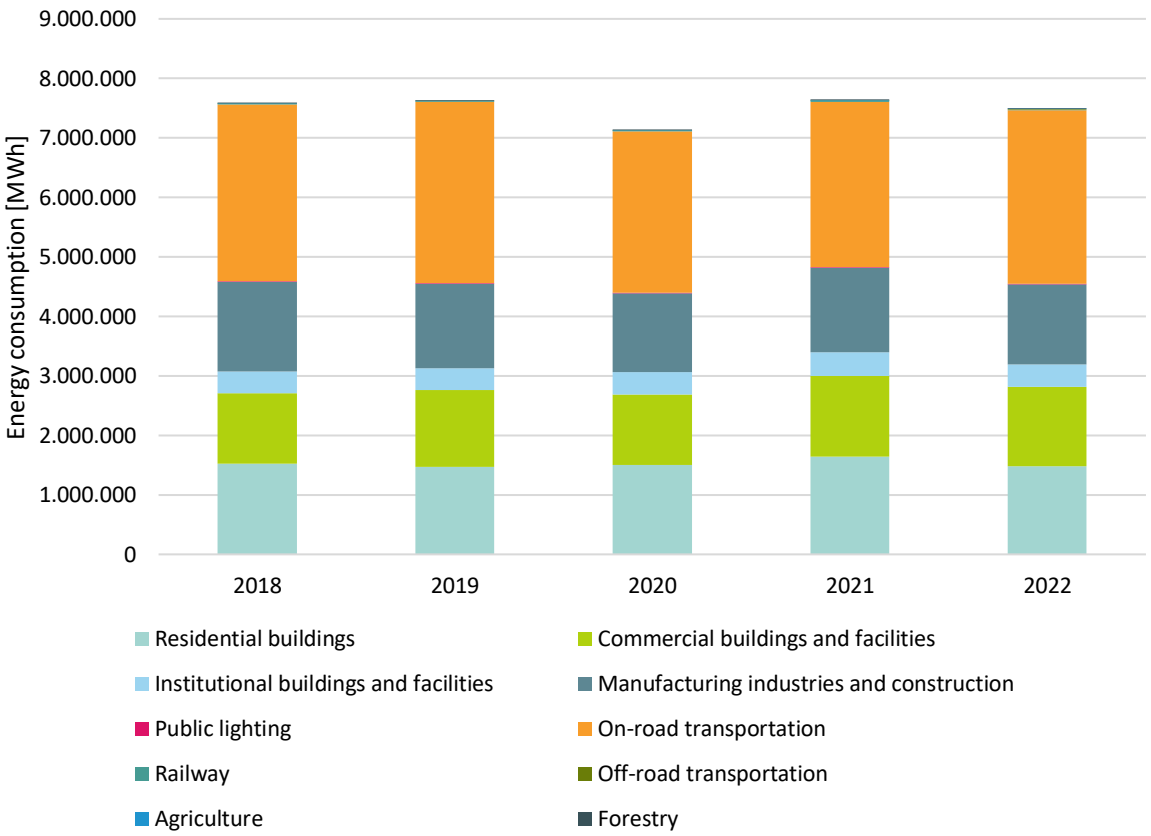

Figure 6: Energy consumption in the period 2018-2022 by subsector.

Energy consumption over the period 2018-2022 is also represented in the next table.

Table 3: Energy consumption in the period 2018-2022 by subsector.

Energy consumption (MWh)	2018	2019	2020	2021	2022
Residential buildings	1,519,111	1,466,748	1,503,873	1,637,320	1,481,440
Commercial buildings and facilities	1,185,511	1,290,148	1,181,219	1,359,970	1,330,718
Institutional buildings and facilities	373,582	371,752	375,267	397,376	385,106
Manufacturing industries and construction	1,501,423	1,420,172	1,330,909	1,421,644	1,337,162
Public lighting	12,111	11,670	11,181	10,453	13,952
On-road transportation	2,968,432	3,040,369	2,703,041	2,779,624	2,914,465
Railway	15,777	15,543	12,450	15,720	15,616
Off-road transportation	718	2,184	1,941	1,825	2,009
Agriculture	7,787	7,754	7,712	7,669	7,687
Forestry	252	283	240	262	256
Total	**7,584,702**	**7,626,622**	**7,127,832**	**7,631,863**	**7,488,412**

In addition to the use of energy and fuels, which largely contribute to GHG emissions, data for some other non-energy emission sources, such as agriculture and waste management, have also been obtained or estimated for the baseline GHG emission inventory. The data used for estimating emissions from both energy and non-energy sources are presented by sectors in the following table.

A-1.2: Activity by source sectors				
Base year: 2018				
	Scope 1	Scope 2	Scope 3	Unit
Sector: Buildings	**1,708,641**	**2,883,097**	**NO**	**MWh/year**
Residential buildings	655,352	863,759	NO	MWh/year
Commercial buildings and facilities	326,411	859,100	NO	MWh/year
Institutional buildings and facilities	50,467	323,115	NO	MWh/year
Manufacturing industries and construction	676,411	825,011	NO	MWh/year
Public lighting	NO	12,111	NO	MWh/year
Energy industries*	2,419,505	80,081	NO	MWh/year
Sector: Transport	**2,968,336**	**16,590**	NO	MWh/year
On-road transportation	2,963,893	4,538	NO	MWh/year
Railway	3,725	12,052	NO	MWh/year
Water-borne transportation	NE	NE	NO	MWh/year
Aviation	NO	NO	NO	MWh/year
Off-road transportation	718	NO	NO	MWh/year
Sector: Waste	/	/	/	/
Solid waste disposal	18,169	NO	NO	t/year
Wastewater management	29,755,660	NO	NO	m3/year
Sector: Industrial Process and Product Use (IPPU)	/	/	/	/
Emissions of refrigerant gases	10,933	NO	NO	kg/year
Sector: Agriculture, Forestry and Other Land Use (AFOLU)	/	/	/	/
Agricultural machinery	7,787	IE	NO	MWh/year
Number of cattle	5,051	NO	NO	-

Agricultural land area	6,001	NO	NO	ha
Forest area	11,488	NO	NO	ha
Logging equipment	252	IE	NO	MWh/year

*Not included in sector total to avoid double counting.

EMISSION FACTORS USED

With the provided emission factors, emissions of individual greenhouse gases in tons are calculated from primary energy in MWh. To convert CH_4, N_2O, and F-gases into CO_2 equivalents, Global Warming Potential (GWP) factors from the IPCC Fifth Assessment Report were used.

The Global Protocol for Community-Scale Greenhouse Gas Inventories (GPC) methodology, which is based on IPCC guidelines, was used to estimate greenhouse gas emissions. To calculate the local emission factor for grid-supplied electricity consumption, a combination of the GPC and Covenant of Mayors (CoM) methodologies was used, as suggested in the Mission's Info Kit for Cities guidelines.

When calculating the local emission factor for grid-supplied electricity consumption, the national emission factor served as the baseline, which was adjusted based on local electricity production and emissions from local production, as well as purchases of green (carbon-free) electricity. Additionally, changes in the national emission factor over the years were considered, reflecting a gradual reduction in specific emissions due to the increasing integration of renewable sources in production and the phasing out of fossil fuels at the national level. Emissions resulting from local electricity production within the Ljubljana area were subtracted from the national emission factor to avoid double-counting, as recommended by the GPC methodology. The national emission factor is calculated annually by the Jožef Stefan Institute (data and methodology are available in Slovenian language here: https://ceu.ijs.si/izpusti-co2-tgp-na-enoto-elektricne-energije/).

As most of the electricity in the City of Ljubljana is generated through cogeneration (combined heat and power) primarily using brown coal and natural gas, this contributes to a higher local emission factor compared to the national factor, even though local solar and hydropower production is considered, along with the purchase of carbon-free electricity by the city administration. However, in the future, as coal is phased out and cogeneration units transition to renewable sources, the local emission factor for both electricity and district heating is expected to significantly decrease. Additionally, there will be a growing contribution from distributed renewable energy production, especially from solar power.

Similar to CO_2, local emission factors for CH_4 and N_2O were also calculated for electricity and district heating. The emission factors provided in the table apply to the base year 2018.

A-1.3: Emission factors applied

Primary energy/ energy source	Carbon Dioxide (CO_2)	Methane (CH_4)	Nitrous Oxide (N_2O)	F-gases (hydrofluorocarbons and perfluorocarbons)	Sulphur hexafluoride (SF_6)	Nitrogen trifluoride (NF_3)
Electricity	0.405	0.0000116	0.0000067	/	/	/
Natural gas	0.202	0.0000036	0.0000004	/	/	/

District heat	0.319	0.0000151	0.0000063	/	/	/
Liquefied petroleum gas	0.227	0.000018	0.00000036	/	/	/
Extra light fuel oil	0.267	0.000036	0.0000022	/	/	/
Wood biomass	0.000*	0.00108	0.0000054	/	/	/
Diesel	0.267	0.000014	0.000014	/	/	/
Gasoline	0.249	0.000014	0.000021	/	/	/
Biodiesel	0.000*	0.000002	0.000011	/	/	/
Biogas	0.000*	0.0000036	0.0000004	/	/	/

* A zero CO_2 emission factor is applied to wood biomass, biogas, and biofuels.
** Emissions of F-gases are not estimated directly from energy consumption, so the emission factors are not listed here.

The following chart illustrates the trend of specific emissions (EF) for electricity and district heating, showing a gradual reduction of the grid-supplied electricity factor and stagnation of the district heating factor. The charts below also showcase the structure of local electricity production, which affects the local EF, and separately, production from renewable sources.

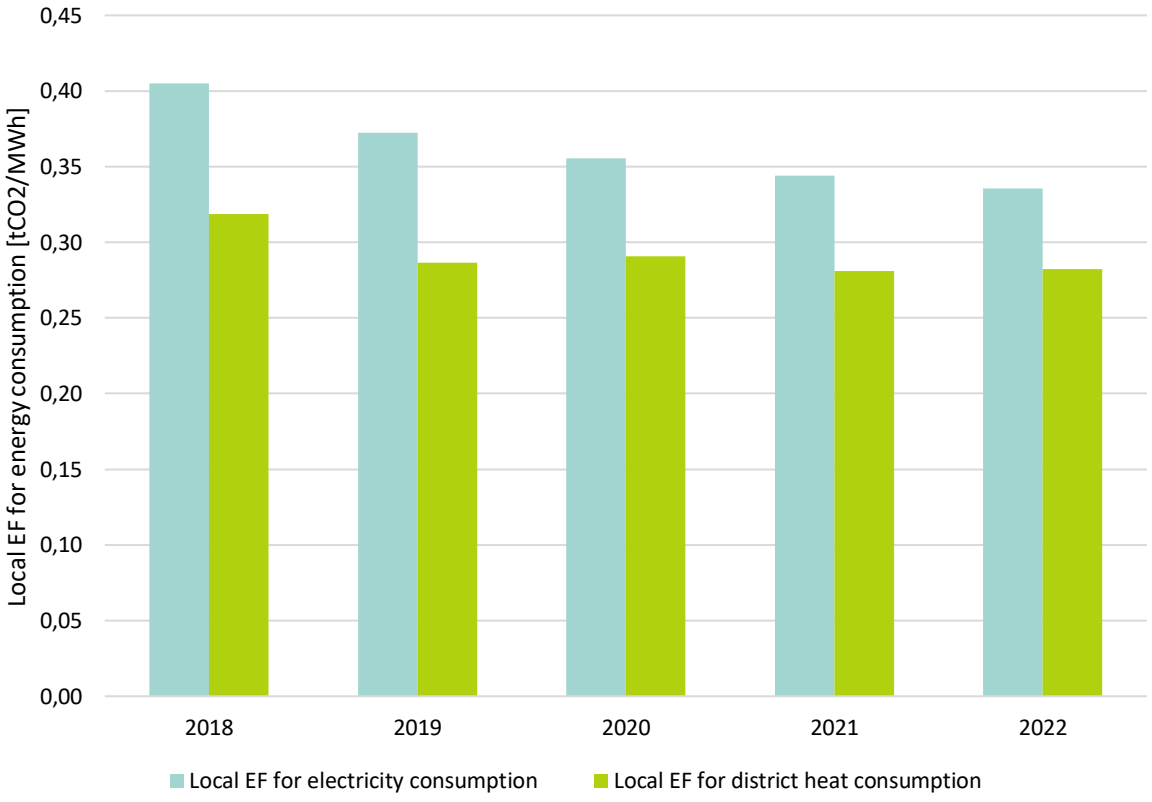

Figure 7: Local emission factor of electricity and district heat in the period 2018-2022.

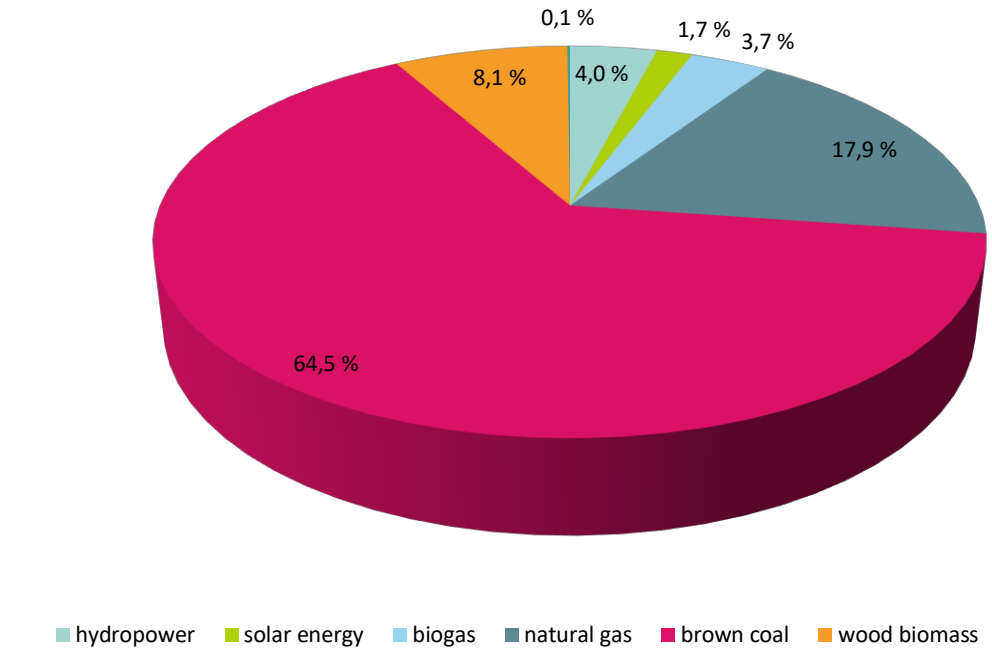

Figure 8: Local electricity production in 2018 by energy sources.

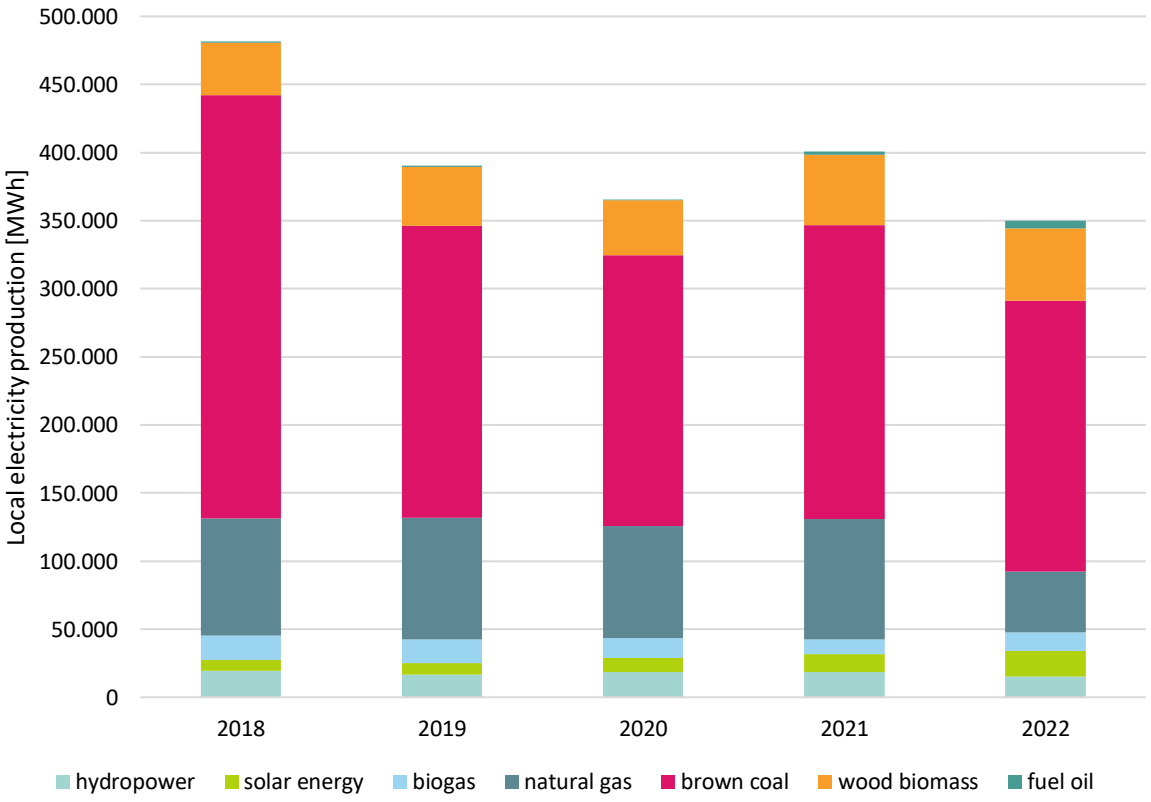

Figure 9: Local electricity production in the period 2018-2022 by energy sources.

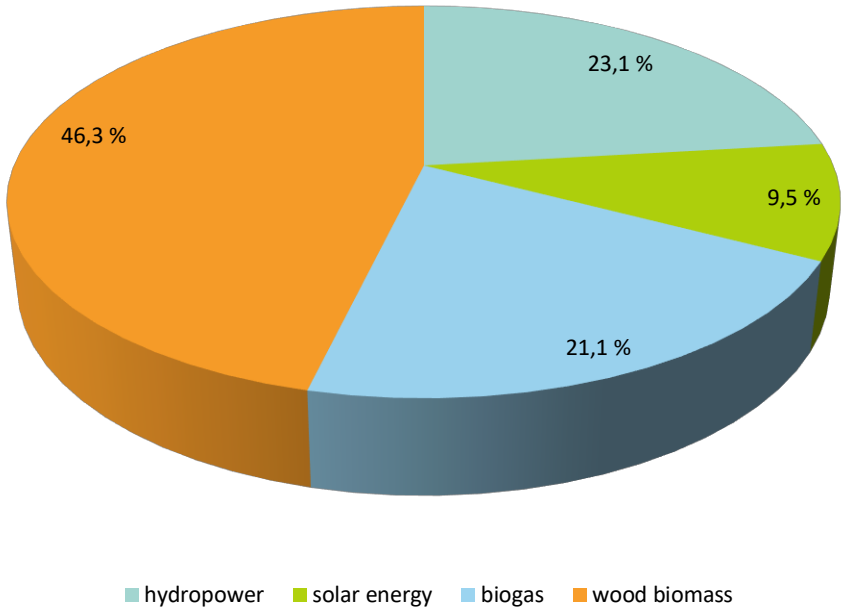

Figure 10: Local production of renewable electricity in 2018 by energy source.

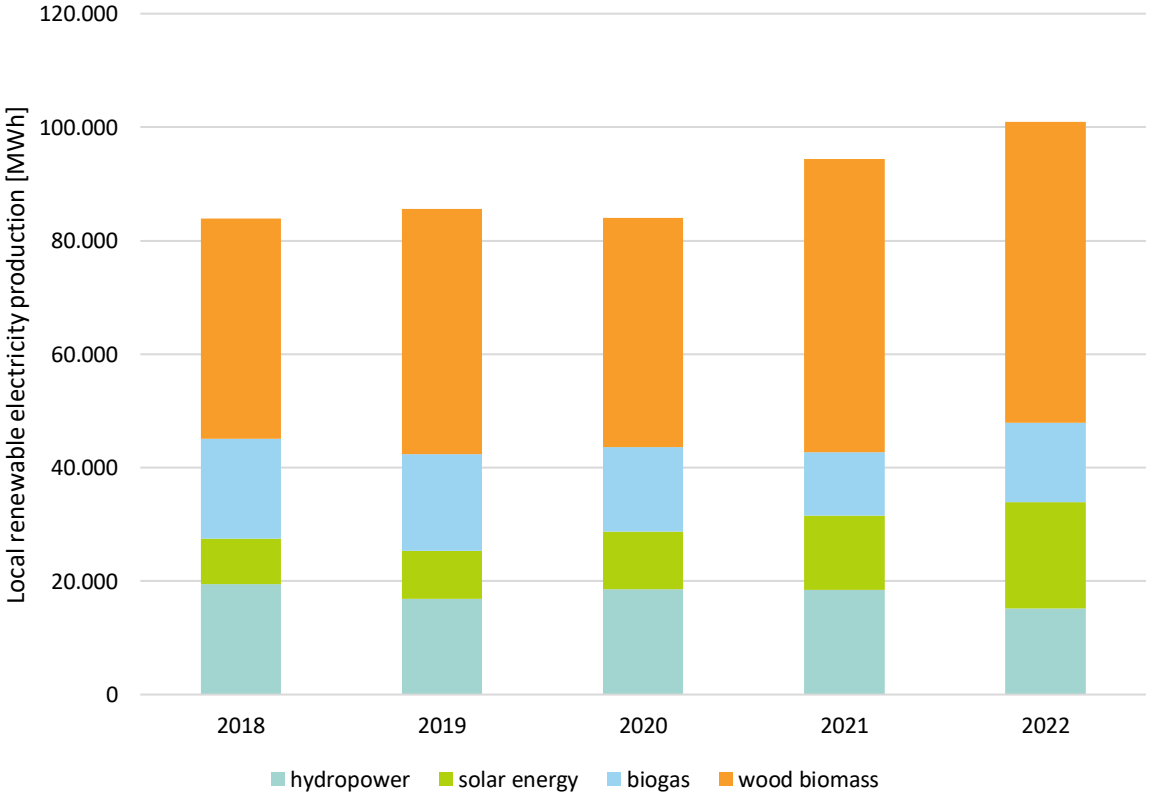

Figure 11: Local production of renewable electricity in the period 2018-2022 by energy source.

The City of Ljubljana, which is an indirect owner of the district heating system through a public company, intends to reduce specific emissions for district heating by decarbonizing the district heating system (cogeneration). Several scenarios for transitioning from coal and natural gas to other energy sources (primarily renewables) are being developed. In addition to biomass cogeneration, plans include large water/water heat pumps (utilizing river heat), solar thermal collectors, waste heat utilization, and waste incineration. Furthermore, simulations of potential energy savings from the energy retrofitting of building stock supplied with district heating have already been prepared.

In addition to transitioning cogeneration plants for the district heating system, the installation of numerous new renewable energy production facilities, especially solar power plants of larger capacity, will contribute to reducing the local emission factor for grid-supplied electricity. The emission factor will also continue to decrease at the national level in the future. Also, increased purchases of electricity from renewable sources will affect the reduction of the local emission factor. More about planned emissions reduction measures is described in the following chapters.

For the year 2030, it is planned that the local emission factor for electricity consumption will reach a value of 0.01 tCO_2e/MWh while the specific emission of district heat will be 0.12 tCO_2e/MWh.

GHG EMISSIONS IN THE CITY OF LJUBLJANA

Most GHG emissions in the City of Ljubljana are generated due to energy consumption in buildings, totalling 1,423,268 tons in 2018, which is 61.8% of total emissions in the city. Indirect emissions from electricity and district heating consumption (scope 2) dominated, amounting to 1,183,332 tons in 2018 (which is 83.1% of total emissions in buildings). Indirect emissions dominate due to a significant share of electricity (37.9%) and district heating (24.9%) consumption in buildings and a relatively high local emission factor for electricity and district heating consumption, as brown coal predominates in local energy production.

In 2018, transportation in the City of Ljubljana accounted for 34.4% of the total GHG emissions (791,604 tons), while waste management and wastewater treatment contributed 2.1% (48,500 tons). A smaller share came from the Agriculture, Forestry, and Other Land Use (AFOLU) sector, contributing 1.0% (23,693 tons), and the Industrial Process and Product Use (IPPU) sector, with a 0.6% share (14,604 tons).

Within the Agriculture, Forestry, and Other Land Use (AFOLU) sector, the City of Ljubljana had a net carbon sink of -54,449 tons (on land where land use has not been changed), primarily driven by forest land (-46,398 tons), settlements (-6,768 tons), grassland (-898 tons), and cropland (-385 tons). Remaining forest land contributed 85% to the net sinks, while changes in land use, like deforestation and conversion, resulted in a net source of 5,349 tons of CO_2 emissions. Overall, the city's net emissions/removals of CO_2 in 2018 were -49,100 tons.

A-1.4: GHG emissions by source sectors				
Base year	2018			
Unit	CO_2equivalent/year			
	Scope 1	Scope 2	Scope 3	Total
Buildings	239,936	1,183,332	NO	1,423,268
Transport	784,577	7,027	NO	791,604
Waste	48,500	NO	NO	48,500
Industrial Process and Product Use (IPPU)	14,604	NO	NO	14,604

Agricultural, Forestry and Land Use (AFOLU)	Sources (positive emissions)	23,693	IE	NO	23,693
	Sinks (negative emissions)	-49,100	NO	NO	-49,100
Total - without carbon sinks		**1,111,310**	**1,190,359**	**NO**	**2,301,669**
Total - with carbon sinks		**1,062,210**	**1,190,359**	**NO**	**2,252,569**

On the charts below, the emission structure is shown for basic (aggregated) and more detailed sectors. Emissions are also outlined annually for the period spanning from 2018 to 2022.

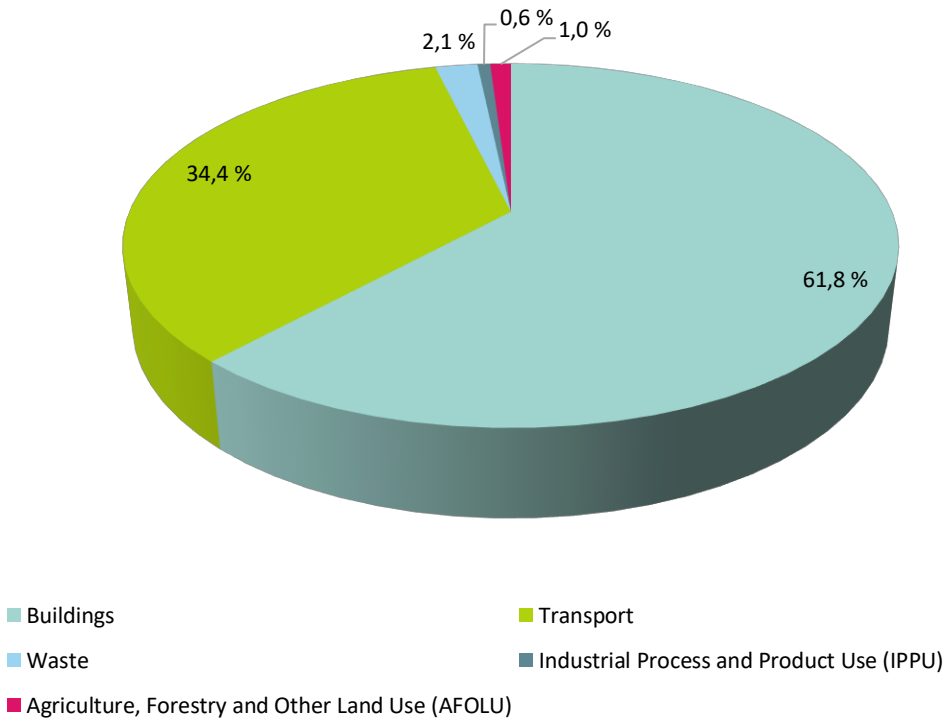

Figure 12: Greenhouse gas emissions in 2018 by basic sectors.

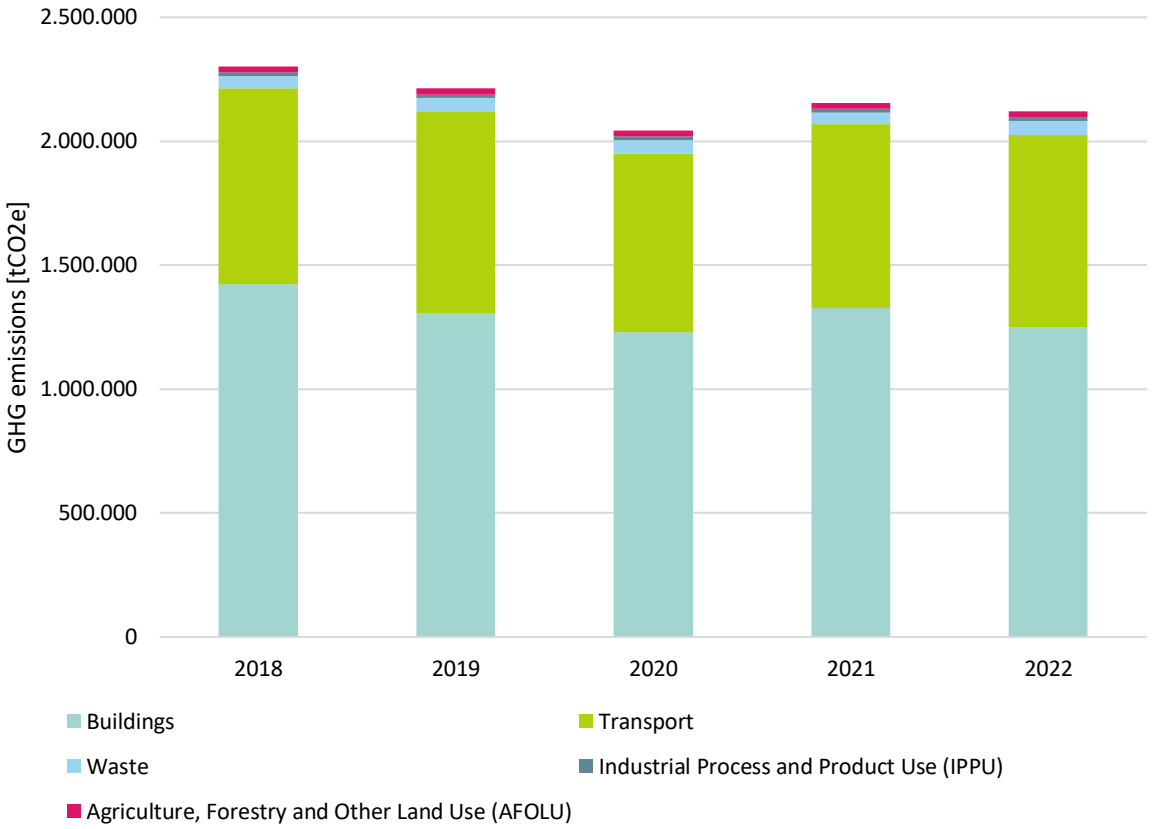

Figure 1: Greenhouse gas emissions in the period 2018-2022 by basic sectors.

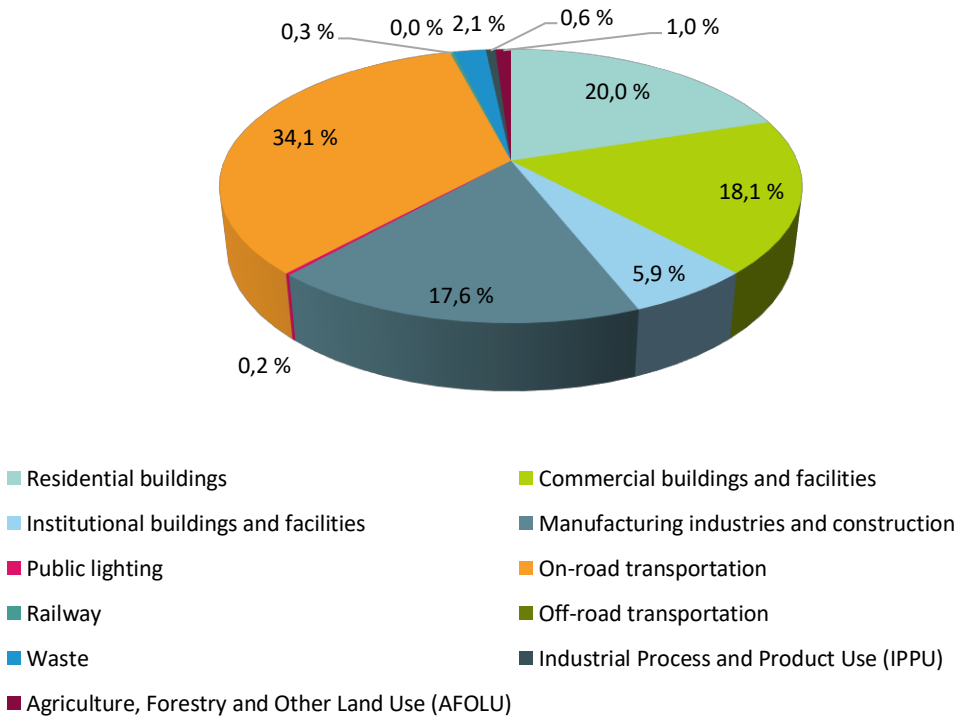

Figure 24 Greenhouse gas emissions in 2018 by subsector.

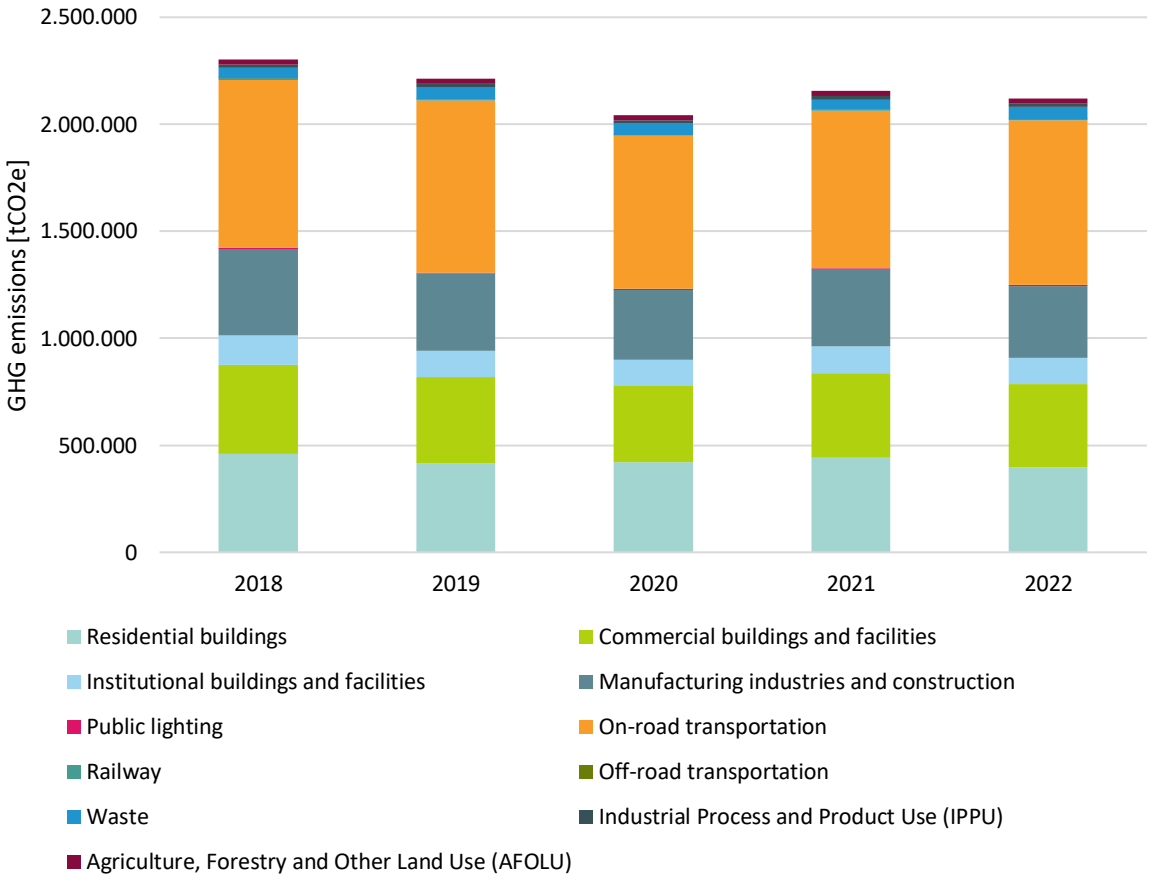

Figure 15: Greenhouse gas emissions in the period 2018-2022 by subsector.

The **following table presents data on GHG emissions by years for the period from 2018 to 2022**.

Table 7: Greenhouse gas emissions in the period 2018-2022 by subsector.

GHG emissions (tCO_2e)	2018	2019	2020	2021	2022
Residential buildings	460,612	413,834	420,236	440,591	396,984
Commercial buildings and facilities	416,391	404,659	356,314	395,796	389,903
Institutional buildings and facilities	135,637	122,977	124,259	126,729	123,064
Manufacturing industries and construction	405,499	361,070	325,493	361,927	334,614
Public lighting	5,130	4,541	4,161	3,748	4,880
On-road transportation	785,191	804,101	715,523	735,396	770,713
Railway	6,201	5,638	4,424	5,370	5,251
Off-road transportation	211	643	571	537	592
Waste	48,500	56,228	52,855	45,482	55,132
Industrial Process and Product Use (IPPU)	14,604	15,073	15,232	15,533	15,768
Agriculture, Forestry and Other Land Use (AFOLU)	23,693	23,935	24,003	23,786	22,578
Total	**2,301,669**	**2,212,700**	**2,043,071**	**2,154,895**	**2,119,477**

The last chart shows specific emissions per city inhabitant for the period 2018-2022, while the data table is provided below. From 2018 to 2022, specific emissions per inhabitant decreased by 9.2%, from 7.94 tons to 7.21 tons CO_2e. The most significant emissions reduction was estimated in buildings, with a decrease of 13.4%.

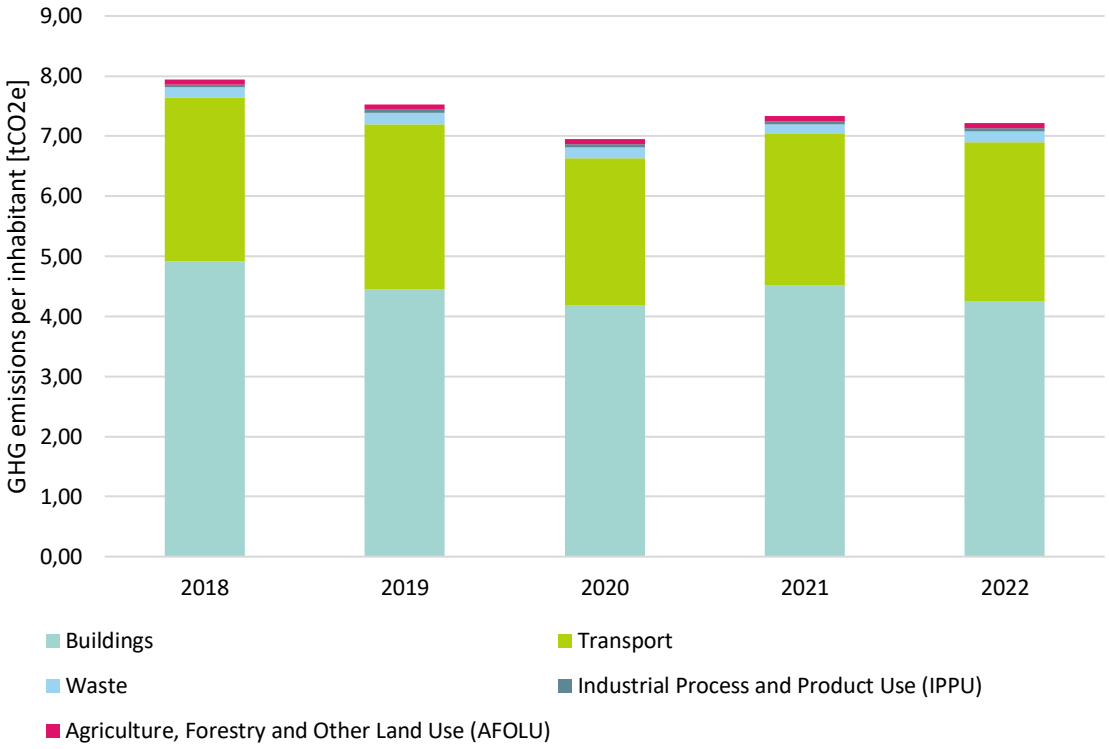

Figure 16: Emissions of greenhouse gases per inhabitant of the city in the period 2018-2022 by basic sectors.

Table 8: Emissions of greenhouse gases per inhabitant of the city in the period 2018-2022 by basic sectors.

GHG emissions (tCO_2e/inhabitant)	2018	2019	2020	2021	2022
Buildings	4.91	4.44	4.18	4.52	4.25
Transport	2.73	2.76	2.45	2.52	2.64
Waste	0.17	0.19	0.18	0.15	0.19
Industrial Process and Product Use (IPPU)	0.05	0.05	0.05	0.05	0.05
Agriculture, Forestry and Other Land Use (AFOLU)	0.08	0.08	0.08	0.08	0.08
Total	**7.94**	**7.52**	**6.95**	**7.33**	**7.21**

In conclusion, the primary source of GHG emissions in the City of Ljubljana is energy consumption in buildings, with indirect emissions from electricity and district heating being the predominant contributors. Transportation plays a significant role in the city's overall emissions, constituting a notable portion of the carbon footprint. Waste management and wastewater treatment have a comparatively smaller impact on GHG emissions in the city while the Agriculture, Forestry, and Other Land Use (AFOLU) sector and the Industrial Process and Product Use (IPPU) sector make minor contributions to the city's total emissions.

Current calculations consider Scope 1 (GHG emissions from sources within the city boundaries) and Scope 2 (GHG emissions resulting from the use of electricity, heat, steam, and/or cooling supplied

through networks within the city boundaries). Scope 3 emissions, representing all other greenhouse gas emissions occurring outside the city boundaries as a result of activities within the city boundaries, are not included in the current emission calculations.

In the stationary energy, scope 3 emissions include losses in the transmission and distribution of electricity, steam, heating, and cooling supplied through the network outside the city boundary. To enhance existing calculations, future efforts will involve obtaining data on losses in the electrical grid and incorporating them into the calculations. However, this is not feasible for district heating systems as they are located within the city's boundaries and are already accounted for in scope 2.

In the transport sector, when calculating emissions, we used the geographic or territorial assessment method, which quantifies traffic emissions within city boundary regardless of the origin or destination of travel. This model aligns with scope 1 emissions as it includes all traffic activities within the city boundaries. Additionally, we also utilized scope 2, which covers all electricity used for electric vehicles within the city. When using the geographic or territorial assessment method, scope 3 is not applicable, as it focuses on quantifying emissions within city boundaries and does not require assessment or quantification of emissions occurring outside the city boundary.

In the waste sector, when calculating emissions from waste processing, we used scope 1, which includes all greenhouse gas emissions from the treatment and disposal of waste within the city boundary, regardless of whether the waste is generated inside or outside the city limits. Only GHG emissions from waste generated by the city were included. Emissions from waste generated by the city but treated outside the city boundary (scope 3) were not calculated, as the city disposes and biologically treat all its waste as well as waste from neighbouring municipalities. Part of the waste that is not landfilled within the city and not recycled is used as fuel in incinerators outside the city boundary, which falls under scope 3. In the future, these emissions can also be included in calculations at the level of the City of Ljubljana.

Emissions from IPPU and AFOLU are calculated only for scope 1, while emissions outside the city are not included in the inventory (not applicable).

2.2 Module A-2 Current Policies and Strategies Assessment

Module A-2 “Current Policies and Strategies” lists and assesses existing policies, strategies, initiatives, or regulation from **local, regional, and national level**, relevant to the city’s climate neutrality transition. This assessment contributes to **identifying the gap** (if any) between the emissions reduction due to existing initiatives and the city´s 2030 climate neutrality target.

A-2.1: Description & assessment of policies

We have considered several existing policies, strategies, programmes, and regulations that impact (directly or indirectly) the 2030 climate neutrality ambition of City of Ljubljana. We have determined their relevance and influence on the climate ambition of Ljubljana as well as anticipated emission reductions attributed to these policies by 2030. The examination involves cross-referencing these policies with the action plan to prevent redundancy and ensure emission gap calculations. Furthermore, it investigates any potential overlap between these policies and the »Business as Usual scenario«, aiming to address the remaining emissions gap toward achieving the 2030 climate target.

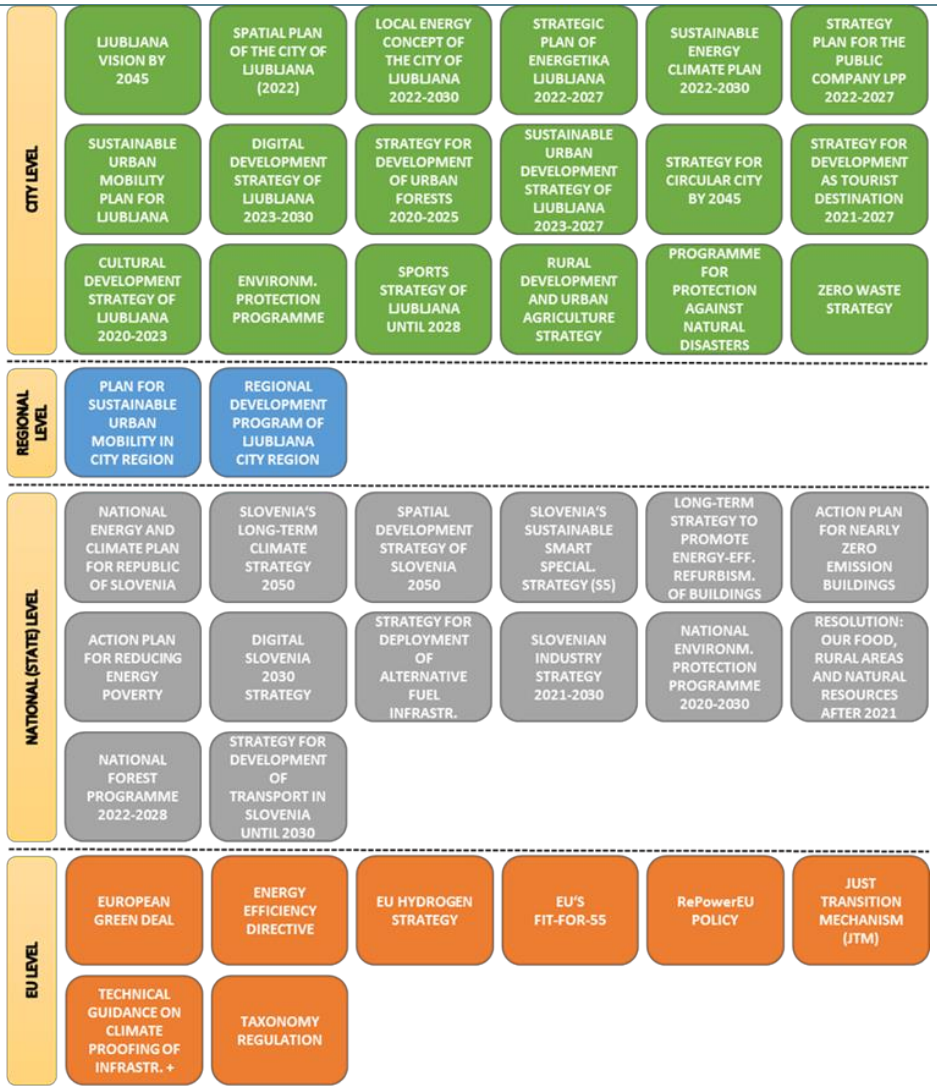

Figure 17: Existing policies, strategies, programmes.

The listed strategies, policies, and action plans are supporting both ongoing and planned activities. The relevance of these policies and strategies is based on following criteria:

- How they connect or bridge national, regional, and local priorities, considering alignment and coherence across different levels of governance, maximizing the impact of climate action efforts.
- How they foster collaboration among crucial policy areas to advance climate neutrality, particularly at the local level. As integrating various policy domains such as energy, transportation, and land use planning, to promote holistic approaches to emissions reduction and sustainability.
- How they promote collaboration and coordination to facilitate joint efforts within the region and on the national level to address shared challenges and opportunities related to climate action.

Assessment (analysis) of relevant policies and strategies

The Ljubljana Vision by 2045, **Local energy Concept of the City of Ljubljana 2022-2030 and Sustainable energy climate plan 2022-2030 (SECAP)** are setting different emission reduction targets including zero emission target for 2045 and 2050, respectively. They are aligned with **National**

Energy and Climate plan (NECP – i.e. national SECAP) and **EU Green Deal**, both setting zero emission target for 2050. However, our action plan sets this ambition for the year 2030, therefore it includes additional measures, or individual measures will be implemented more quickly, in shorter implementation period.

Local district heating network and natural gas distribution currently account for more than 1/3 of existing emissions, and **Strategic plan of Energetika Ljubljana d.o.o. for period 2022 to 2027** (local district heating and gas network operator) already incorporates ambitions investments plans towards decarbonization of their production sources. Our Action plan builds on this strategy considering extra effort (i.e. additional measures, such as CCU – Carbon Capture and Use, for 138,029 t CO_2 of residual emissions buildings sector) to support our 2030 target. While the direct impact of the **EU Hydrogen Strategy** on Ljubljana's emission reduction targets may vary depending on the city's specific implementation plans and the deployment (availability) of hydrogen technologies, the integration of hydrogen into the energy mix (which is included in this action plan) offers opportunities for the transition to cleaner energy sources and thus already contributes to the city's 2030 emission reduction targets.

All the above policies are highly relevant and have direct impact on our climate neutrality ambition, however BAU scenario based only on them is not sufficient for 2030 zero emission scenario, therefore this action plan is way more ambitious, setting the same goals for as early as 2030 with its measures.

National **Long-term strategy to promote the energy-efficient refurbishment of buildings**, national **Action plan for nearly zero-energy buildings** and **Energy efficiency directive** are aligned with local targets as they all already apply to all new buildings and thus have a direct impact on Ljubljana's efforts to reduce energy consumption and achieve emission reduction target. However, AP goes beyond BAU scenario based on these policies, by setting more ambitious targets for 2030 (as outlined in Section B-2) in terms of renovation of existing buildings portfolio.

By emphasising sustainable mobility, the city aims to improve living standards, reduce pollution, and reduce emissions. **Strategy Plan of the public company Ljubljanski potniški promet, d.o.o. for the period 2022 – 2027** already anticipates and is fully aligned with the action plan for achieving carbon neutrality, meaning that by 2030 all local public transport buses will be powered by renewable energy sources or electricity. On the other hand, both **Sustainable Urban mobility plan for the city of Ljubljana** and **Plan for sustainable urban mobility in the Ljubljana city region** (comprises 26 municipalities in central Slovenia) support short-term decarbonization of urban public transportation (and are thus aligned with AP), while both also focus on other areas of sustainable mobility such as promoting walking, cycling, etc. The primary issue where these strategies and plans lack a proper answer is transit traffic, which passes through the city via the motorway, and the city itself does not have decisive influence on its limitation. Therefore, within this action plan, we have envisaged a solution to neutralize emissions caused by transit traffic (i.e. residual emissions of 259,881 tCO_2e) with other measures outside the sector (CCU – Carbon Capture and Use).

The local **Environmental Protection Program and Strategy for a circular city by 2045** is a key strategic document for the City of Ljubljana, outlining the vision of Ljubljana as an environmentally successful capital. It is based on the current environmental situation, establishing strategic goals, and specifying necessary measures to guide sustainable practices and development in spatial, economic, and social aspects within the city. It is important for co-benefits (e.g. air quality, water purification, mobility, local food production, etc.) that can indirectly reduce energy use and GHG emissions.

Spatial plan of the City of Ljubljana (2022) and its objective to develop a vision and strategy for the development of the city for the next 20 years in terms of harmonious spatial development of the city.

The fundamental strategic objectives of the spatial development of City of Ljubljana are to maintain and strengthen the spatial, natural, and cultural values of the city as well as the wider surroundings of the City of Ljubljana, which mean the identity and potential for high-quality city development and quality of living in it. This also means that we prefer renovation or replacement of obsolete facilities over building new ones, however the construction of new facilities is never completely excluded. Sustainable spatial development contributes to more energy efficient building and consequently less carbon pollution due to decreased heat demand, which is aligned with this action plan. The long-term effects of city's sustainable spatial development, for example a well-managed Ljubljana's urban forest, will contribute to a gradual reduction in emissions.

The Strategy for the development of Ljubljana's urban forests (2020-2025), which is aligned with action plan for carbon neutrality, plays an important role in the implementation of the city's climate goals and emission reduction, since they create significant carbon sinks (49,900 t CO_2e in 2018, with AP envisages extra effort of 15,800 t CO_2e). The direct impact on emissions reduction based on this strategy may not be immediate, but the long-term effects of a well-managed urban forest strategy is significant and can contribute to additional reduction in emissions.

The Rural Development and Urban Agriculture Strategy of the City of Ljubljana for the period 2021-2027 defines the vision, objectives, measures, and activities for the development of rural areas and urban agriculture, also addresses cross-cutting themes such as adaptation to climate change and is in line with presented action plan.

Here is another series of important policies and strategies (e.g. **Strategy for the development of Ljubljana and Ljubljana region as a tourist destination 2021-2027**, **Digital development strategy of the city of Ljubljana 2023-2030**, **Strategy for cultural development in the city of Ljubljana 2020-2023 with guidelines until 2027**, **Sports strategy of the city of Ljubljana until 2028**, etc.) that may not have a direct short-term impact on emission reduction but contribute significantly to creating conditions for achieving and maintaining the city's goals in the long run. They notably influence on the quality of life in the city and on the content the city offers to its residents.

Table 9: Analysis of existing policies, strategies, and programmes.

Name (title)	Type	Level	Impact/relevance	Need for action, present risks
Energy & environment				
The Ljubljana Vision by 2045	strategy	city	• direct impact (strategic) • BAU scenario, but it forms good foundation for AP (very relevant) • target period 2045	• Faster action needed - time frame is less ambitious compared to AP.
Environmental Protection Programme	action plan	city	• indirect impact • supports BAU scenario, however considered in	• To achieve the goals by 2030, programme objectives need to be adjusted to

			all measures (B-2).	support shorter time frame.
Local Energy Concept of the city of Ljubljana 2022-2030	action plan (SEAP)	city	• direct impact (key strategic document) • very relevant for AP (included in B-2) • target period 2050	• Less ambitious compared to AP (additional measures needed). • Enhancements primarily in the field of social innovation activities, interdisciplinary perspectives (e.g., agriculture).
Strategic plan of Energetika Ljubljana d.o.o. for period 2022-2027	action plan	city (public company)	• direct impact • very relevant for AP (included in B-2, AP envisages additional measures) • individual target periods in line with AP	• Strategic plan needs revision (to include new measures/projects – e.g. CCU, decarbonization of DHS, etc.). • Lengthy procedures to obtain necessary permits (high risk).
Sustainable energy climate plan 2022-2030	action plan (SECAP)	city (public company)	• direct impact • very relevant for AP (included in B-2, AP envisages additional measures) • individual target periods in line with AP	• Measures do not ensure 2030 climate neutrality target. • Alignment of plan and AP (e.g. CCU, decarbonization of energy sector, etc.).
National energy and climate plan of the Republic of Slovenia (NECP)	action plan (National SECAP)	national	• direct & indirect impact • very relevant for AP • target period longer compared to AP • included in B-2 (hydrogen use, photovoltaic,	• Lengthy coordination process, national implementation support instruments are needed.

			transport-mobility) • AP (B-2) envisages additional (new) measures	
National environmental action programme 2020-2030	action plan	national	• indirect impact	• Risk of long procedures on national level.
Slovenia's long term climate strategy 2050	strategy	national	• indirect impact. • climate-neutral and climate-resilient society by 2050 • AP more ambitious (time frame)	• Risk of slow action. • Need for supportive legislation and funding at the national level (subsidies).
Long-term strategy to promote the energy-efficient refurbishment of buildings	strategy	national	• direct impact • very relevant for AP • included in B-2, AP has additional measures in shorter timeframe	• More ambitious timeframe needed (in combination with adequate financial support). • Necessary alignment with the state regarding energy renovation of state-owned buildings (important to achieve 2030 AP targets). • How will the strategy follow local goals.
Action plan for nearly zero-emission buildings	action plan (SEAP for buildings)	national	• direct impact • very relevant for AP (included in B-2) • impacts only new buildings • longer target timeframe (beyond 2030)	• Does not affect existing buildings. • Risk: electrical infrastructure does not allow for a rapid transition to self-sufficient solar power plants.
Action plan for reducing energy poverty	action plan	national	• indirect impact	• Socio-cultural factors (e.g. traditional wood-fired boilers).

				• Limited infrastructure for delivering energy services (rural area).
Strategy for deployment of alternative fuel infrastructure	strategy	national	• indirect impact	• Technology availability. • Time constraints. • Risk of high costs (compared to fossil fuels).
European Green Deal	strategy/ regulation	EU	• direct impact • very relevant for AP (BAU) • AP envisages early action	• Longer target timeframe (beyond 2030).
Energy efficiency directive	regulation	EU	• direct impact • affect buildings sector, taken into account in B-2 • AP sets more ambitious targets (extra action envisaged)	• /
EU Hydrogen strategy	strategy	EU	• indirect impact, very relevant for promotion and development of hydrogen based technologies • AP envisages early action	• /
EU's FIT-FOR-55	strategy	EU	• direct impact • mostly affect energy and buildings sectors • AP sets more ambitious targets (extra action envisaged)	• /
RePowerEU policy	strategy	EU	• direct impact of faster transition to RES energy	• Risk of high energy prices.

The technical guidance on climate proofing of infrastructure +	regulation	EU	• indirect impact (through) national legal framework)	• /
Mobility & transport				
Strategy plan of the public company Ljubljanski potniški promet d.o.o., for period 2022-2027	action plan	city (public company)	• direct impact • very relevant for AP (in line, included in B-2), except for existing fleet	• Strategy covers new vehicles (buses) does not address existing fleet. • Charging infrastructure and energy storage for electric buses is big challenge.
Sustainable urban mobility plan for the city of Ljubljana	action plan (SUMP)	city	• direct impact • very relevant for AP (included in B-2), but longer timeframe	• Charging infrastructure, especially in dense settlements (multi-apartment buildings). • Affordability of BEV for broader population (high prices) and lack of subsidies in coming years (risk). • For individual measures emission reduction should be determined, KPI's developed in this AP could be used.
Sustainable urban mobility plan in the Ljubljana city region	action plan (regional SUMP)	regional	• direct impact • very relevant for AP (suburban traffic), included in B-2	• Influence of international road transport corridor (high risk of increasing traffic).
Strategy for the development of transport in the RS until 2030	strategy	national	• indirect impact (through development of transport corridors)	• Opportunity: switch of road transport to railway. • Transport corridors remain strategic objective, which

				creates risk of increased traffic in near future.
Spatial development & circular economy				
Spatial plan of the city of Ljubljana (2022)	action plan	city	• direct impact • supports BAU scenario • very relevant for implementation of AP, included in B-2	• Additional measures needed to preserve green areas outside the urban area of the City of Ljubljana, thereby reducing emissions from deforestation by 50% and emissions from construction by 25% by 2030 compared to 2018. • Next revision of spatial plan will have to include new targets - net zero emissions by 2030. • Risk: lack of suitable land for new construction, as a result, pressure for construction also on less suitable land (they could be used for other purposes instead).
Spatial development strategy of Slovenia 2050	strategy	national	• indirect impact	• Incoherencies between public policies at all administrative levels.
Strategy for the development of Ljubljana's urban forest 2020-2025	strategy	city	• direct impact • very relevant for AP (carbon sinks) • BAU scenario (included in B-2)	• Strategy does not include detailed action plan, only guidelines.
Strategy for a circular city by 2045	strategy	city	• direct impact	• Individual measures in the

			• very relevant for AP • BAU scenario (included in B-2)	strategy should be evaluated in terms of emission reduction.
Zero waste strategy	strategy	city	• direct impact. • BAU scenario (included in B-2)	• Impact of the planned waste incineration plant on the implementation of the zero-waste policy.
National forest programme 2022-2028	action plan	national	• indirect impact. • BAU scenario (included in B-2)	• Risk regarding (natural) circumstances that may hinder successful forest restoration.
Other strategies				
Strategy for the development of Ljubljana as a tourist destination and Ljubljana region 2021-2027	strategy	local (city), regional	• indirect impact • relevant for AP • relevant for individual measures, but nor directly included in B-2	• Additional development and promotion of sustainable mobility within the destination, particularly in the areas of public transport, cycling, environmentally friendly transport, park-and-ride schemes, bus mobility, etc.
Digital development strategy the city of Ljubljana 2023-2030	strategy	city	• indirect impact • relevant for AP (BAU scenario) • relevant for individual measures, but nor directly included in B-2	• Lack of human resources (IT experts). • The strategy must actively follow the rapid development of the field.
Digital Slovenia 2030-Strategy	strategy	national	• indirect impact	• Lack of human resources (IT experts in general).
Slovenian industry strategy 2021-2030	strategy	national	• indirect impact	• Ability of the industry to adapt to the green transition (availability of

				technologies, e.g. hydrogen).
Sustainable Urban development strategy the city of Ljubljana 2023-2027	strategy	city	• direct impact • very relevant for AP	• /
Regional development program of the Ljubljana urban region 2021-2027	action plan	regional	• indirect impact	• Additional measures to promote cross-sectoral cooperation among different decision-making levels.
Cultural development strategy in the city of Ljubljana 2020-2023 with guidelines until 2027	strategy	city	• indirect impact • relevant for AP (BAU scenario) • relevant for individual measures, but nor directly included in B-2	• A considerable portion of the infrastructure is protected as monuments and cannot withstand interventions that would facilitate the achievement of the 2030 goal New strategy in preparation, to support 2030 targets.
Sports strategy of the city of Ljubljana until 2028	strategy	city	• indirect impact • relevant for AP (BAU scenario) • relevant for individual measures (included in B-2)	• Lack of infrastructure (i.e. not enough suitable sport objects). Many existing objects are not energy efficient. • New strategy from 2028 onwards will allow for improvements aimed at supporting the ambitions of climate neutrality by 2030.
The rural development and urban agriculture strategy 2021-2027	strategy	city	• indirect impact	• Time constraints for implementation.
The programme for protection against	action plan	city	• indirect impact	• Implementation of this program is

natural and other disasters				demanding and time-consuming, especially considering the nature of the program.
Resolution: our food, rural areas and natural resources after 2021	strategy	national	• indirect impact	• Based on different strategies (could be hard to direct activities).
Slovenia's sustainable smart specialization strategy (S5)	strategy	national	• indirect impact	• Sets out national strategic development priorities and niches that are supported on the ground by a comprehensive, focused, and tailored policy mix – implementation risk considering 2030 target.
The taxonomy regulation (EU 2020/852)	regulation	EU	• indirect impact	• Risk: time perspective on the operation of the mechanism in light of the 2030 goal.
The just transition mechanism (JTM)	action plan	EU	• Indirect impact	• /

DETAILED DESCRIPTION OF CURRENT POLIES AND STRATEGIES

CITY LEVEL

THE LJUBLJANA VISION BY 2045

(Strategy & guidelines for sustainable urban development)

The strategy entitled "The Vision of Ljubljana by 2045" outlines extremely ambitious goals aimed at making Ljubljana a carbon-neutral city by 2045. Within this framework, we actively encourage our citizens, businesses, academic institutions, research organisations, non-governmental organisations, neighbouring cities/municipalities, and other stakeholders to participate and contribute to achieving the set goals.

The fundamental development principles that we are pursuing until 2045 are based on three main pillars:

- **Adaptability:** We are building on the city's ability to adapt to rapid changes and new challenges. This includes flexibility in urban planning, the use of advanced technologies and adaptation to climate change.

- **Innovation:** We promote continuous innovation in all areas, with a focus on sustainable solutions. Innovation should drive development and enable effective solutions to current challenges, particularly in the area of energy efficiency and renewable resources.
- **Visibility and reputation**: We want to create a strong visual identity and improve Ljubljana's reputation. This includes improving the visibility of efforts to reduce the carbon footprint and promoting sustainable practices locally and internationally.

We have included the following key elements in the vision as well as in the urban spatial plan and sectoral strategies:

- **Reducing energy consumption**: this includes activities to reduce energy consumption in buildings, transport and energy infrastructure. The aim is to achieve efficient energy management in order to reduce the environmental impact.
- **Increasing the share of renewable energy sources**: We are committed to a transition to energy sources with a lower carbon footprint and to increasing local production from renewable energy sources.
- **Protecting natural carbon sinks**: We actively endeavour to preserve and protect natural areas that serve as important carbon sinks and contribute to reducing the concentration of CO_2 in the atmosphere.
- **Maintaining food self-sufficiency and local water supply areas**: We emphasise the importance of ensuring sustainable food self-sufficiency and preserving areas that are important for local water supply.

Relevant actions/measures in section B-2: Mobility and transport, green infrastructure and nature-based solutions, built environment.

ENVIRONMENTAL PROTECTION PROGRAMME
(Action Plan for Environmental Protection)

The Environmental Protection Programme is the central strategic document of the City of Ljubljana, outlining the vision of Ljubljana as an ecologically successful capital city. Based on the environmental situation, the document defines strategic goals and describes in detail the measures necessary for sustainable management.

It serves as a clear guideline for spatial, economic and social development and at the same time lays the foundation for sustainable practices. The Environmental Protection Programme for the City of Ljubljana (2014-2020) was adopted by the Ljubljana City Council at its 36th meeting on 7 July 2014.

The primary objectives of the programme are:

- **Long-term safeguarding of water resources:**
  - Improving the quality of drinking water sources.
  - Achieving a long-term balance between abstraction and replenishment of groundwater.
  - Improving the ecological status of surface waters in the urban area of Ljubljana.
- **Conservation of the natural environment:**
  - Preservation and improvement of biodiversity.
  - Establishment of a comprehensive system for the efficient management of natural values and protected areas.
  - Creation of a comprehensive green system for the city and its efficient management.
- **Utilisation of available land for food production and local self-sufficiency:**

- Formulating a comprehensive approach to ensure local self-sufficiency.
- Increasing the amount and improving the quality of land available for agricultural production.
- Developing allotment networks and food production projects among citizens.
- Promoting the transition to organic food production.

- **Play an active role in linking and promoting sustainable practices in business, economy and urban living:**
  - Establish a monitoring system for the implementation of the environmental protection programme.
  - Involving and informing stakeholders and changing habits.
  - Creating a stimulating environment for the development and realisation of green jobs and eco-innovations.
  - acting as a role model through sustainable behaviour in the city administration, public companies, and public institutions.

Relevant actions/measures included in section B-2: All action areas.

LOCAL ENERGY CONCEPT THE CITY OF LJUBLJANA 2022-2030
(Strategy - Action Plan for Sustainable Energy)

The **Local Energy Concept (LEC)** of the City of Ljubljana for the period from 2022 to 2030 consists of a status analysis and an action plan. The LEC represents a development concept for the local community in terms of energy supply and utilisation. It includes measures for the efficient use of energy and the procurement of energy from renewable sources, combined heat and power, waste heat and other sources. The concept outlines spatial and economic development plans for the city, focussing on the development of local energy services, efficient energy use and conservation, the use of renewable energy sources and the improvement of air quality in the city. The document contains specific targets and measures to save energy and increase the energy efficiency of buildings owned by local authorities and housing associations.
It also includes **local plans for energy efficiency**, taking into account long-term strategies to encourage investment in building renovations and the possibility of efficient individual heating and cooling systems. Seven **main directions** have been formulated:

- Secure, competitive, and reliable energy supply and energy sources.
- Ensuring energy efficiency throughout the energy chain and for all energy sources (generation, distribution, storage, consumption).
- Energy independence or self-sufficiency of the city (vision by 2050).
- Decarbonisation of the entire energy chain within the city.
- Diversification of natural/renewable/waste resources.
- A city without energy poverty.
- Economic development of the city based on globally competitive production and services in the field of energy and environment.

The **strategic objectives** of the LEC are:

- Reduce CO_2 emissions by 40% by 2030 compared to 2008 levels.
- Achieve net-zero greenhouse gas emissions by 2050.

The specific target of reducing CO_2 emissions by 40% by 2030 compared to 2008 shows a strong commitment to reducing emissions within a specific timeframe. The measures envisaged in this action plan will close the remaining gap by 2030.

Relevant actions/measures included in section B-2: All fields of action.

STRATEGIC PLAN OF ENERGETIKA LJUBLJANA d.o.o. for the period 2022-2027
(Development strategy for the city's district heating and local gas network)

The strategic goals of Energetika Ljubljana are related to the realisation of its basic mission - the comprehensive energy supply of the entire Ljubljana city region. This includes reliable, environmentally friendly and cost-effective performance through the management of cogeneration, distribution and supply of heating and industrial steam, distribution and supply of natural gas, energy supply, provision of system services for the operation of the electricity transmission network and the provision of services related to the construction, operation and maintenance of heating systems.

In the past, Energetika Ljubljana relied almost exclusively on fossil fuels. In order to reduce the carbon footprint, the production sources must be decarbonised. This means that coal, which previously accounted for 95% of the energy used, will gradually be replaced by natural gas, woody biomass, and the use of fuels from mixed municipal waste. In addition to the decarbonisation of conventional production sources, the integration of decentralised renewable energy sources (e.g. solar power plants) and flexibility sources (e.g. batteries, electric charging stations, demand response, heat pumps, etc.) is essential. These will enable the company to actively engage in the market for ancillary services and flexibility. The company's **strategic goals** for the period from 2022 to 2027 are:

- Decarbonisation of production sources and district heating supply.
- Decarbonisation of the natural gas distribution system.
- Ensure high reliability in the operation of production sources and distribution networks for district heating and natural gas.
- Mitigating the decline in demand, developing, and increasing the utilisation of the district heating network.
- Developing and increasing the utilisation of the natural gas network by expanding its use in the transport sector.
- Generation and supply of green electricity.
- Provision of system services for the electricity grid.
- Supplying users, integrating products and services into new, customer-attractive packages, and thus offering a comprehensive energy service.

Relevant actions/measures are included in Section B-2: Energy Systems.

SUSTAINABE ENERGY CLIMATE PLAN 2022-2030
(SECAP)

The overall objective of SECAP is to foster the sustainable development of the cross-border territory by promoting low-carbon strategies for all types of territory, in particular urban areas, creating relevant adaptation and mitigation measures. The project will lead to the cross-border sharing of tools, methodologies and databases and will generate positive effects on local planning in the whole programme area. The transition to a low-carbon society will be implemented in the infrastructure interventions of two (case) project partners and in the evolution of SEAPs into SECAPs for some municipalities/ITUs/metropolitan cities. The sustainable development models of the Covenant of Mayors will therefore be promoted by improving the quality of life and resilience to climate change.

Relevant actions/measures included in section B-2: All fields of action.

STRATEGY PLAN OF THE PUBLIC COMPANY LJUBLJANSKI POTNIŠKI PROMET, d.o.o. for the period 2022 - 2027
(Strategy for public road transport)

The strategic goals include expanding bus lines, increasing the number of buses, promoting lanes reserved for buses, improving the network of ticket vending machines, taking into account special needs, integrating into national public transport, ensuring user awareness through technology, participating in international projects and maximising environmental protection.
The company's **strategic objectives** for the period 2022 - 2027 are:

- Core activity - passenger transport services.
- Maintenance, servicing and reconditioning of commercial vehicles.
- Technical inspections.
- Protection of the environment.
- Occupational health and safety.
- The company's ongoing objectives for the period from 2022 to 2027 are to
- Provide reliable and high-quality services.
- Improve user satisfaction with our services.
- Focus on employee care through better working conditions.
- Expanding the route network and attracting new passengers.
- Commitment to environmental protection.
- Our primary goal remains to offer the best services to all citizens. Therefore, the continuous improvement of service quality in all areas of work and the optimal organisation and control of work processes while maintaining cost efficiency remain the company's guiding principles.

The company's strategic orientations include:

- Expanding the range of routes and maintaining its position as a leading and high-quality public bus company in the Republic of Slovenia.
- Expansion of public transport activities in the Central Slovenia region, particularly in connection with the construction of P & R centres, as envisaged in RRA Plan LUR 37.
- Increase the number of buses to 300.
- Collaboration with decision-makers to establish "yellow lanes" on main roads leading to Ljubljana and widen existing lanes. This initiative aims to increase the average travelling speed, improve passenger satisfaction, and increase transport capacity.
- Expand the network of Urbanomat terminals in conjunction with the planned P & R centres.
- Adaptation of services for users with special needs (elderly people, people with disabilities, parents with children).
- Active participation in the implementation of an integrated public transport system in Slovenia.
- Maintaining market share in technical vehicle inspections and registrations in COL, commercial vehicle maintenance and tachograph inspections and repairs.
- Ensuring a high level of user awareness using new technologies (Internet, SMS, smartphones, displays, mobile applications).
- Participation in international development projects.
- Ensuring maximum protection of the environment.
- Preventing injuries in the workplace as the primary objective of ensuring occupational safety.
- Renovation of the Urbana system and addition of new functionalities.

- Strengthening employee loyalty to the company, the JHL Group and COL through appropriate motivation.

Relevant actions/measures are included in Section B-2: Mobility and Transport.

SUSTAINABLE URBAN MOBILITY PLAN FOR THE CITY OF LJUBLJANA
(Action Plan - SUMP)

The strategy aims to replace the current transport system with more sustainable and environmentally friendly modes of transport. It emphasises long-term planning and includes a green urban policy, the strategic integration of electromobility and specific action plans to change travel habits that promote public transport, cycling, walking and active mobility. The strategy addresses the impact of transport on various aspects of urban development and prioritises sustainability, mobility, and accessibility to achieve climate neutrality. Sustainable mobility promotes a higher quality of life, green urban spaces and social inclusion. The vision prioritises sustainable transport and active mobility and promotes local living and social equity.

In order to achieve the targets, set by the European Union to reduce greenhouse gas emissions by 30% by 2030 compared to 2008 levels, transport must be comprehensively planned. Sustainable mobility is therefore a crucial prerequisite for connecting people and ensuring access to goods in such a way that the environment can be sustainably protected and favourable living conditions can be maintained in the long term.

- In 2012, we adopted the **City of Ljubljana's Sustainable Urban Mobility Plan**, which focuses on limiting motorised private transport and changing people's travel habits to more sustainable ways - walking, cycling or public transport - and on distributing mobility in such a way that one third of journeys are made by public transport, one third on foot or by bicycle and one third by private vehicle.
- In 2017, we **updated the plan for sustainable urban mobility** from 2012. We redefined the goal for an even better quality of life in Ljubljana in cooperation with various stakeholders and on the basis of our achievements to date. We have committed to making two thirds of journeys in a sustainable way by 2027 - on foot, by bike and by public transport.

The comprehensive transport strategy builds on the City of Ljubljana's previous efforts to promote sustainable mobility. It includes continuous spatial planning based on various already adopted documents (e.g. the City Spatial Plan, etc.).

The fact that modern transport planning prioritises the mobility of people over vehicle traffic is widely accepted, which also changes the perspective of spatial planning. Sustainable mobility means choosing modes of transport that are spatially, financially, and environmentally more efficient, healthier, safer and contribute to a higher quality of life. The City of Ljubljana is constantly endeavouring to promote walking, cycling and the use of public transport, while at the same time reducing the number of car journeys. The comprehensive transport strategy is a continuation of these efforts and emphasises the mobility of people rather than vehicles. On this basis, four main pillars of sustainable mobility have been established, followed by 21 individual strategic objectives.

Corresponding actions/measures are included in Section B-2: Mobility and transport.

SPATIAL PLAN OF THE CITY OF LJUBLJANA (2022)
(Plan for the spatial development of the city)

The main objective of the Spatial Development Plan of the City of Ljubljana is to develop a vision and strategy for the development of the city in the next fifteen to twenty years that will enable the harmonious spatial development of the city. During this period, it is crucial to:

- Upgrade the already built-up areas to a high standard.
- Eliminate scattered construction or other underutilised areas.
- Building a resilient city through climate change mitigation and adaptation measures, as well as measures to rehabilitate buildings and areas that jeopardise people's health.
- Sustainable settlement expansion, with the construction of buildings outside designated areas only permitted in exceptional cases necessary for the development of the city.
- Promoting sustainable land use by taking into account the principles of rational land use, a long-term secure natural drinking water supply, efficient energy use, the promotion of sustainable mobility and the use of public transport, the preservation of green spaces, the implementation of nature-based solutions and the promotion of local self-sufficiency in all spatial reorganisations and redevelopments of existing urban areas.

Relevant actions/measures included in section B-2: All fields of action

STRATEGY FOR THE DEVELOPMENT OF LJUBLJANA'S URBAN FORESTS 2020-2025
(Strategy for urban forestry)

The Strategy for the Development of Ljubljana's Urban Forests defines the vision and long-term priorities for the comprehensive development of Ljubljana's urban forests. The strategy serves as a basis for the management of urban forests in order to ensure a high-quality living environment for residents. It expresses the interest of the local population in the city's forests and their immediate surroundings and at the same time contributes to responsible forest management planning. The strategy initiated by the City of Ljubljana was developed as part of the Interreg project URBforDAN for the area of Ljubljana's urban forests, which includes those forests that are designated as forests with clearly emphasised social functions according to the urban spatial plan.

The aim of the strategy is to encourage various institutions, non-governmental organisations and individuals to actively participate in the decision-making processes for the development of Ljubljana's urban forests. It also aims to raise awareness of the importance of these forests, improve the basis for forest management and strengthen the social and ecological functions of Ljubljana's urban forests. The strategy is in line with current legislation and takes into account the objectives for the development of forests and green areas set out in other spatial and sectoral plans and guidelines. The preparation of the strategy was led by the City of Ljubljana - Department of Economic Activities and Transport - and the Slovenian Forest Institute. Numerous experts from administrative and research institutions as well as consulting companies contributed to the development of the strategy. The strategy outlines seven priorities for the management of urban forests in Ljubljana:

- Ensuring a healthy living environment.
- Providing opportunities for leisure activities, recreation, and promotion of sustainable tourism.
- Creating opportunities for education and lifelong learning.
- Preserving nature and cultural heritage.
- Creating a supportive environment for forest owners.
- Promoting circular economy practices.
- Developing comprehensive management.

Based on the strategy, operational plans will be prepared for specific areas within the urban forests of Ljubljana. These plans detail the implementation of activities related to the use of forests for leisure and recreation, including the development of infrastructure, visitor management systems, the establishment of urban infrastructure, communication with forest owners and visitors, as well as awareness raising, education and stakeholder involvement.

Relevant actions/measures are included in Section B-2: Green infrastructure and nature-based solutions.

DIGITAL DEVELOPMENT STRATEGY OF THE CITY OF LJUBLJANA 2023-2030
(Strategy for digital development)

The strategy aims to use modern digital solutions to overcome challenges, improve city services and optimise the interaction between the city administration and its citizens. This approach aims to simplify and speed up the management of urban processes, improve efficiency and promote collaboration with businesses and academia, while ensuring the security and utility of data for the benefit of citizens.

Digital development will contribute to greater carbon neutrality and economic progress in the city. Through the targeted use of digital solutions, the City of Ljubljana will drive the implementation of various urban strategies, with a focus on climate neutrality.

Relevant actions/measures in section B-2: All action areas.

STRATEGY FOR A CIRCULAR CITY BY 2045
(Strategy for the circular economy)

The aim of the document is to support Ljubljana on its path towards a circular economy by involving the widest possible range of stakeholders, their existing practices, innovation potentials and specific initiatives.

The basic idea of a circular economy is to preserve value in the production and consumption cycle for as long as possible. In contrast to a linear economy, in which the "take-make-dispose" model is applied, the value chains in a circular economy are geared towards getting the most out of resources, with a focus on careful and rational use. The new circular economy models revolve around reuse, repair, refurbishment and sharing, maximising the efficiency of (re)used resources, supported by the right design and manufacturing of services and products, as well as circular processes in production and consumption. This means a transition from waste management to resource management, with the ultimate goal being "zero waste". The City of Ljubljana acts within planetary boundaries and strives for the well-being of all people by integrating economic, environmental, and social aspects.

The document covers three levels:

- Overarching vision of the city until 2045 - consistency of all COL strategic documents and their compatibility with EU and national legislation in order to achieve optimal synergies and effective performance.
- Strategic guidelines that include circular principles - link to the city's code for sustainable and circular urban management.

- Concrete activities in the 2027 perspective and guidance to monitor their implementation - an open process that allows the involvement of different actors to create closed loops for selected areas.

The circular economy is a horizontal content, and its principles are to be integrated into all sectoral strategies.

Relevant actions/measures in section B-2: All fields of action.

SUSTAINABLE URBAN DEVELOPMENT STRATEGY OF THE CITY OF LJUBLJANA 2023-2027

(Urban development strategy)

The strategy includes an implementation plan for other investments/projects contributing to the comprehensive city development approach. In the operative sense, with the indication of key project. Priority projects and measures are the ones with a higher chance of implementation in the program period. This means their execution has already been confirmed in the budget of the City of Ljubljana and project documentation has already been prepared or the construction permits for the implementation have already been obtained.

Strategic development goals of the City of Ljubljana wish to preserve the already recognised quality of life in the city and strengthen necessary development activities appropriate for the times we are living in. The City of Ljubljana is also aware of its responsibility as the most important urban centre in the country, and at the same time, its competences, and capacities.

The Sustainable Urban Strategy of the City of Ljubljana and the Implementation Plan for the Sustainable Urban Strategy of the City of Ljubljana are development documents which the City of Ljubljana also needs to absorb EU funds, primarily to absorb funds within the Comprehensive Territorial Investment mechanism.

Relevant actions/measures in section B-2: All fields of action.

THE RURAL DEVELOPMENT AND URBAN AGRICULTURE STRATEGY

(Strategy for rural development and agriculture)

The Rural Development and Urban Agriculture Strategy of the City of Ljubljana for the period 2021-2027 defines the vision, objectives, measures, and activities for the development of rural areas and urban agriculture from 2021 to 2027.

Main goals of the strategy are:

- Ensuring adequate conditions for quality food production and achieving a higher level of self-sufficiency.
- Well-connected rural providers and rural offerings.
- Informed and responsible citizens who actively support a well-recognized rural area.
- Vital, attractive, and promising rural area with preserved identity.

During the formulation of the objectives, several external factors were identified, the future development of which can significantly affect both the efficiency and the success of pursuing the above-defined objectives. Therefore, in addition to the presented objectives, the Rural

Development and Urban Agriculture Strategy of the City of Ljubljana for the period 2021-2027 also addresses the following cross-cutting themes:
a) Adaptation to climate change.
b) Preserved and sustainably managed natural resources.
c) Enhanced social capital.

Relevant actions/measures in section B-2: Nature based solutions.

STRATEGY FOR THE DEVELOPMENT OF LJUBLJANA AS A TOURIST DESTINATION AND THE LJUBLJANA REGION 2021-2027
(Strategy for the development of tourism in the city)

The strategy builds on the findings that Ljubljana achieved enviable development results in the previous strategy period. Therefore, it makes sense to continue building on the foundations, such as ensuring coexistence between the local population and tourists, spreading the tourist offer beyond the narrow city centre, adhering to sustainability principles and developing tourist offers that lead to increased visitor spending.

With the new strategy, Tourism Ljubljana aims to position the Slovenian capital as a leading and most creative urban destination for a sustainable lifestyle worldwide. The new strategy introduces a number of substantive innovations aimed at creating innovative tourist experiences and attractions, extending the average length of stay in the destination, increasing daily tourist spending and connecting tourism with other important sectors.

The qualitative objectives focus on the satisfaction of locals and tourists, the development and diversification of the tourism offer outside the city centre, the improvement of accessibility and sustainable mobility, international recognition and awards and the development of an internationally recognised brand.

According to the strategy, the tourism sector must become a more important partner in urban planning. Improving accessibility, especially by improving rail connections and rail infrastructure, must be a priority for the city government, with strong support from the national government.

At the same time, sustainable mobility within the destination must be further promoted, especially in the areas of public transport, cycling, green transport, park-and-ride schemes, bus mobility, etc. To avoid overcrowding in the city centre, the development of new tourism products must take place in less developed and less upgraded areas of the city.

Relevant actions/measures are included in Section B-2: Green infrastructure and nature-based solutions.

CULTURAL DEVELOPMENT STRATEGY IN THE CITY OF LJUBLJANA 2020-2023 WITH GUIDELINES UNTIL 2027
(Strategy for cultural development)

The cultural development strategy, the fourth in a row, addresses the most important challenges facing society.

We began drafting the strategy in collaboration with public institutions, non-governmental organisations and individuals before the coronavirus outbreak and completed it when this new reality had already had a major impact on the cultural sector. In addition to the general priority tasks

and objectives, the document includes a chapter on culture in times of crisis. The preparation of the document was also strongly influenced by Ljubljana's bid for the title of European Capital of Culture 2025.

The new cultural strategy contains a number of substantive innovations that conceptually establish a new paradigm for Ljubljana's cultural policy. It is based on the conclusion that cultural policy is truly progressive when it is able to adapt and meet the challenges of the cultural and creative sectors and society as a whole.

Among the substantive innovations that we are introducing in the area of culture by the end of 2023 in line with the strategy, we emphasise the following:

- Stronger international orientation with the aim of positioning Ljubljana more strongly as a globally recognised city that offers its citizens and all visitors cultural and artistic programmes of the highest quality.
- Increased cultural co-operation with the municipalities within the Ljubljana city region with the aim of creating new audiences, a new regional cultural identity, lasting connections between cultural professionals and the mobility of artists.
- Expansion of the network of artist residencies for domestic and foreign artists.
- Support for participatory cultural projects and programmes that strengthen social cohesion and the inclusion of members of disadvantaged groups in social life.
- Support for community projects proposed by the residents of Ljubljana to improve the quality of life in their local environment.
- Establishing a system that enables the inclusion of the so-called "artistic share" in investment projects of the City of Ljubljana.

The strategy aims to organise sustainable cultural events, raise awareness, promote the reuse of materials, and educate residents about animal and nature conservation and the importance of biodiversity in the city.

Relevant actions/measures in section B-2: All fields of action.

SPORTS STRATEGY OF THE CITY OF LJUBLJANA UNTIL 2028
(Strategy for sport)

The City of Ljubljana Sports Strategy until 2028 defines the mission of the City of Ljubljana, which together with the sports development programme providers (i.e. the Public Institute Sport Ljubljana, the Ljubljana Sports Association, other sports associations, sports clubs, primary and secondary schools, the university, and other providers) fulfils the public interest in the field of sports.

The strategy therefore emphasises sustainability, accessibility, competent staff, and fairness. It aims to increase sports participation among residents, from children to senior citizens, and to improve sports facilities.

In terms of sustainability and the city's climate goals, the strategy aims to minimise waste at sporting events. Participants can use free public buses to get to the city centre or park for free in designated areas. Waste separation and recycling bins are available and ensure efficient use of resources. Key sports infrastructure developments have been designed with carbon neutrality in mind and focus on environmentally friendly design and energy efficient practices.

Relevant actions/measures in section B-2: All fields of action

THE PROGRAMME FOR PROTECTION AGAINST NATURAL AND OTHER DISASTERS
(Programme for protection against natural disasters)

Protection against natural and other disasters is one of the fundamental original competencies of local communities. This is particularly important for the City of Ljubljana. On one hand, there are hazards: the area of the City of Ljubljana is threatened by fires, floods, landslides, storms, accidents involving hazardous substances, air pollution, major traffic accidents, earthquakes, and other hazards, including climate change. On the other hand, there are social characteristics, referred to as vulnerability elements in relation to disasters: Ljubljana is the capital and largest city, the city of numerous institutions, the city with the largest population, the intersection of the Slovenian traffic hub, the city with many cultural, historical, and other important objects and activities taking place in them. Due to all vulnerability elements, each disaster in the City of Ljubljana has a much greater social impact than it would elsewhere in Slovenia, as disasters have social consequences that exceed the direct physical consequences of the disaster in a highly structured, complex urban environment with a multitude of critical services. This especially refers to interruptions in the supply of services important for both residents and organizations: electricity, water, sewage disposal, waste collection, telecommunications, information technologies, public and other transportation, payment network, supply of food and other products, health and social care, etc.

The program follows the overarching objective of protecting against natural and other disasters in our community, which is to reduce the number of accidents and prevent or mitigate their consequences, thus making life safer and of higher quality. It is oriented towards prevention, which is more effective and also cheaper in the long run than other forms of protection against natural and other disasters. Because it is not possible to eliminate or sufficiently mitigate all hazards that cause accidents, the program equally addresses all forms of protection against natural and other disasters, which enable prompt and effective action in case of accidents, namely protection, rescue, and assistance, as well as ensuring basic living conditions.

Relevant actions/measures in section B-2: Natural based solutions.

ZERO WAST STRATEGY
(Zero waste strategy)

Ljubljana’s Zero Waste Strategy embraces EU waste management best practices by prioritising waste prevention. The Slovenian capital's exemplary approach to managing urban waste and developing a local circular economy is multi-pronged. Such a strategy facilitates recycling and reuse, improves the separation and treatment of waste, and encourages citizens and businesses to reduce the amount of waste they generate in the first place. This is a remarkable achievement, accomplished over the past decade, in which policymakers, businesses and citizens have worked together to create a more sustainable urban environment. As part of its commitment to zero waste, the city aims to halve its amount of residual waste and to improve its recycling rate to 78 per cent by 2025.

Relevant actions/measures in section B-2: Waste and circular economy.

REGIONAL LEVEL

REGIONAL DEVELOPMENT PROGRAMME OF THE LJUBLJANA URBAN REGION 2021-2027
(Strategy for regional development)

The programme is the basic regional-level strategic and programming document for coordinating the development objectives within the region. It outlines the instruments and resources for the realisation of those objectives. It comprises a strategic and a programming section. The strategic section contains an analysis of regional development potentials, a definition of the region's key development obstacles and strengths and of its development objectives, vision and priorities over the programming period, and a definition of the region's development specialisation. The programming part contains programmes for stimulating development within the region, with a timetabled and financial evaluation of those programmes, and sets out a system for monitoring, evaluating, and organising the implementation of the Regional Development Programme (RDP).

The key challenges facing the region are high daily commuting levels, which are the result of the marked centralisation of services within its centre, the negative impacts of traffic (e.g. pollution, noise, accidents, traffic congestion), a large share of young jobseekers and the departure of the educated workforce from the region. It has been estimated that investment is needed in the construction of water supply infrastructure in almost half the 25 municipalities that make up the LUR; there is also a considerable need for investment in wastewater drainage and treatment in agglomerations generating a load of less than 2,000 p.e. The region is also home to a large number of flood-risk areas, which places something of a restriction on development. In national terms, Ljubljana is among those areas at highest risk of flooding, with 15 of the 25 municipalities within the LUR having high flood-risk levels.

Relevant actions/measures in section B-2: All fields of action.

PLAN FOR SUSTAINABLE URBAN MOBILITY IN THE LJUBLJANA CITY REGION *(Action Plan - SUMP)*

The Ljubljana Urban Region (LUR) comprises 26 municipalities in central Slovenia and is the region with the greatest potential for knowledge and creativity: important national, scientific, research, educational and cultural institutions are concentrated here. It is also home to numerous companies that employ a large number of people and generate more than a third of Slovenia's gross domestic product. The Ljubljana Urban Region (LUR) strategy is an innovative, sustainable approach that aims to reduce car use, promote public transport and improve the quality of life in the Ljubljana urban region.

The strategy plays a crucial role in efforts to achieve climate neutrality. By focusing on sustainable mobility and reducing greenhouse gas emissions through measures such as the promotion of walking, cycling, public transport and low-emission vehicles, it addresses the challenges of urban transport and ultimately supports the climate neutrality goals.

Corresponding actions/measures are included in Section B-2: Mobility and transport.

NATIONAL LEVEL

NATIONAL ENERGY AND CLIMATE PLAN OF THE REPUBLIC OF SLOVENIA (NECP) *(National SECAP – 2023 revision proposal)*

The action plan has been coordinated with the National Climate Strategy and sets out the most important measures and targets up to 2030 in five defined areas: decarbonisation, energy efficiency, energy security, the internal energy market, research and development and competitiveness.

The Comprehensive National Energy and Climate Plan (NECP) is Slovenia's guiding document and an important step towards a climate-neutral Slovenia and the European Union (EU) by 2050. It outlines Slovenia's energy and climate targets, policies, and measures to achieve these targets by 2030 and by 2040.

The NECP's objectives are supported by a comprehensive environmental impact assessment (EIA), which is a formal part of the NECP preparation process. In addition to assessing the environmental impacts, the EIA allows for broad stakeholder participation (ministries, organisations, NGOs, sectors, interested individuals) to determine the appropriate way for Slovenia to achieve the objectives. The EIA process continues through public consultations and definitions and leaves room for additional considerations within the NECP proposal and the Environmental Report.

The most ambitious goal of the NECP is to improve energy and resource efficiency across all sectors, thereby reducing the consumption of energy and natural resources - a first and crucial step towards a climate-neutral society. This has a significant impact on other areas (decarbonisation, energy security, the internal energy market, research, and innovation).

Slovenia aims to increase energy efficiency by 35% compared to the base year 2007. Fulfilment of the NECP targets will lead to less dependence on fossil fuels and increased reuse. The NECP is also committed to sustainable solutions in the areas of transport (sustainable public transport), buildings (heating, cooling, major renovation) and industry (ongoing competitiveness). Currently, transport accounts for over 50% of emissions in Slovenia (outside the EU Emissions Trading Scheme).

Through an active national approach and co-operation, we can ensure that energy costs do not become an even greater burden. At the same time, we are making an important contribution to decentralised and local electricity generation by empowering users to opt for better solutions and become active participants - which requires adequate support from the state. Sustainable solutions such as the introduction of heat pumps and the construction of solar power plants are already demonstrating their cost-effectiveness in the medium term and offer significant environmental benefits in the long term, thereby fulfilling our responsibility to future generations.

Ljubljana's alignment with national strategies such as the NECP ensures a coherent and concerted effort to achieve emission reduction and climate targets by 2030. By harmonising local actions with overarching national targets, the city can effectively contribute to Slovenia's wider efforts to transition to a more sustainable and climate-resilient future.

Relevant actions/measures in section B-2: Energy systems, mobility, and transport, built environment.

SLOVENIA'S LONG-TERM CLIMATE STRATEGY 2050
(National climate strategy)

The document outlines Slovenia's commitment to achieving climate neutrality by 2050, aligning with EU regulations and the Paris Agreement. It emphasizes the importance of immediate action across all sectors to reduce greenhouse gas emissions and transition to a low-carbon society, upgrade existing policies, and halt practices contrary to emission reduction goals. The strategy is built on principles of sustainability, inclusiveness, and scientific findings, aiming for a climate-resilient society based on energy efficiency, renewable sources, and a circular economy. Key

focuses include enhancing biodiversity as a climate action strategy, integrating climate policy across sectors, and fostering innovations for a sustainable transition. This comprehensive approach underlines the necessity of multi-level cooperation, from local to international, ensuring that Slovenia's actions contribute effectively to global climate goals. This strategy is aligned with the European Green Deal, including the Just Transition Mechanism. The principle of a just transition is crucial to ensure that the move towards climate neutrality leaves no one behind and supports those most affected.

Relevant actions/measures in section B-2: All fields of action.

ACTION PLAN FOR REDUCING ENERGY POVERTY FOR PERIOD OF 3 YEARS
(Action plan for reducing energy poverty)

Action Plan for Reducing Energy Poverty for a Three-Year Period outlines a comprehensive strategy aimed at mitigating energy poverty within Slovenia. It establishes a framework for targeted interventions, financial measures, and collaborative efforts across sectors to enhance energy efficiency and promote the use of renewable energy sources among the energy-poor households. The plan prioritizes the mobilization of approximately €55 million from 2021 to 2027, focusing on the most affected regions to alleviate the socio-economic consequences of energy poverty. By fostering innovations, providing financial incentives, and offering technical support, the plan seeks to ensure an inclusive transition to a more sustainable, low-carbon economy, ensuring that no one is left behind. The approach is designed to integrate seamlessly with existing national energy and climate strategies, reinforcing Slovenia's commitment to energy security, sustainability, and social equity**.**

Relevant actions/measures in section B-2: Energy systems.

LONG-TERM STRATEGY TO PROMOTE THE ENERGY-EFFICIENT REFURBISHMENT OF BUILDINGS
(National strategy for energy renovation of buildings)

The long-term strategy to promote the energy renovation of buildings, in accordance with Directive 2012/27/EU on energy efficiency, mandates Member States to develop a strategy to promote investment in the renovation of the national building stock, covering both public and private residential and commercial buildings. Slovenia has adopted this long-term strategy in accordance with Article 348 of the Energy Act (EZ-1) and has laid down specific provisions:
Identification of bodies responsible for energy renovations in the public sector.

- Assessment of building areas owned and used by public organisations.
- Determination of the share of refurbishment in the total usable area of buildings in the public sector.
- Review of the national building stock on the basis of statistical samples.
- Define cost-effective renovation approaches for different types of buildings, taking into account their category, location and climate zone.
- Develop strategies and measures to promote cost-effective comprehensive building renovation.
- Initiatives to guide investment decisions by private individuals, construction companies and financial institutions.
- Assessment of expected energy savings and overall benefits.

This strategy focuses in particular on buildings in the narrower public sector and requires an annual renovation of 3% of their total useful floor area from 1 January 2014 to ensure that they meet at least the minimum energy efficiency requirements set out in Directive 2010/31/EU.

It must comply with all associated programmes and action plans, be updated every three years, and provide for comprehensive building renovation, taking into account the structure, including the building envelope, equipment, operation and maintenance. Buildings with the lowest energy efficiency are prioritised for renovation where technically and economically feasible.

The strategy pays particular attention to culturally protected buildings, with the exception of buildings used for national defence, excluding individual residential or commercial premises, and ritual or religious purposes. Slovenia aims to significantly improve the energy efficiency of its building stock and sees this strategy as the basis for the implementation of the Operational Programme for the Implementation of the European Cohesion Policy for 2014-2020. The targets are described for the crucial years 2020 or 2023 (the final year of the OP ECP) and 2030, assessing energy savings, required public funding and job creation. For 2050, only the expected energy savings are estimated.

The long-term strategy to promote the energy renovation of buildings directly supports Ljubljana's emission reduction targets by prioritising the improvement of energy efficiency in the building sector. Through mandatory renovations, targeted improvements and integration into national and European programmes, this strategy contributes significantly to the city's wider efforts to reduce energy consumption and emissions from buildings.

Relevant actions/measures are included in Section B-2: Energy Efficiency.

ACTION PLAN FOR NEARLY ZERO-ENERGY BUILDINGS
(National Action Plan for Nearly Zero-Energy Buildings - SEAP)

The action plan for nearly zero-energy buildings stipulates that all new buildings must fulfil the criteria for nearly zero energy. This mandate, taken from Directive 2010/31/EU, outlines the technical definition of such buildings and prescribes the obligation to introduce them in Slovenia. The law requires the government to adopt and renew an action plan for nearly zero-energy buildings every three years, outlining the targets, programmes and measures to achieve these goals, with a focus on public buildings.

The directive stipulates that all new buildings constructed after 31 December 2020 must be nearly zero-energy buildings, with public buildings having to meet this standard two years earlier. To comply with the directive, member states must draw up national plans to increase the number of nearly zero-energy buildings and adopt policies to promote the conversion of renovated buildings into nearly zero-energy buildings. Slovenia has carried out cost-optimal analyses for energy efficiency requirements, which form the basis for the definition of nearly zero-energy buildings.

The technical definition of such buildings sets specific criteria that limit the energy demand for heating, cooling, hot water, and lighting in accordance with building legislation (PURES 2010), including the maximum primary energy consumption and the minimum share of renewable energy in the total energy supply of the building. The planned reduction in heating requirements for buildings from 48 kWh/m2a to 25 kWh/m2a is in line with the transition to nearly zero-energy structures.

This action plan already applies to all new buildings and thus contributes to Ljubljana's emission reduction targets.

Corresponding actions/measures are included in Section B-2: Energy Efficiency.

EU-LEVEL

EUROPEAN GREEN DEAL
(Strategy & regulation)

The European Green Deal is a package of policy initiatives, which aims to set the EU on the path to a green transition, with the ultimate goal of reaching climate neutrality by 2050.

It supports the transformation of the EU into a fair and prosperous society with a modern and competitive economy.

It underlines the need for a holistic and cross-sectoral approach in which all relevant policy areas contribute to the ultimate climate-related goal. The package includes initiatives covering the climate, the environment, energy, transport, industry, agriculture, and sustainable finance – all of which are strongly interlinked.

The European climate law regulation turns the political ambition of reaching climate neutrality by 2050 into a legal obligation for the EU.

By adopting it, the EU and its member states committed to cutting net greenhouse gas emissions in the EU by at least 55% by 2030, compared to 1990 levels. This target is legally binding and based on an impact assessment carried out by the Commission.

Relevant actions/measures are included in Section B-2: All fields of action.

ENERGY EFFICIENCY DIRECTIVE
(EU Regulation)

Energy efficiency contributes to reducing overall energy consumption and is therefore central to achieving the EU's climate change objectives, while improving current and future energy security and affordability. To ensure that the EU's 2030 target of reducing greenhouse gas emissions by at least 55% (compared to 1990) can be achieved, the Commission has revised the Energy Efficiency Directive together with other energy and climate legislation.

The revised Directive for 2023 raises the EU energy efficiency target so that EU countries are obliged to collectively ensure an additional 11.7% reduction in energy consumption by 2030 compared to the 2020 reference scenario projections. As a result, the EU's total energy consumption should not exceed 992.5 million tonnes of oil equivalent (Mtoe) for primary energy and 763 Mtoe for final energy by 2030.

Under the updated rules, EU countries have agreed to contribute to the EU target by setting indicative national contributions based on a combination of objective criteria reflecting national circumstances (energy intensity, GDP per capita, energy saving potential and reduction in fixed energy consumption). The Directive also includes an improved "gap-filler" mechanism that is triggered when countries fall behind in making their national contributions.

This new target underlines the EU's increased ambition in the area of energy efficiency and exceeds the 9% target proposed by the Commission in July 2021 as part of the Fit for 55 package and goes even further than the existing 2030 target set in 2018. Under the revised directive and as part of their energy efficiency commitments, EU countries will have to achieve an average annual energy savings rate of 1.49% from 2024 to 2030, up from 0.8% in the 2021-2023 period, to achieve energy savings in critical sectors such as buildings, industry and transport. To emphasise the exemplary role of the public sector, there is also a new annual energy savings target of 1.9% for the entire public sector, and the 3% annual building renovation obligation will be extended to all levels of public administration.

Relevant actions/measures are included in Section B-2: Energy systems.

EU HYDROGEN STRATEGY
(EU Strategy)

The EU Hydrogen Strategy (COM/2020/301) was adopted in 2020 and proposed policy measures in five areas: Investment promotion, promotion of production and demand, creation of a hydrogen market and infrastructure, research and cooperation, and international cooperation.

The full list of 20 key actions was implemented by the first quarter of 2022. Hydrogen is also an important part of the EU's energy system integration strategy.

While the direct impact of the EU Hydrogen Strategy on Ljubljana's emission reduction targets may vary depending on the city's specific implementation plans and the deployment of hydrogen technologies, the integration of hydrogen into the energy mix (which is included in this action plan) offers opportunities for the transition to cleaner energy sources and thus already contributes to the city's 2030 emission reduction targets.

Relevant actions/measures are included in Section B-2: Energy systems.

EU's FIT-FOR-55
(EU Strategy)

Fit for 55 package refers to the EU's target of reducing net greenhouse gas emissions by at least 55% by 2030 and to make EU climate-neutral by 2050. The package of proposals aims at providing a coherent and balanced framework for reaching the EU's climate objectives, which:

- ensures a just and socially fair transition,
- maintains and strengthens innovation and competitiveness of EU industry while ensuring a level playing field vis-à-vis third country economic operators,
- underpins the EU's position as leading the way in the global fight against climate change.

Relevant actions/measures are included in Section B-2: All fields of action.

RePowerEU POLICY
(EU Policy)

The policy emphasizes a multi-faceted approach to reducing EU dependency on Russian fossil fuels, highlighting the significance of diversifying energy sources, enhancing energy efficiency, and boosting renewable energy production and use. It sets ambitious targets for renewable hydrogen and biomethane, highlighting the need for substantial investments in new technologies and

infrastructure, and the importance of sector-wide changes towards cleaner energy alternatives. This policy's objectives directly support the assignment's goals to enhance energy security, promote a green transition, and build resilience against supply disruptions.

Relevant actions/measures are included in Section B-2: Energy systems.

THE JUST TRANSITION MECHANISM (JTM)
(EU mechanism)

An EU mechanism designed to support regions and industries that heavily rely on fossil fuels and high-carbon activities in their transition towards a more sustainable, low-carbon economy. It provides targeted support to help mobilize about €55 billion over the period 2021–2027 in the most affected regions to mitigate the socio-economic impacts of the transition. It focuses on alleviating the social and economic impacts of this transition by providing targeted financial support, investments, and technical assistance. This mechanism strives to ensure that no one is left behind during the shift to a green economy, supporting affected workers, communities, and businesses.

Relevant actions/measures are included in Section B-2: All fields of action.

THE TECHNICAL GUIDANCE ON CLIMATE PROOFING OF INFRASTRUCTURE
(EU Technical guidance)

The Technical Guidance on Climate Proofing of Infrastructure (2021/C 373/01) provides technical guidance on the climate proofing of investments in infrastructure covering the programming period 2021-2027. It is consistent with the Paris Agreement and EU climate objectives, which means it is consistent with a credible greenhouse gas (GHG) emission reduction pathway in line with the EU's new climate targets for 2030 and climate neutrality by 2050, as well as with climate-resilient development. It follows the principle "energy efficiency first", which is defined in Article 2(18) of Regulation EU 2018/1999 and it follows the principle "do no significant harm" (DNSH).

Relevant actions/measures are included in Section B-2: All fields of action.

THE TAXONOMY REGULATION
(EU Regulation)

It is a framework to classify economic activities according to their contribution to six environmental objectives, namely:

- climate change mitigation,
- climate change adaptation,
- sustainable use and protection of water and marine resources,
- transition to a circular economy,
- pollution prevention and control,
- protection and restoration of biodiversity and ecosystems.

Relevant actions/measures are included in Section B-2: All fields of action.

EMISSIONS GAP AND RESIDUAL EMISSIONS

To report the city´s emissions gap and residual emissions, you can use table A-2.1 and the associated definitions. You will have to refer to estimates from your iterations of Climate Neutrality Scenarios and Impact Pathways (Part C).

A 2-1 EMISSIONS GAP AND RESIDUAL EMISSIONS											
	(1) Baseline emissions	**(2) Emissions Reduction Target 2030**		**(3) Emission reduction through other Action Plans**		**(4) Emissions Gap**		**(5) Emissions reduction through the CCC Action Plan to address the Gap**		**(6) Residual emissions**	
	Baseline emissions (ideally not older than 2018) - referring to the inventory used for target setting	The emissions reduction target for 2030 ideally achieves a minimum 80% reduction from the baseline, as reported in Section 2 of the Commitments document of the CCC. The overall target should be absolute or net-zero (i.e. including the compensation of any residual emissions).		These are the emissions reductions that would be achieved through existing policies, and plans, outlined in Section A-2.1. Those actions are by definition not part of the action portfolio in section B. If they are fully or partially incorporated in module B-2, their associated reduction potential should be referenced in column (5) and not be included here. WARNING if the baseline is a BAU scenario: If the BAU modelling includes any of these existing measures, please also do not include the associated emissions reduction in this column as otherwise it would be double counted.		(4) = (2) – (3)		This column is used to present the already quantified emission reduction associated with the action portfolios outlined in module B-2. Ideally, this equals the gap. If the there is a difference between the reduction potential of the actions specified in module B-2 (for instance because their reduction potential has not been fully estimated or because additional measures will be identified in future iterations), the CCC AP should be explicit about this difference and explain how the difference will be closed. In principle, as long as the difference has not been addressed, it would be considered as part of the residual emissions.		(6) = (1) – (2)	
	(absolute) t CO_2e	(absolute) t CO_2e	(%)	(absolute) t CO_2e	(%)	(absolute) t CO_2e	(%)	(absolute) t CO_2e	(%)	(absolute) t CO_2e	(%)
Buildings	1,423,268	1,285,238	55.8	845,337	36.7	439,901	19.1	439,901	19.1	138,029	6.0
Transport	791,604	531,723	23.1	45,501	2.0	486,222	21.1	486,222	21.1	259,881	11.3
Waste	48,500	19,990	0.9	0	0.0	19,990	0.9	19,990	0.9	28,510	1.2
Industrial Process and Product Use (IPPU)	14,604	766	0.0	0	0.0	766	0.0	766	0.0	13,838	0.6

A 2-1 EMISSIONS GAP AND RESIDUAL EMISSIONS											
	(1) Baseline emissions	**(2) Emissions Reduction Target 2030**		**(3) Emission reduction through other Action Plans**		**(4) Emissions Gap**		**(5) Emissions reduction through the CCC Action Plan to address the Gap**		**(6) Residual emissions**	
Agriculture, Forestry and Other Land Use (AFOLU) - sources (positive emissions)	23,693	3,634	0.2	0	0.0	3,634	0.2	3,634	0.2	20,058	0.9
Agriculture, Forestry and Other Land Use (AFOLU) - sinks (negative emissions)	**-49.900**	15,800	/	0	/	15,800	/	15,800	/	-65,700	/
Total emissions	**2.301.669**	**1,841,353**	**80.0**	**890,839**	**38.7**	**950,514**	**41.3**	**950,514**	**41.3**	**460,316**	**20.0**
Total net emissions	**2.251.769**	**1,857,153**	**82.5**	**890,839**	**39.6**	**966,314**	**42.9**	**966,314**	**42.9**	**394,616**	**17.5**

The city estimates the emissions gap to be addressed in the Climate Action Plan at 950,514 t CO_2e. The residual GHG emissions in 2030 are estimated at 460,316 t CO_2e (20.0%). Emission sources which will not be feasible to eliminate till 2030 are coming from **transport and building sectors**. The **transport sector's contribution** to baseline emissions is around one third. Despite very optimistic and ambitious measures, 259,881 tonnes of CO_2e or 56.5% of total residual emissions would remain in the transport sector. Residual emissions in the **buildings sector** would amount to 138,029 tonnes (30.0%), emissions from waste management to 28,510 tonnes (6.2%), in agriculture, forestry and other land use (AFOLU) to 20,058 tonnes (4.4%) excluding natural carbon removals and in the industrial processes and product use (IPPU) sector to 13,838 tonnes (3.0%). In total, the remaining emissions amount to 460,316 tonnes of CO_2e and are offset by natural carbon sinks in forests and other areas and by carbon capture and utilisation (CCU) technologies to achieve climate neutrality. To achieve the set target, measures are planned to increase the natural carbon sinks in the City of Ljubljana to reach the target value of -65,700 tonnes of natural CO_2 sink. With a focus on forest areas, grassland, urban green areas and cropland, measures will be implemented to further strengthen efforts to increase natural carbon sinks. This will strengthen the role of forests and other natural ecosystems as efficient carbon sinks and contribute to more sustainable land management in the urban environment. To reduce the remaining residual emissions, carbon capture and utilization (CCU) technologies will be used. Carbon capture and storage (CCS) technology cannot be used in Slovenia due to the unsuitable geological structure, so the CCU technology will be used instead.

See also: **B-2.3: Summary strategy for residual emissions.**

The highest residual emissions that cannot be fully contained are still in the transport sector, as most of this sector currently depends on the use of fossil fuels. The City of Ljubljana is located within the pan-European transport network, which comprises ten corridors, among them Corridor V and Corridor X. Since these corridors (motorways) facilitate transit, a substantial portion of the traffic passing through is transit traffic. Ljubljana's strategic location at the intersection of these two corridors enhances its favourable traffic conditions. Since the city of Ljubljana has no control over transit traffic passing through its territory, it also has no influence on reducing this traffic and consequently reducing emissions. The reduction of emissions from transit traffic primarily depends on transitioning vehicles to zero-emission energy sources at the national and broader levels.

In the building sector, despite ambitious measures, there remains a residual 138,029 t CO_2e, mainly due to the planned waste-to-energy plant, where part of the waste-derived fuel is fossil-based. This facility will be integrated as a production unit into the district heating system, resulting in heat consumers not being completely decarbonized. Additionally, a small portion of energy consumption in the industrial sector remains on natural gas. Complete decarbonization is not possible because, in addition to CO_2, emissions of CH_4 and N_2O are also considered, which are released even with carbon-neutral fuels.

By 2030, despite implementing waste reduction measures and waste management, it is expected that approximately 28,510 t CO_2e will remain from landfilling. Due to previously disposed waste in the landfill body, landfill gas with approximately a 50 percent methane content is generated. This gas is a byproduct of the anaerobic decomposition of biodegradable waste deposited in landfill cells. Immediately after the disposal of biodegradable waste, biochemical processes begin in the landfill body, breaking down the organic matter present in the waste. Gas typically begins to form about a year after waste disposal and continues to generate for several decades, with smaller amounts potentially forming fifty years or more after disposal. The formation of landfill gas primarily depends on the composition, age, and quantity of waste deposited in the past. Due to the changed composition of disposed waste in recent years (primarily inert waste being disposed of), the quantities of landfill gas are gradually decreasing. However, emissions are likely to persist for several more decades.

Emissions of refrigerant gases (HFCs), used as substitutes for ODS and included in the IPPU sector, are estimated for mobile air conditioning and transport refrigeration. Since the modernization of the

vehicle fleet is planned gradually, emissions from refrigerants will decrease gradually and will not reach zero by 2030.

Livestock farming, especially cattle breeding, accounts for the majority of emissions in the AFOLU sector. The planned measures will reduce emissions to some extent, but due to the presence of livestock farming, it will not be possible to completely achieve decarbonisation.

2.3 Module A-3 Systemic Barriers and Opportunities to 2030 Climate Neutrality

This module aims to document the conclusions of a systems and stakeholder mapping aimed at identifying systemic barriers and opportunities. In conjunction with the GHG inventory and the policy baseline analysis in the previous two modules of Part A, the analysis reported here serves as a basis for designing actions that address these barriers or exploit the underutilised opportunities in Part C.

A description of the main systems related to the city´s GHG emission domains, e.g., technological/infrastructural, institutional/ regulatory, organisational, financial, political, social and behavioural systems.

A-3.1: Description of urban systems, systemic barriers, and opportunities

Barriers and opportunities in the systems span across various sectors, highlighting the complexity of their assessment:

Technological/Infrastructural Systems

Challenges such as grid capacity and stability, compatibility with existing infrastructure, and the nascent stage of new technologies pose significant barriers (CCU, hydrogen, energy storage). Opportunities lie in investing in smart grid technologies, upgrading infrastructure to support renewable energy sources (RES), and fostering innovation in energy technologies.

Institutional/Regulatory Systems

Long coordination processes and bureaucratic hurdles impede efficient energy, transportation, and waste management systems. Streamlining procedures, enhancing permit processes, and developing regulations that support sustainable practices across all sectors are pivotal steps toward overcoming these barriers.

Organizational Systems

Legacy infrastructures and organizational resistance to change limit the adoption of advanced systems for energy, transportation, and waste management. Organizational transformation, investment in smart infrastructure, and fostering a culture of innovation within institutions can help to mitigate these challenges.

Financial Systems

Limited financial resources and high investment costs restrict the city's ability to transition to sustainable systems. Exploring innovative financing models, leveraging public-private partnerships, and creating revenue streams from recyclable materials are opportunities for financial sustainability.

Political Systems

A gap in political support for sustainable transportation and energy initiatives can hinder progress. Advocacy, engaging policymakers, and building consensus for ICT-enabled development are critical to securing the necessary political backing for sustainability goals.

Social Systems
Public resistance to new technologies and a lack of awareness or motivation for sustainable practices present significant social barriers. Enhancing community engagement, transparent information sharing, and targeted education campaigns can foster a collective move toward sustainability.

Behavioural Systems
Personal habits and consumer culture that promotes disposability contribute to the city's GHG emissions. Promoting energy efficiency, sustainable consumption, and the use of public transportation through incentives and education are essential for driving behavioural change.

Monitoring and Data Collection
The **CCC** will be supplemented by annual reports in the form of annexes. The reports will include an overview of the activities carried out and their impacts. They will be prepared by the Core City Team and will be reviewed by the City's Climate Change Council, which consists of all the key stakeholders from each area (health, energy, mobility, etc.). The report will be discussed by the mayor and the mayor's committee, ensuring a comprehensive review and assessment of the city's progress towards sustainable development. The reports will be made available to the public. The final decision on the measures to be taken lies with the Mayor and the City Council.

From 2024 on, **an updated CCC will be uploaded to the CDP/ ICLE approved reporting system by 100 CNSC Mission Platform every two years**. Ljubljana is **reporting to the CDP/ICLEI** since 2017.

Monitoring will, in addition to tracking the specified indicators in Part B. 3 of this AP, also consider the integration and effectiveness of sustainable technologies, regulatory compliance, organizational transformation efforts, financial performance of sustainability initiatives, levels of political support, public engagement, and behaviour change metrics. This comprehensive approach to data collection and analysis will inform the further refinement of Ljubljana's strategies for achieving climate neutrality. Here, it is emphasized that the city will approach this monitoring in the future, and it is not part of the current AP.
The detailed analysis in regard to the main systems related to the city´s GHG emission domains e.g., technological/infrastructural, institutional/ regulatory, organisational, financial, political, social and behavioural systems is given in table below.
Stakeholder mapping was conducted as part of the CCC Participatory-Communication Strategy (CCC-PCS), identifying three groups:

- The General stakeholder group encompasses a wide array of entities, including citizens, non-governmental organisations, social enterprises, science and educational sector, governmental institutions, city public administration, city council, city public companies, state-owned enterprises (SOEs), business sector, civil society, socially vulnerable groups – youth, elderly, children, socially vulnerable groups , low-income households, population facing health disparities, refugees, people with disabilities and special needs, stakeholders with higher purchasing power, public media, European commission, European parliament, and relevant EU agencies.
- The Field of action stakeholder group consists of stakeholders specific to key areas such as energy systems, mobility & transport, waste & circular economy, green infrastructure & nature-based solutions, built environment, digitalization, engaging and collaborating with stakeholders.
- Additionally, there's a Horizontal stakeholder group comprising stakeholders focusing on health, digitalization, and funding.

How and which specified stakeholder groups, based on their placement in the groups, address the systems, GHG gap system barriers, and opportunities to achieve the city's set goals, are defined in A-3.2.

Table 11: Description of urban systems, systemic barriers, and opportunities.

		URBAN SYSTEMS						
		ENERGY DISTRIBUTION SYSTEMS	MOBILITY AND TRANSPORTATION	WASTE MANAGEMENT	DIGITALISATION	NATURE BASED SOLUTIONS	BUILD ENVIRONMENT	AFLOU
FRAMEWORKS	TECHNOLOGICAL/INFRASTRUCTURAL							
	BARRIER	Grid Capacity and Stability Issues. Compatibility issues with existing infrastructure. The lack of maturity of new technologies to be widely implemented at scale. Large financial investments are needed. Just transition mechanism – potentially higher cost of energy.	Due to spatial limitations, ensuring the development of new infrastructure, such as dedicated lanes for buses and bicycles, alongside new roads situated away from existing traffic thoroughfares. Public transport facilities, such as bicycle lanes in some areas, require upgrades to support a good user experience. The complexity of adapting infrastructure to accommodate EVs, cycling, and pedestrian traffic presents challenges in embracing new, cleaner technologies and modes of transport. Technological Limitations of Alternative Fuel Vehicles include issues such as battery life, fuel cell efficiency, and the availability of green hydrogen.	Integrating advanced waste processing technologies into existing waste management systems. Lack of infrastructure in the area of separate waste collection. Insufficient facilities for sorting and processing various types of waste, from household recyclables to electronic waste and hazardous materials, hindering the ability to fully implement circular economy principles.	Lack of standardization and interoperability. Technological obsolescence within public institutions and infrastructure. Ensuring security and data protection while simultaneously promoting innovation and openness. Lack of integrated data platforms: centralized platforms that collect, analyse, data to enable monitoring of progress and to make effective decisions (e.g. mobility data).	Limited space in urban areas to implement large-scale NBS projects, such as urban forests, parks. The complexity of retrofitting existing buildings and infrastructure with green solutions, such as green roofs, walls, and permeable pavements, to manage stormwater and improve urban biodiversity. Maintenance and sustainability of NBS over time (ongoing care, climate changes...). Technological limitations in monitoring and assessing the effectiveness of NBS, including data collection, analysis tools, and methodologies to quantify benefits such as biodiversity enhancement, air quality improvement,	Integrating sustainable building technologies, material, energy systems into existing urban fabric, building layouts especially in historic or densely built areas.	The absence of mechanisms to implement monitoring and control of logging. The slow adoption of precision agriculture technologies, such as satellite imagery, drones, and IoT devices for monitoring soil moisture and nutrient levels.

		URBAN SYSTEMS						
		ENERGY DISTRIBUTION SYSTEMS	MOBILITY AND TRANSPORTATION	WASTE MANAGEMENT	DIGITALISATION	NATURE BASED SOLUTIONS	BUILD ENVIRONMENT	AFLOU
						and carbon sequestration.		
	OPPORTUNITY	Investing in Smart Grid Technologies to enhance capacity and stability, facilitating the integration of RES. Upgrading existing grid infrastructure to be compatible with new technologies and RES. Encouraging innovation in emerging energy technologies through research and development to accelerate their maturity and scalability. Developing new financial models and incentives to overcome the barrier of large upfront. Developing comprehensive policies that support a Just transition.	Expanding and Integrating Multimodal Transport Networks. Investing in Smart Mobility Solutions. Enhancing Infrastructure for public transport, cycling and walking. Accelerating the Adoption of Electric Vehicles (EVs). Engaging in partnerships between the public sector and private companies can accelerate the deployment of sustainable transport solutions. Implementing Policy and Regulatory Support that support sustainable transportation.	Regulations could encourage the adoption of circular economy principles such as designing products for durability, repairability, and recyclability. Implementation of digital solutions in the field of waste prevention, reuse and separate waste collection. Use of data from the field of waste management via the Smart city platform in other areas. For example: traffic.	Modernizing public infrastructure with green tech. Balancing security with innovation. Implementing integrated data platforms, decision making layers for climate action.	Integrated urban planning that prioritizes green spaces as essential urban infrastructure. Developing and promoting policies and incentives that support the creation, maintenance, and enhancement of NBS.	Implementing climate proofing of infrastructure. Encouraging the use of sustainable materials and construction practices through incentives and regulations. Fostering collaboration between governments, industry, and academia to support innovation in sustainable building practices.	Development and implementation of integrated monitoring and control mechanisms. Promotion and support for precision agriculture. Investment in research and development to make new technologies more accessible. Policy and regulatory framework enhancements.
	MONITORING	Collecting data on the compatibility of existing infrastructure with new technologies. Monitoring the maturity and scalability of new technologies. Data on investment costs, operational	Data on the construction and maintenance of new infrastructure designed to accommodate various modes of transport. Data on the implementation of upgrades to public	Measuring the proportion of separately collected waste. Measuring the degree of recyclability.	Tracking the establishment and utilization of centralized data platforms specifically designed for climate action.	Data collection on vegetation coverage, biodiversity, and ecosystem services.	Number of energy retrofitted buildings and their energy efficiency and greenhouse gas emissions.	Data collection on used fertilizers.

		URBAN SYSTEMS						
		ENERGY DISTRIBUTION SYSTEMS	MOBILITY AND TRANSPORTATION	WASTE MANAGEMENT	DIGITALISATION	NATURE BASED SOLUTIONS	BUILD ENVIRONMENT	AFLOU
		expenses, and energy pricing.	transport facilities, such as bicycle lanes and pedestrian walkways. Integration of multimodal transport networks data. This includes information on the connectivity between different transportation options and the development of seamless multimodal networks.					
		INSTITUTIONAL/REGULATORY						
	BARRIER	Long coordinating procedures among various energy sector stakeholders. Bureaucratic Hurdles and Slow Permitting Processes. Lengthy preparatory processes of strategies, plans programme due to the complexity of cross-sectoral collaboration, challenges in data acquisition, rapidly changing legislation, lack of personnel.	Coordination issues between transportation authorities and local governments. No mandate to act (e.g. transit transport, railway). Challenges in achieving synergy between local actions and national climate strategies. Regulation on no. of parking spaces defines min. no. of parking spaces instead of max. no. of parking spaces. Lengthy preparatory processes of strategies, plans programme due to the complexity of cross-sectoral collaboration, challenges in data acquisition, rapidly	Lack of incentives for businesses to adopt circular economy practices. The lack of understanding of the majority of stakeholders in society why changes are needed in the direction of decarbonization of society.	Data protection regulations that may inhibit the sharing and utilization of data for e.g. smart city solutions. Cybersecurity risks.	Lack of coordinated planning for green space development and maintenance. No legally binding regulation on prioritizing NBS.	Slow regulatory acceptance in adopting new construction technologies, such as modular or prefabricated components, which offer potential for reducing waste and improving efficiency but require changes in traditional building practices and regulatory acceptance. Lengthy preparatory processes of strategies, plans programme due to the complexity of cross-sectoral collaboration, challenges in data acquisition, rapidly changing legislation, lack of personnel.	Lengthy coordination processes among various stakeholders in the agricultural and forestry sectors, which slow down the implementation of sustainable practices and innovations. Bureaucratic hurdles and slow permitting processes for new land management practices, such as agroecology, agroforestry, or regenerative farming, can delay or prevent the adoption of

		URBAN SYSTEMS						
		ENERGY DISTRIBUTION SYSTEMS	MOBILITY AND TRANSPORTATION	WASTE MANAGEMENT	DIGITALISATION	NATURE BASED SOLUTIONS	BUILD ENVIRONMENT	AFLOU
			changing legislation, lack of personnel.					sustainable solutions. Lack of coordinated policies and regulations to promote integrated land use that balances the needs of agriculture, forestry, and natural resource conservation, leading to conflicts and inefficient land use.
	OPPORTUNITY	Developing standardized procedure, establishing collaborative platforms, or working groups to enhance cooperation. Enhance permit application processes, improving communication and coordination between relevant authorities. Implementing climate proofing of infrastructure.	Establish multi-stakeholder alliances for better alignment of transportation policies and projects. Establish collaborative frameworks and advocacy channels with higher-level authorities and stakeholders, thereby influencing policies, regulations, and actions in these sectors. Leveraging national policies and resources to support local climate initiatives, fostering a	Embracing innovation and technology adoption within institutional frameworks allows for the exploration and deployment of new tools, techniques, and solutions to address waste-related challenges. Regulations could encourage the adoption of circular economy principles, such as designing products for durability, repairability, and recyclability and business practices	Supportive government policies and initiatives aimed at promoting digital transformation, such as funding schemes or tax incentives for digital projects. Regulatory reforms aimed at streamlining processes and reducing administrative burdens can help organizations adopt digital technologies more effectively.	Integrated urban planning that prioritizes green spaces as essential urban infrastructure. Supporting the implementation of NBS – prioritizing option (through building networks and working with key stakeholders.	Acceleration of the adoption of innovative and sustainable urban solutions; improvement in regulatory processes to support climate goals. Promoting green building practices and updating building codes to reflect sustainability goals. Implementing climate proofing of infrastructure.	Close to nature forest management implemented in Slovenia. Active mobilization and inclusion of forest owners into forest management. Identification and promotion of all forest ecosystem services.

		URBAN SYSTEMS						
		ENERGY DISTRIBUTION SYSTEMS	MOBILITY AND TRANSPORTATION	WASTE MANAGEMENT	DIGITALISATION	NATURE BASED SOLUTIONS	BUILD ENVIRONMENT	AFLOU
			unified approach to climate action. Enhancing policy coherence and coordination between different levels of government, leading to more	for returnable packaging.				
	MONITORING	Reporting on environmental and social standards Reporting on climate-proofing implementation and monitoring. Reporting on environmental and social standards Reporting on climate-proofing implementation and monitoring.	Monitoring of emissions originating in traffic Monitoring of air quality in the city Availability of public transport – indicators of sustainable transport – regular monitoring.	Monitoring the number of integrated business circular practices in the city.	Tracking key performance indicators (KPIs) related to ICT deployment, adoption, and impact, as well as conducting regular evaluations and reviews. Monitor and address emerging risks and threats associated with the use of ICT.	Area of green spaces in urban settlements (defining the trend, regular monitoring).	The area of build land in the urban environment (defining the trend and regular monitoring). No. of buildings that implemented climate proofing. No. of buildings that are energy efficient, zero emission buildings, passive houses, active houses, etc.	Identified gaps in policies. Monitoring of the improved policy and addressed gaps.
	ORGANIZATIONAL							
	BARRIER	Existing infrastructure and associated challenges in its transformation (integration of RES) Existing organizational structures still support big energy-producing facilities and show less support for distributed energy production. Lack of professionals with know-how on climate neutrality, complexity, and	Legacy infrastructure limiting the integration of advanced transportation systems. Lack of professionals with know-how on climate neutrality, complexity, and interdependence btw. sectors and the need for stakeholder collaboration.	Impact of the planned waste incineration plant on the implementation of the Zero waste policy. Readiness of stakeholders for changes in business models in establishing circular loops of materials. Organizational support of reduction	Siloed ICT systems that hinder interoperability and data sharing. Lack of IT experts. Lack of professionals with know-how on climate neutrality, complexity, and interdependence btw. sectors and the need for stakeholder collaboration.	Insufficient resources dedicated to the maintenance and enhancement of green spaces. Existing organizational structure shows low understanding of the benefits greenspaces provide. Lack of professionals with	Resistance to change within the construction industry and among property developers. Lack of professionals with know-how on climate neutrality, complexity, and interdependence btw. sectors and the need for stakeholder collaboration.	The AFLOU sector often involves numerous stakeholders with diverse interests and objectives, leading to fragmented decision-making and coordination challenges.

		URBAN SYSTEMS						
		ENERGY DISTRIBUTION SYSTEMS	MOBILITY AND TRANSPORTATION	WASTE MANAGEMENT	DIGITALISATION	NATURE BASED SOLUTIONS	BUILD ENVIRONMENT	AFLOU
		interdependence btw. sectors and the need for stakeholder collaboration.		in one-way-packaging. Lack of professionals with know-how on climate neutrality, complexity, and interdependence btw. sectors and the need for stakeholder collaboration.		know-how on climate neutrality, complexity, and interdependence btw. sectors and the need for stakeholder collaboration.		Limited financial resources, technological capabilities, and access to information may inhibit organizations within the AFLOU sector from investing in sustainable practices and innovation.
	OPPORTUNITY	Increase in energy efficiency, Development of new business models, Reduction of greenhouse gas emissions, Increase in energy independence. Enhanced capacity building on climate neutrality, complexity, and interdependence btw. sectors and stakeholder collaboration.	Organizational transformation and investment in smart infrastructure to support efficient transportation. Enhanced capacity building on climate neutrality, complexity, and interdependence btw. sectors and stakeholder collaboration.	Most of the collected waste is collected in such a way that it is either recycled or used as energy. It will be necessary to upgrade the waste collection systems at the source in such a way that reuse, repair, ... Enhanced capacity building on climate neutrality, complexity, and interdependence btw. sectors and stakeholder collaboration.	Adoption of open standards and platforms to enable system integration and interoperability. Enhanced capacity building on climate neutrality, complexity, and interdependence btw. sectors and stakeholder collaboration.	Establish dedicated teams and funding for the management of urban green spaces (private and public). Capacity building and awareness raising on climate neutrality, complexity, and interdependence between sectors and stakeholder collaboration. of existing organizations' members.	Fostering collaboration between governments, industry, and academia to support innovation in sustainable building practices. Capacity building and awareness raising on climate neutrality, complexity, and interdependence, between sectors and stakeholder collaboration. of existing organizations' members.	Investing in training, education, and capacity-building programs for farmers, landowners, and other stakeholders can empower them with the knowledge and skills needed to adopt sustainable practices, comply with regulations, and adapt to changing environmental conditions.
	MONITORING	Number of Capacity building trainings implemented.	Number of Organizational Transformation Measures and their impacts.	Number of units for implementation of activities in the field of prevention, reduction, and reuse.	Number of engaged IT experts. Monitoring of available open access data.	Number of existing green spaces (in m^2).	Number of Capacity building and awareness raising of existing organizations' members.	Assessing the adoption and utilization of technology and innovation in agricultural and

		URBAN SYSTEMS						
		ENERGY DISTRIBUTION SYSTEMS	MOBILITY AND TRANSPORTATION	WASTE MANAGEMENT	DIGITALISATION	NATURE BASED SOLUTIONS	BUILD ENVIRONMENT	AFLOU
			Number of Capacity building trainings implemented.	Number of Capacity building trainings implemented.	Monitoring of the number of users of these data. Number of Capacity building trainings implemented.	Number and amount of managed green spaces (in m^2). A number of capacity-building and awareness-raising campaigns.		forestry practices, such as precision agriculture, remote sensing, GIS mapping, and forest monitoring systems.
DYNAMICS	FINANCIAL							
	BARRIER	Limited financial resources due to high investment values required.	High costs associated with transitioning to sustainable transportation systems.	Insufficient financial resources are allocated to waste management initiatives that hinder investments in infrastructure upgrades, technology adoption, and capacity building.	High upfront costs associated with implementing ICT infrastructure, technologies, and systems.	Partnerships with private sector and community organizations to co-fund green space projects.	Not sufficient financial incentives for developers and homeowners to invest in energy-efficient and sustainable building technologies.	Limited access to affordable credit, loans, grants, and other financial instruments for farmers, landowners, and rural communities to invest in sustainable agricultural practices, forest management, land conservation, and ecosystem restoration.
	OPPORTUNITY	Exploring innovative financing models and incentives for investment in energy systems.	Leveraging public-private partnerships to fund and develop sustainable transportation projects.	Creation of revenue streams from the recovery and valorisation of recyclable materials, organic waste, and other resources or reducing costs for processing unseparated waste.	With ICT infrastructure and applications, organizations can lower their operational costs and achieve significant savings over time.	Competing political priorities that overlook the benefits of green spaces.	Lack of political support for comprehensive urban sustainability initiatives.	Increasing availability of green finance mechanisms, such as green bonds, climate funds, impact investing, and sustainable investment funds, that prioritize investments in climate-smart

		URBAN SYSTEMS						
		ENERGY DISTRIBUTION SYSTEMS	MOBILITY AND TRANSPORTATION	WASTE MANAGEMENT	DIGITALISATION	NATURE BASED SOLUTIONS	BUILD ENVIRONMENT	AFLOU
								agriculture, sustainable forestry, land restoration, and biodiversity conservation.
	MONITORING	Available financial resources. Number of implemented innovative financial models.	Available financial resources. Number of implemented innovative financial models.	Available financial resources. Financial monitoring of revenue streams from the recovery and valorisation of recyclable materials, organic waste, and other resources or reducing costs for processing unseparated waste.	Monitoring of savings potential and realization as a consequence of ICT implementation.	Cost benefit analysis of implementing NBS. Number of NBS implemented.	Number and amount of financial incentives for developers and homeowners to invest in energy-efficient and sustainable building technologies.	Assessment of financial risks, uncertainties, and vulnerabilities associated with AFLOU activities, such as market risks, price volatility, climate-related risks, policy changes, and funding constraints.
	POLITICAL							
	BARRIER	Political Support Gap Political changes in priorities.	Lack of political will to prioritize sustainable transportation initiatives. Political changes in priorities.	Political pressure from industry stakeholders. The conflict between the interest of maintaining society in a state of comfort and the engagement of political forces in the direction of necessary changes.	Varying levels of political commitment to digital transformation initiatives.	Competing political priorities that overlook the benefits of green spaces (unsustainable spatial planning dominated by political interests). Political changes in priorities.	Lack of political support for comprehensive urban sustainability initiative (unsustainable spatial planning dominated by political interests).	Regulatory gaps, inconsistencies, or delays may discourage stakeholders from adopting best practices, complying with regulations, or making long-term commitments to AFLOU activities.
	OPPORTUNITY	Engaging in advocacy to influence policy makers and stakeholders about the importance of aligned	Engage policymakers in dialogue to underscore the economic and environmental benefits	Seeking political support to encourage innovation and technology adoption in waste	Engaging stakeholders to build consensus and support for ICT-	Advocacy and public campaigns to emphasize the value and benefits of urban green spaces.	Lobbying for policies that incentivize sustainable development and	Stakeholder consultations, policy forums, and advocacy campaigns to

		URBAN SYSTEMS						
		ENERGY DISTRIBUTION SYSTEMS	**MOBILITY AND TRANSPORTATION**	**WASTE MANAGEMENT**	**DIGITALISATION**	**NATURE BASED SOLUTIONS**	**BUILD ENVIRONMENT**	**AFLOU**
		and supportive political action for decarbonization goals.	of sustainable transportation.	management by supporting research and development efforts, piloting new technologies, and incentivizing private sector investment in clean and renewable energy solutions. Seeking political support for reduced one-way packaging.	enabled development.	Supporting climate resilience through NBS and green spaces.	energy efficiency in buildings. Supporting climate resilience.	raise awareness about key issues, mobilize support for policy reforms, and promote sustainable practices and land management strategies.
	MONITORING	Key political stakeholders/players supporting the carbon neutrality – Local coalition for climate neutrality.	Political stakeholder mapping: Key political stakeholders/players supporting sustainable mobility– Local coalition for climate neutrality.	Political stakeholder mapping: Key political stakeholders/players supporting innovative sustainable waste management– Local coalition for climate neutrality.	Political stakeholder mapping: Key political stakeholders/players supporting digital transformation– Local coalition for climate neutrality.	Political stakeholder mapping: Key political stakeholders/players supporting NBS– Local coalition for climate neutrality.	Political stakeholder mapping: Key political stakeholders/players supporting.	Tracking compliance with commitments, and progress towards achieving targets and objectives related to land use, ecosystem conservation, and natural resource governance.
	SOCIAL							
	BARRIER	Public acceptance of new technologies and infrastructure. Resistance to the installation of new energy facilities. Inequality in access to renewable energy sources and energy efficiency. Energy poverty.	Public resistance to changes in transportation habits and preferences.	Lack of awareness or motivation among the public to participate in waste reduction and recycling initiatives. It may require targeted education and outreach campaigns, community engagement initiatives, and incentives to encourage	Digital divide and lack of digital literacy among certain population groups.	Public disengagement or lack of interest in local green spaces.	Public unawareness of the benefits of sustainable building and living environments.	Lack of active involvement of private forest owners into sustainable close-to-nature forest management practices.

		URBAN SYSTEMS						
		ENERGY DISTRIBUTION SYSTEMS	MOBILITY AND TRANSPORTATION	WASTE MANAGEMENT	DIGITALISATION	NATURE BASED SOLUTIONS	BUILD ENVIRONMENT	AFLOU
				behavioural change towards more sustainable waste practices.				
	OPPORTUNITY	Enhanced community engagement. Transparent information sharing. Equitable access programs. Addressing energy poverty.	Community engagement programs to highlight the benefits of sustainable transportation options. Connecting various community engagement programmes, enabling networking and synergies among measures and key stakeholders. Heightened sense of belonging and accountability among citizens.	Potential for community engagement and collaboration – need to foster a sense of shared responsibility and collective action towards achieving climate goals. Improve the local economy and strengthen self-sufficiency by closing material loops of individual waste/materials.	Programs aimed at reducing the digital divide and improving digital skills across the community.	Community-driven initiatives and programs to increase public engagement with and investment in green spaces.	Public education campaigns and demonstration projects to showcase the benefits of sustainable buildings.	Active involvement of private forest owners into sustainable close-to-nature forest management practices.
	MONITORING	Monitoring of number of energy poor households/individuals. Monitoring of investments into energy efficiency for energy poor households.	Number of Community engagement programs to highlight the benefits of sustainable transportation options.	Percentage of recycled household waste. Number of educational and awareness rising campaigns implemented/year.	Number of Programs aimed at reducing the digital divide and improving digital skills across the community.	Number of community driven initiatives and programs to increase public engagement with and investment in green spaces supported by the City of Ljubljana.	Number of Public education campaigns and demonstration projects to showcase the benefits of sustainable buildings.	Number of private forest owners included into close-to-nature forest management practices.
		BEHAVIORAL						
	BARRIER	Personal habits and consumption patterns. A lack of awareness or motivation among consumers to adopt energy-efficient solutions and technologies can slow	Individual preferences for private vehicle use over public transportation.	Consumer culture that promotes disposability and excessive waste.	Resistance to adopting new technologies and digital services.	Perception of green spaces as non-essential or low priority in urban planning.	Consumer preference for traditional building methods and reluctance to adopt new technologies.	Familiarity with traditional methods, reluctance to take risks, and inertia may deter individuals from

		URBAN SYSTEMS						
		ENERGY DISTRIBUTION SYSTEMS	MOBILITY AND TRANSPORTATION	WASTE MANAGEMENT	DIGITALISATION	NATURE BASED SOLUTIONS	BUILD ENVIRONMENT	AFLOU
		the transition to sustainable energy.						embracing innovative solutions and transitioning to more sustainable AFLOU practices.
	OPPORTUNITY	Promoting energy efficiency through consumer education and incentives, as well as research on behavioural aspects.	Incentives for public transportation use and awareness campaigns about its benefits.	Through incentives and education, promote sustainable consumption and the use of tools in the area of reducing the amount of waste generation (returnable packaging, shopping without packaging, repair of objects, ...).	User-centred design and engagement strategies to increase technology adoption and usage.	Education and awareness campaigns to promote the health, social, and environmental benefits of green spaces.	Incentive programs and educational initiatives to change consumer behaviour towards sustainability in the built environment.	Community-based approaches, such as participatory planning processes, collaborative decision-making platforms, and community-led conservation projects, enable stakeholders to contribute their insights, perspectives, and local knowledge to the design and implementation of sustainable AFLOU interventions, fostering greater social cohesion and resilience.
	MONITORING	Number of energy efficient households.	Accurate data on traffic monitoring and analysis based on mathematical models.	Monitoring household, commercial, and industrial waste generation trends, including the types,	Feedback from users to gather insights into their experiences, perceptions, satisfaction levels,	Number of education and awareness campaigns implemented.	Number of incentive programs and educational initiatives to change consumer behaviour towards	Surveys, interviews, and focus group discussions with stakeholders

		URBAN SYSTEMS						
		ENERGY DISTRIBUTION SYSTEMS	MOBILITY AND TRANSPORTATION	WASTE MANAGEMENT	DIGITALISATION	NATURE BASED SOLUTIONS	BUILD ENVIRONMENT	AFLOU
				quantities, and composition of waste generated by different sectors. Monitoring of the level of recyclability. Monitoring the amount of materials that go into the reuse material flow. Number of incentives, promotions, campaigns to promote reduction of waste generation.	and suggestions for improving the design, functionality, and effectiveness of climate-focused ICT solutions.		sustainability in the built environment.	involved in AFLOU activities to gather data on their perceptions related to land use, agricultural practices, forest management, and conservation efforts.

A-3.2: Systems & stakeholder mapping			
System	Stakeholders	Influence on the city´s climate neutrality ambition	Interest in the city´s climate neutrality ambition
GENERAL STAKEHOLDER GROUPS			
Technological/infrastructural, institutional/ regulatory, organisational, financial, political, social, and behavioural systems	Citizens	High	Their collective engagement, informed choices, and advocacy efforts contribute significantly to the overall impact, making their involvement essential for fostering sustainable change on a broader scale. Their main interest lies in **quality of life, including cost savings environmental quality, green spaces, recreational areas, a reliable public transport system, resilience to climate events, community engagement, fostering empowerment, social cohesion, and a vibrant, resilient society.**
Technological/infrastructural, institutional/ regulatory, organisational, financial, political, social, and behavioural systems	Non-Governmental Organisations, social enterprises	High	The NGOs possess valuable expertise and experience. Their primary interest lies in fostering positive changes across various domains. Their interests extend to **influencing policy, conducting advocacy, and implementing projects that address to action plan related concerns.** Additionally, they may **prioritize community education and engagement** to foster awareness and **social responsibility** on the road to climate neutrality.
Technological, institutional, regulatory, organisational, financial, political, social, and behavioural systems	Science and educational sector	High	Science and educational sector represent a vital role in advancing climate action and sustainability. Through research, innovation, and education, they contribute essential knowledge and solutions. Their primary interest is in **scientific discovery, technological advancements, and educational initiatives**. The sector aims to drive positive change by fostering a deeper understanding of climate issues, inspiring future leaders, and developing innovative solutions addressed within action plan. Their interest is as well **collaboration in research projects, consultations, and educational initiatives** that contribute to success of action plan, **finance-related possibilities,** and **other favourable operating conditions for the sector.**
Technological/infrastructural, institutional/ regulatory, organisational, financial, political, social, and behavioural systems	Governmental institutions	High	Governmental institutions have a delegated interest in guiding the cities towards climate neutrality. Their focus encompasses **establishing robust regulatory frameworks and policies that effectively support efforts of cities to become climate neutral**. They allocate resources and **explore diverse funding options for climate initiatives,** ensuring alignment with set objectives. Their interest is as well **strategic collaborations across various levels of government** are essential in creating a unified approach to achieving climate neutrality. They are focused as well in **reducing emissions from sources under their jurisdiction.**
Technological/infrastructural, institutional/ regulatory, organisational, financial, political, social, and behavioural systems	City Public Administration	High	The public city administration plays a crucial role in localising the city's climate-neutral ambitions. Their primary interest lies in **translating policies and commitments into effective city-level strategies and actions**. City public administration creates an environment that encourages sustainable practices, ensures compliance, and supports initiatives aligned with climate neutrality. Additionally, their interest extends to **exploring funding options** and providing other favourable conditions on the road to climate neutrality. Furthermore, they aim **to collaborate with governmental institutions to advocate viewpoints they may not have the mandate to enforce directly**, fostering a united and impactful approach to climate action goals.
Regulatory, organisational, financial, political	City council	High	The City Council of Ljubljana **exhibits a strong and proactive interest in the city's ambition to achieve climate neutrality.** This commitment is reflected in their active role in formulating and endorsing policies and initiatives that align with the city's goals. Recognising the urgency of climate change, the council prioritises sustainability and green practices in its urban development plans, emphasising the need for a holistic approach to reduce carbon emissions, investment in sustainable transportation, and enhancement of green urban spaces. They support collaboration with various stakeholders, including businesses, community groups, and international partners, to integrate diverse perspectives and expertise in climate action. They actively **pursuing policies and actions that contribute to responsible future.**
Technological/infrastructural, institutional/ regulatory, organisational, financial, political, social, and behavioural systems	City Public companies	High	Their primary interest lies **in efficient and sustainable service delivery,** aligning with the broader goals of the action plan. This sector aims **to enhance operational efficiency, reduce environmental impact** (emissions reduction), and **contribute to the city's overall sustainability.** Key areas of focus include **optimising resource use, implementing eco-friendly technologies, and fostering community engagemen**t. Additionally, their interest extends to **exploring funding options and collaborating with various stakeholders** to ensure the successful implementation of climate action initiatives.
Technological/infrastructural, institutional/ regulatory, organisational, financial, political, social, and behavioural systems	State-owned enterprises (SOEs)	Medium	Their **engagement extends beyond business interests** to actively support the city's journey towards carbon neutrality. They play a crucial role in advancing climate action and sustainability, **aligning their interests with broader societal goals**. Their primary interest should lie in efficient and **sustainable service delivery,** contributing to the success of the city's action plan. SOEs interest should be to **thoroughly understand city requirements** and **offer comprehensive support**, including specialised knowledge and expertise crucial for urban decision-making. This expertise, often not available in the

			open market due to its specialised nature, is vital for cities to make informed decisions.
Technological/infrastructural, regulatory, organisational, financial, political, social, and behavioural systems	Business sector	High	Businesses recognise the importance of **efficient and sustainable services**. Today, profit is not the only driver, as it cannot be achieved without following trends related to responsible environmental business practices. These are also demonstrated through alignment with city policies, shared commitments, and the successful implementation of the action plan. Sectors interests are **promoting sustainable business models, using renewable energy, implementing circular economy, and fostering collaboration.** Their interest are as well **new business opportunities** e.g. investing in green technologies and RES.
Regulatory, organisational, financial, political, social, and behavioural systems	Civil Society	Medium	Their engagement extends to **advocacy for policies** that foster **collaboration,** cultural **exchange, and support initiatives** that contribute to the overall success of the action plan, **ensuring social well-being,** contributing to a vibrant and **cohesive community.**
Technological/infrastructural, regulatory, organisational, financial, political, social, and behavioural systems	Socially Vulnerable Groups - Youth	Medium	Deeply invested in **shaping a climate-neutral city**, with a **focus on ensuring a sustainable, vibrant future.** Their interests revolve around environmental stewardship, advocating for renewable energy, waste reduction, and sustainable transport systems. They prioritise the **development of green spaces and sustainable urban planning** to **enhance quality of life.** They seek educational and **career opportunities in green jobs**, **emphasising the importance of innovation and technology** in solving environmental challenges. Additionally, they advocate for **affordable, eco-friendly housing,** reflecting their commitment to sustainability in every aspect of urban living.
Technological/infrastructural, regulatory, organisational, financial, political, social, and behavioural systems	Socially Vulnerable Groups - Elderly	Medium	Their interests include **creating an age-friendly city with accessible public spaces and transport, ensuring their mobility and independence**. They emphasise the importance of social inclusion and community support systems that address their health and well-being in a changing climate. The elderly also advocate for **energy-efficient housing suitable for their needs**, contributing to reduced emissions. Their valuable experience and perspectives are crucial in shaping a city that is not only resilient and sustainable but also considerate of the diverse needs of all generations, thus ensuring a liveable environment for both present and future residents.
Technological/infrastructural, regulatory, organisational, financial, political, social, and behavioural systems	Socially Vulnerable Groups - Children	Medium	Although their direct involvement in decision-making is limited due to their age, their engagement focuses on **creating resilient and vibrant and supportive community** for children. Their interests **include fostering educational initiatives, advocating for safe and accessible recreational spaces, and supporting policies that promote a sustainable and inclusive urban environment** (e.g. Air quality, availability of natural resources, low ecological footprint). Additionally, their engagement emphasizes the importance **of long-term planning** to create a resilient and vibrant city for future generations.
Technological/infrastructural, regulatory, organisational, financial, political, social, and behavioural systems	Socially Vulnerable Groups - Low-Income Households	Medium	Low-income households prioritise policies for a **better quality of life, including affordable housing and economic support.** Their engagement stresses social inclusion, community support, and initiatives for urban resilience. Involving them is vital to address needs and reduce social inequality, especially as they are vulnerable to climate change impacts due to poorer housing conditions. Limited resources may hinder their access to information and participation, emphasising the need for inclusive climate neutrality strategies considering their interests and needs in policy development.
Technological/infrastructural, regulatory, organisational, financial, political, social, and behavioural systems	Socially Vulnerable Groups - populations facing health disparities	Medium	Their interest is inclusive healthcare and accessible support systems. Their interests include **affordable health care** and **healthy environment**. Advocating for **job security** and **mental health support**, they engage in policymaking to ensure comprehensive, equitable health strategies. Their experiences shape resilient, inclusiveness, influencing health policies for societal wellbeing and diverse needs.
Technological/infrastructural, regulatory, organisational, financial, political, social, and behavioural systems	Socially Vulnerable Groups - refugees	Medium	Their interests often revolve around **seeking stable, sustainable livelihoods and integrating into the community**. Potential interest that could contribute to city success of action plan: interest in **participating in urban initiatives** to foster social integration, build networks, **green jobs- employment**, valuable knowledge and unique insights and experience that supports city's objective.
Technological/infrastructural, regulatory, organisational, financial, political, social, and behavioural systems	People with Disabilities and Special Needs	Medium	Their perspectives and experiences are crucial in shaping a more accessible, understanding, and supportive community, reducing societal barriers and provide equal opportunities. Their interests could be **accessibility to urban spaces, public transport, and housing, universal design, adaptive technologies. reducing societal barriers and equal opportunities.**
Technological/infrastructural, regulatory, organisational, financial, political, social, and behavioural systems	Stakeholders with Higher Purchasing Power	Medium	The interests of stakeholders with higher purchasing power in the context of a climate-neutral action plan, can vary and may not always align perfectly with action plan goals. However, there is a growing trend of environmental consciousness among affluent segments of society. Potential interest that could contribute to city success of action plan: **investing in green technologies and RES**, not only for environmental benefits but also for the potential **long-term economic returns, influencing policies that favour sustainable practices**, particularly if these align with their personal or business values or offer **economic benefits like tax incentives**, **recognition of the role of social responsibility, community leadership and legacy** in business and personal

			practices, leading to support for eco-friendly local businesses and initiatives.
Technological/infrastructural, regulatory, organisational, financial, political, social, and behavioural systems	Public Media	High	**Supporting a city's journey** towards climate neutrality can be identified as follows, **awareness and education** about specific actions the city is taking, **fostering community involvement** and public dialogue around the city's climate actions, **reporting the city's progress** towards climate neutrality, ensuring transparency, **advocacy for effective climate policies and actions,** encouraging decision-makers to prioritize and implement strategies that align with the goal of climate neutrality of a city.
Technological/infrastructural, regulatory, organisational, financial, political, social, and behavioural systems	European Commission, European Parliament, and relevant EU agencies.	High	They are pivotal in **driving the EU towards climate neutrality.** Their efforts focus on **policy development, funding, and fostering innovation and sustainability** across member states. These bodies aim to enhance EU-wide collaboration, support green technologies, and ensure the bloc's resilience to climate challenges, making Europe a leader in global climate action.
FIELDS OF ACTION STAKEHOLDER GROUPS			
Energy - Technological/infrastructural, regulatory, organisational, financial, political, social and behavioural systems	Ministry of the Environment, Climate and Energy Ministry of Natural Resources and Spatial Planning Ministry of Infrastructure Energetika Ljubljana d.o.o. ELES d.o.o. Elektro Ljubljana Faculty of Mechanical Engineering Faculty of Electrical Engineering Innovation and Development Institute of the UL Focus Association for Sustainable Development Centre for social work	High	Interest is on **transitioning** to **renewable energy sources and improving energy efficiency**, while **advocating for policies and incentives** that support sustainable energy investments**.** Key concerns include economic sustainability**, ensuring affordability, and exploring job creation** in new energy markets. **Technological innovation** is a major interest, with emphasis on adopting advanced, efficient energy solutions. The industry also seeks **funding opportunities** and navigates legal and regulatory frameworks that impact energy projects, including **land use planning**. Understanding and **influencing consumer behaviour** towards energy-saving practices is crucial, alongside ensuring **technology readiness and availability.** Investment in research and development for new energy technologies is vital for staying competitive. Operational efficiency, adapting to market dynamics, managing **sustainable supply chains**, and **mitigating risks** associated with energy production are additional focal points. Moreover, maintaining a **positive corporate image** through social responsibility initiatives in line with environmental goals is essential. These interests reflect the sector's role in supporting a city's climate neutrality ambitions, balancing economic, technological, and regulatory aspects with societal and environmental responsibilities
Mobility - Technological/infrastructural, regulatory, organisational, financial, political, social and behavioural systems	Ministry of the Environment, Climate and Energy Ministry of Natural Resources and Spatial Planning Ministry of Infrastructure The Infrastructure Directorate Slovenian Railways JP LPT JP LPP RRA LUR The Coalition for Sustainable Transport Policy Ljubljana Cyclists Network City Mobility Center IPOP, Institute for Spatial Policies, BTC d.d., University Medical Centre Ljubljana PNZ , d.o.o. JCDecaux, Europlakat DoorDash – Wolt Glovo DPD Zero električna dostavna vozila Nomago d.o.o. Avant2Go, Share'n go, Go Giro, Bolt, eskiro-servis	High	Interests differ among stakeholder groups within sector. Common interests are **safety, accessibility, and convenience, good infrastructure and services, reliability, and smooth traffic flow** with emphasis as well to elderly and people with disabilities. Other interests are as well **enhancing sustainable transportation methods, eco-friendly transportation modes, promotion of cycling and walking** and others. These stakeholders collectively drive the transformation towards a more sustainable mobility landscape, balancing user needs, environmental considerations, and economic viability in pursuit of a greener, more efficient urban transport system. They also seek **funding opportunities** and **favourable regulatory frameworks.** Users of traffic Infrastructure: Includes car drivers, public transport passengers, pedestrians, and cyclists (residents and visitors, children and youth, people with disabilities, and the elderly). This group also includes organisations representing the interests of these groups, such as non-governmental organisations, taxi services, delivery companies, bike services, etc. Other organisations, such as those implementing sustainable mobility projects, tourist associations, sports clubs, etc., that use public roads for their activities are also part of this group. Manufacturers and Sellers of Motor Vehicles and Fuels: Includes automobile manufacturers, fuel manufacturers, motor vehicle traders, and companies providing maintenance and repair services for motor vehicles. Motor vehicle traders can influence the sale of vehicles with lower CO_2 emissions and promote the transition to alternative propulsion methods. Managers of Traffic Infrastructure: Includes all public authorities responsible for planning, construction, and maintenance of infrastructure. Public Service Transport Companies: This group includes providers of public passenger transport. They are essential in offering affordable and accessible transportation to all city residents. These companies are responsible for maintaining a reliable and efficient public transit system. They also focus on sustainable practices, like integrating electric buses or using alternative fuels, to reduce environmental impact and contribute to the city's climate goals. Business Service Transport Companies: This category encompasses commercial transport providers, offering intercity bus services and other commercial transportation

			options. These companies cater to both residents and visitors, providing additional travel choices that complement public transit. Major traffic generators: Refers to entities, locations, or events that significantly contribute to traffic volume in an area. These can include commercial centres, educational Institutions, train/bus station, employment centres (BTC), medical facilities (UKC Ljubljana). Other Interest Groups: Business owners and employees dependent on an efficient traffic network for operations, facing the consequences of traffic closures or pollution.
Waste and Circular economy - Technological/infrastructural, regulatory, organisational, financial, political, social and behavioural systems	Ministry of the Environment, Climate and Energy JP VOKA Snaga Chamber of Commerce and Industry of Slovenia Faculty of Chemistry and Chemical Technology Innovation and Development Institute of the UL JP VOKA Snaga Technology park Ljubljana d.o.o. REUSE center Ecologists Without Borders Association ETRI community Smetumet cultural ecological association and social enterprise Climate-KIC Holding B.V. CER Sustainable Business Network Major retailers (Spar, Hofer, Mercator, Tus, Eurospin, Lidl)	Medium	Stakeholders interest is on **sustainable waste management** and **promoting circular economy principles.** Key focuses include enhancing recycling and waste reduction techniques, improving wastewater treatment, and developing eco-friendly waste disposal methods. Businesses and industries are inclined towards **integrating circular models in their operations,** emphasizing **resource efficiency** and **product lifecycle extension.** Policy makers aim to support these initiatives through **favourable regulations**, while community members actively seek **efficient, accessible waste services.** There is as formed opposition from some stakeholders regarding planned waste incineration plant. Users of Waste Collection Services: Includes all types of users where waste is generated, collected, or processed (non-hazardous and hazardous). Manufacturers and Sellers of Waste Processing, Reuse, and Circular Economy Services: Includes organisations implementing recycling programs and projects in the field of waste processing, reuse, and other circular economy activities. Provision of Public Infrastructure for Waste Collection and Separation and Public Services Ensuring Proper Waste Management: JP VOKA SNAGA Other Interest Groups: Organizations raising awareness about waste management issues.
AFFLOU - Technological/infrastructural, regulatory, organisational, financial, political, social and behavioural systems	Ministry of Agriculture, Forestry and Food Ministry of the Environment, Climate and Energy Biotechnical Faculty Slovenia Forest Service Slovenian Forestry Institute Agricultural Institute of Slovenia Slovenski državni gozdovi Slovenian Environment Agency	Low	In **agriculture and forestry**, stakeholders face pressures to adopt eco-friendly practices, **often challenging due to policy demands for organic farming**. They focus on sustainable land management, protecting against and mitigating the effects of natural changes. Collaborating with experts to plant climate-resilient species is key. Soil quality and water availability are crucial, as are strategies to safeguard against price pressures and ensure fair market access. Balancing environmental conservation with economic viability, they seek policies that support damage compensation and sustainable market practices, ensuring the sector's resilience and productivity. Farmers, foresters, forest owners, managers of public and city forests and parks: changing practices that can reduce greenhouse gas emissions e.g. sustainable forest management can contribute to reducing emissions and increasing carbon sinks. Decision-makers: shaping policies and regulations that can promote emissions reduction in the AFOLU sector. Forestry and Agricultural Expertise: provision of recommendations for the development of sustainable practices and development of expert basis that are needed for decision making- Industry and Trade Linked to the Sector: Includes wood processing industry, food industry, food and agricultural product retailers by improving production processes and the supply chain, promoting sustainable production and raising public awareness of emissions related to food. Other Interest Groups: Stakeholders who can influence demand and supply in the agricultural sector, such as consumers who can promote the production of sustainable products with a lower environmental impact, non-governmental organisations.
IPPU - Technological/infrastructural, regulatory, organisational, financial, political, social and behavioural systems	Chamber of Commerce and Industry of Slovenia LEK D.D. HELLA SATURNUS SLOVENIJA D.O.O. AQUAFILSLO D.O.O. KOLEKTOR ETRA D.O.O. LJUBLJANSKE MLEKARNE D.O.O. ISKRA, D.O.O. SŽ - VIT, D.O.O. LITOSTROJ POWER D.O.O. PAPIRNICA VEVČE PROIZVODNJA D.O.O. DANFOSS TRATA, D.O.O. FOTONA D.O.O. MDM D.O.O. PAPIRNICA VEVČE D.O.O. KPL D.O.O. BIOIKS D.O.O.	Medium	In the **industrial sector**, stakeholders **focus on sustainable production, energy efficiency, and reducing environmental impact.** They're interested in **adopting cleaner technologies and renewable energy sources** to lower carbon emissions. Emphasis is on waste minimisation and embracing circular economy principles, reusing materials and reducing resource consumption. Compliance with environmental regulations and achieving sustainability certifications are also priorities. Industry leaders look to innovate in green product development, responding to consumer demand for eco-friendly options. Collaboration with policymakers and experts is key for shaping industry practices that align with climate goals. These interests reflect a commitment to **balancing economic growth with environmental stewardship, c**ontributing to broader sustainability and climate action initiatives.

	OMEGA AIR D.O.O. LJUBLJANA MEDEX D.O.O. KOTO D.O.O. MAGNETI LJUBLJANA, D.D., LJUBLJANA SILGAN LJUBLJANA D.O.O. OLMA D.O.O. TAČ D.O.O. BELINKA PERKEMIJA, D.O.O. PLUTAL 2000 D.O.O. VARSI, D.O.O. LAJOVIC TUBA, D.O.O. ELMA TT D.D. KOLEKTOR TURBOINŠTITUT D.O.O. PLASTIKA - ANDREJ MESOJEDEC S.P. HIDROTEHNIK D.O.O. ELCOM, D.O.O. LTH Castings d.o.o JATA EMONA D.O.O.		
NATURE-BASED SOLUTIONS - Technological/infrastructural, regulatory, organisational, financial, political, social and behavioural systems	Ministry of Agriculture, Forestry and Food Ministry of the Environment, Climate and Energy Biotechnical Faculty JP VOKA SNAGA Urban Planning institute of the Republic of Slovenia Slovenia Forest Service Slovenian Forestry Institute Agricultural Institute of Slovenia Tivoli, Rožnik and Šiška Hill Landscape Park Public Institute KP Ljubljana Marshes Slovenski državni gozdovi Geological Survey Of Slovenia Slovenian Environment Agency Institute for Water of the Republic of Slovenia IPOP, Institute for Spatial Policies, Town and Spatial Planning Association of Slovenia, Slovenian Association of Landscape Architects owner of city forests and parks LUZ, d.d. Tisa d.o.o. Inštitut za arhitekturo in urbanizem d.o.o.	Medium	In the **field of Nature-Based Solutions (**NBS), stakeholders' interests **focus on integrating natural elements into urban environments for ecological, social, and economic benefits**. Key areas include enhancing urban biodiversity, creating green spaces for community well-being, and using natural systems for climate adaptation and mitigation, like green roofs and urban forests. Stakeholders from various sectors, including urban planners, environmental NGOs, and local governments, collaborate to implement NBS projects that address issues like air quality, heat island effect, and flood management. These initiatives are seen as vital for creating healthier, more resilient, and sustainable cities, aligning with broader environmental and climate action goals.
BUILT ENVIRONMENT- Technological/infrastructural, regulatory, organisational, financial, political, social and behavioural systems	Ministry of the Environment and Energy Urban Planning Institute of the Republic of Slovenia Chamber of Architecture and Spatial Planning of Slovenia Museum of Architecture and Design Chamber of Engineers of Slovenia Slovenian National Building and Civil Engineering Institute Ministry of Infrastructure Ministry of Culture Institute for the Protection of Cultural Heritage of Slovenia Biotechnical Faculty - Department of Landscape Architecture Faculty of Architecture Faculty of Social Sciences, Center for Spatial Sociology Faculty of Civil and Geodetic Engineering Spatial Planning Association of the City of Ljubljana IPOP, Institute for Spatial Policies Cultural Association prostoRož Society of Urbanists and Spatial Planners of Slovenia Trajna Kolektiv Krater Center of Architecture Slovenia Ljubljana Architects' Society LUZ, d.d. Gradbeni inštitut ZRMK, d.o.o.	High	In the **built environment sector**, stakeholders are dedicated to **creating sustainable, resilient, and inclusive urban spaces**. Their focus is on green building practices, energy efficiency, and the use of eco-friendly materials. Urban planning emphasises quality of life, integrating green spaces and enhancing walkability. Developers and construction companies are increasingly involved in sustainable projects and retrofitting for better energy efficiency. Local governments enforce regulations for sustainable development and investigate eco-friendly urban regeneration. Community groups advocate for affordable, sustainable housing and public involvement in urban planning, while transportation planners integrate sustainable transit options. Environmental experts concentrate on the sector's role in climate change mitigation and adaptation, promoting resilient city designs. These collective efforts aim to develop urban areas that are environmentally sustainable, socially equitable, and economically viable.

	AgiliCity d.o.o. Locus prostorske informacijske rešitve, d.o.o. Inštitut za arhitekturo in urbanizem d.o.o. A - PROJEKT d.o.o.		
HORIZONTAL STAKEHOLDER GROUPS			
HEALTH - Technological/infrastructural, regulatory, organisational, financial, political, social and behavioural systems	Ministry of Health University Medical Center Ljubljana The National Institute of Public Health (NIJZ) National Institute of Biology Faculty of Social Sciences Faculty of Arts Faculty of Health Sciences Institute of Health and Environment FOCUS, Association for Sustainable Development	Medium	In the **healthcare sector**, enhancing **access to medical care, particularly for the elderly, disabled, and chronically ill, is key.** Stakeholders focus on innovative technologies to improve patient care and support, and on developing resilient systems ready for emergencies, including climate-related health issues. Collaboration with social services for comprehensive support (e.g., tackling energy poverty) is vital. Training healthcare professionals for specific needs during events like heatwaves is emphasised. Essential too is cooperation with decision-makers in charge of the built and natural environment, ensuring services like clean water, waste management, and local environmental care (e.g., green spaces, air quality), crucial for a healthy living environment. These endeavours aim to ensure equitable healthcare access and a vibrant, healthy community life.
DIGITALISATION - Technological/infrastructural, regulatory, organisational, financial, political, social and behavioural systems	Ministry of Digitalization Ministry of the Environment, Climate, and Energy Faculty of Mathematics and Physics Elektro Ljubljana d.d. Energetika Ljubljana d.o.o. Urban Planning Institute of the Republic of Slovenia Directorate of the Republic of Slovenia for Infrastructure Slovenian Railways Ljubljana Passenger Transport Slovenian Forestry Institute Slovenian Forestry Institute Agricultural Institute of Slovenia Geological Survey of Slovenia T2 d.o.o. PNZ , d.o.o. LUZ, d.d AgiliCity d.o.o Locus prostorske informacijske rešitve, d.o.o.	Medium	The interest differs among **different stakeholders within the group Digitalisation**. **Technology companies and startups focus on smart city solutions to reduce emissions and enhance energy efficiency.** City administrations seek digital **tools to optimise infrastructure and public services**. Research institutions develop technologies supporting climate goals. Consumers and residents are interested in applications promoting sustainable behaviour. Investors look for opportunities in digital innovations contributing to climate neutrality. Regulators formulate policies encouraging the use of digital solutions in combating climate change. The common goal is to leverage digital technologies for sustainable development and climate neutrality.
FOUNDING - Technological/infrastructural, regulatory, organisational, financial, political, social and behavioural systems	Ministry of Finance Eco Fund SID - Slovenska izvozna in razvojna banka, d.d. NLB d.d. SKB d.d. Slovenian Regional Development Fund	High	In the **financial sector**, organisations financing sustainability measures, particularly state-funded entities in Slovenia, have distinct interests. **The Eco Fund, Slovenia's Environmental Public Fund, focuses on financing environmental projects**, offering incentives for energy efficiency, renewable energy, and other green initiatives. SID Bank, Slovenia's National Development and Export Bank, provides funding for larger infrastructure and development projects, often with a focus on sustainability and economic development. **Regional Development Funds play a crucial role** in supporting local and regional sustainability initiatives, often targeting specific community needs and smaller-scale projects. **Commercial banks in Slovenia** offer financing to entrepreneurs and individuals, increasingly incorporating green loans and sustainability-focused financial products into their portfolios. **Ministries and the government directly** support these goals through targeted calls for proposals, funding projects that align with national sustainability objectives, including climate action, energy efficiency, and environmental conservation. These efforts collectively aim to facilitate the transition to a sustainable economy, support local and national environmental initiatives, and encourage individual and entrepreneurial contributions to Slovenia's sustainability goals.
CRITICAL STAKEHOLDERS			
To assessed critical stakeholders the stakeholder analysis, was made within CCC Participatory-Communication Strategy (CCC-PCS) (January 2023). The stakeholders were categorized into four groups based on the significance and power dynamics of each stakeholder group, as well as their level of interest (please see example below).			

Critical stakeholders were identified as stakeholders whose involvement, influence, and interests are essential to the success and impact of a project or policy, individually as organisation or as a group.

Critical stakeholders are not only included as a matter of principle; their involvement is essential for the fulfilment of commitments, particularly in the reduction of greenhouse gas emissions. These reductions are to be achieved primarily through the activities of the stakeholders and not directly by the city. It is important to understand that only a limited percentage of emissions can be influenced by the city; the majority depends on the proactive initiatives and measures implemented by these stakeholders:

- **European Union and Slovenian Government authorities and regulatory bodies:** They enforce policies and incentivize the adoption of renewable energy and sustainable transport solutions, directly reducing emissions from key sectors such as energy production and transport. As they develop and enforce regulations that not only guide but mandate sustainable practices, this is particularly important for cities in sectors where the city has limited or no jurisdiction (transit), thereby increasing the impact of sustainable initiatives.
- **City, state, privately owned companies, and institutions:** These players invest in and implement energy-efficient technologies and sustainable practices in the supply chain, significantly reducing industrial emissions and promoting the principles of the circular economy. These companies are the driving force behind innovation and practical application. Their commitment to incorporating sustainable technologies and practices into their operations has a direct, significant impact on reducing the city's greenhouse gas emissions, demonstrating the multiplier effect of sector's initiatives.
- **Academia and research:** Science plays a crucial role. Research, innovation and development of new technologies and materials contribute significantly to reducing emissions and highlight the importance of intellectual and practical contributions to the city's sustainability goals in various sectors, from construction and energy production to human behaviour change and social initiatives.
- **Citizen:** Citizens contribute by adopting a sustainable lifestyle, e.g. using public transport, saving energy, and participating in waste-recycling programmes, which directly reduces emissions in the private and public sectors. The collective action and commitment of citizens, including vulnerable groups, is invaluable. Their participation in sustainable practices and support for urban initiatives creates a domino effect that contributes significantly to the reduction of greenhouse gas emissions and emphasizes the power of the community as a driver of change.
- **NGOs:** These groups facilitate the implementation of projects, promote sustainable practices in communities and industries, and enforce environmental regulations. They act as a catalyst for change by holding various stakeholders accountable and advocating for sustainable practices. Their role is crucial in ensuring that commitments to reduce greenhouse gas emissions are not only made but also honoured, thereby increasing the impact of collective effort.

The critical stakeholders represent as well-formed groups as: The City Transition Team (CTT), Interested Stakeholder Group (ISG), The Specialized Focus Teams (SFT), The Council for Climate Change City of Ljubljana, City Council. Neighbouring municipalities, international strategic partnerships as Euro cities network, ICLEI Circular Cities, Ellen MacArthur Foundation's CE100, Zero Waste Network.

Ljubljana invited various stakeholders, including experts and NGOs, to form the Interested Stakeholder Group (ISG), broadening the range of input into the city's climate strategy.

In the table below, an example of stakeholder mapping (pattern), the entire analysis is integrated into the CCC Participatory-Communication Strategy (CCC-PCS) (January 2023).

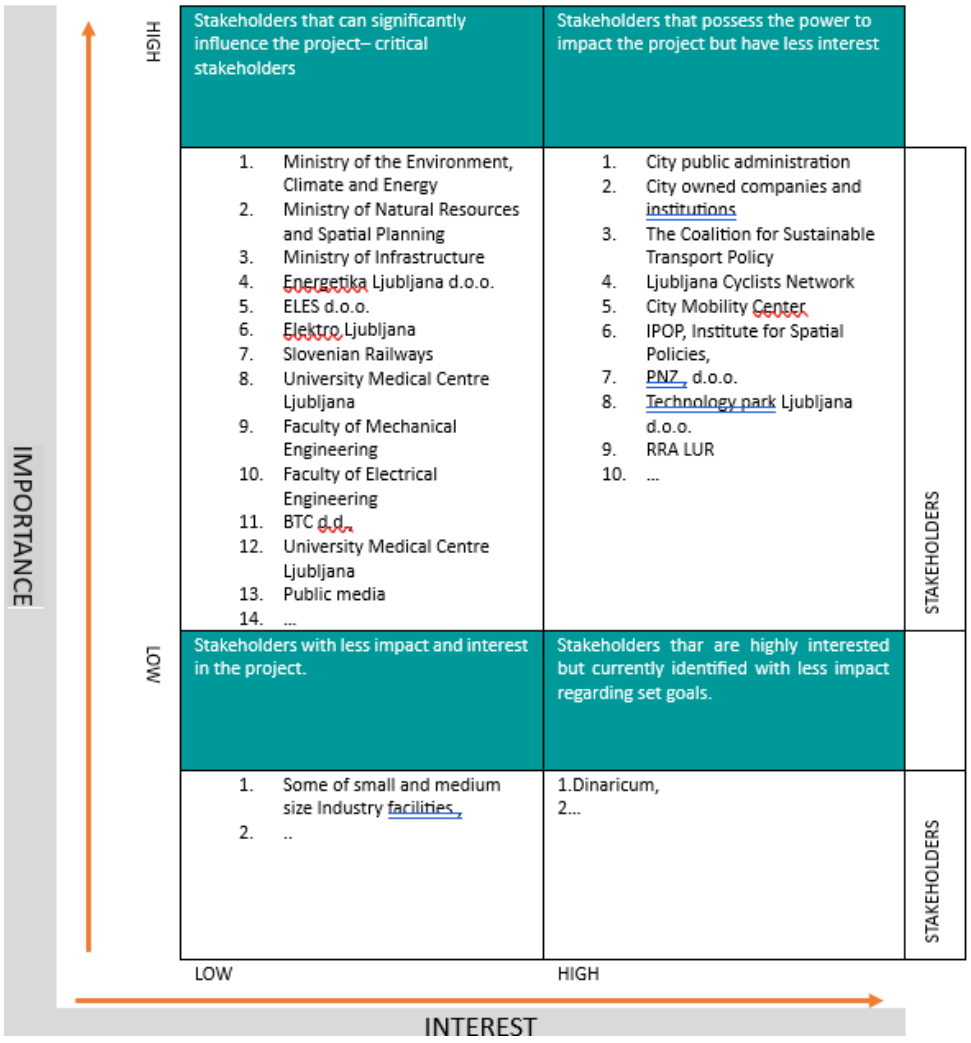

Figure 18: Stakeholder analysis.

3 Part B – Pathways towards Climate Neutrality by 2030

Part B represents the core of the CCC Action Plan, shaped by local authorities, local businesses, and stakeholders, comprising of the most essential elements: scenarios, strategic objectives, impacts, action portfolios and indicators for monitoring, evaluation, and learning.

3.1 Module B-1 Climate Neutrality Scenarios and Impact Pathways

Module B-1 “Climate Neutrality Scenarios and Impact Pathways” lists and describes impact pathways, early and late outcomes and direct and indirect impacts (co-benefits) according to and adapted from the NetZeroCities Theory of Change and the CCC Action Plan Guidance – clustered by fields of action.

B-1.1: Impact Pathways					
Fields of action	**Systemic levers**	**Early changes (1-2 years)**	**Late outcomes (3-4 years)**	**Direct impacts (Emission reductions)**	**Indirect impacts (co-benefits)**
Energy systems	Technology/ infrastructure	Utilizing waste heat from industry for integration into the district heating network. Acceleration of innovation in hydrogen production processes. Local biogas production and purification for injection into the distribution pipeline network. Concluded agreements on the purchase of emission-free electricity. Purchases of zero-emission electricity for public sector, public transport, industry, business sector, and households (65% of consumed electricity). Dynamic adjustment of electricity and heat production/consumption. Effective balancing of electricity supply and demand dynamics. Utilization of digital and advanced technologies for grid management.	District heating system using renewable energy sources. Purchases of zero-emission electricity for district heating system. Construction of a facility for energy recovery from municipal waste, producing heat and electricity. Construction of smaller district heating systems. Transition from fossil fuels to green hydrogen in energy-intensive industries. Decarbonization of the distribution gas pipeline network through the injection of green hydrogen and locally produced biomethane.	Overall GHG emission reduction as a synergistic outcome of implementing all planned measures: **1,165,147** tCO_2e/year. Total captured CO_2 emissions with carbon capture and utilization technology: **394,616** tCO_2e/year.	Reduced energy costs. Decrease in dependence on fossil fuels. Improvement of reliability and resilience of the power grid. Reduction of the industry's impact. Improved air quality and public health. New green jobs. Increased energy security. Long-term cost stability. Community engagement. Investment incentives. Technological innovation.

B-1.1: Impact Pathways					
Fields of action	**Systemic levers**	**Early changes (1-2 years)**	**Late outcomes (3-4 years)**	**Direct impacts (Emission reductions)**	**Indirect impacts (co-benefits)**
		Provision of continuous electricity supply to meet varying demands. Replacement of non-efficient lamps with energy-saving LED lighting. Implementation of dynamic lighting where appropriate for energy-efficient and smart public lighting. Reduction of heat losses and increase in the overall energy efficiency of the district heating system. Upgrading and optimizing industrial energy systems. Implementation of advanced HVAC solutions with intelligent management. Implementation of energy management systems across various sectors (public sector and businesses). Efficient and rapid access to information in the field of energy and climate.	Gradual replacement of boilers with fossil fuels in individual heating systems. Installed new electricity production facilities using renewable sources (solar power plants, hydropower plants, biomass and biogas cogeneration units). Improved grid reliability for the integration of renewable energy production sources. Implementation of battery energy storage systems into the electrical power grid. Replacement of wood biomass and natural gas (biogas) heating devices with newer energy-efficient boilers. Introduction of energy-efficient drives, thermal insulation, CHP plants, and low-temperature technologies to enhance energy efficiency in industrial processes. Implementation of a pilot project for carbon		Enhanced capacity building. Fostering technological Innovation. Reducing time to market Attracting investment. Facilitation of Stakeholder Collaboration.

B-1.1: Impact Pathways					
Fields of action	**Systemic levers**	**Early changes (1-2 years)**	**Late outcomes (3-4 years)**	**Direct impacts (Emission reductions)**	**Indirect impacts (co-benefits)**
			capture and utilisation. Collection and analysis of data for decision-making and city policy planning.		
	Governance & policy	Implementation of energy audits in the public sector and businesses. Development of strategies to promote sustainable habits and address energy poverty. Policy mechanisms orients market structures to net-zero.	Requirement for companies to establish energy management systems. Introduction of dynamic tariff system to alter consumer behaviour.		
	Social innovation	Increased awareness through workshops and events. Accessible web tool for energy-efficient home renovation information. Establishment of regional advisory points and energy counselling. The comprehensive initiative promotes sustainable certifications and encourages sustainable practices within the relevant sector. The information point serves as a central hub providing comprehensive information to various stakeholders. Local challenges in the field of sustainable development: Regulatory sandpits.	Promotion of research and innovation for new technologies. Greater awareness of sustainable energy use at the local level. New forms of public-private & community collaborations.		
	Democracy/ participation	Collaboration with educational institutions for training programs. Encouragement of collaboration and	Enabling active participation of consumers in energy schemes.		

B-1.1: Impact Pathways					
Fields of action	**Systemic levers**	**Early changes (1-2 years)**	**Late outcomes (3-4 years)**	**Direct impacts (Emission reductions)**	**Indirect impacts (co-benefits)**
		networking among residents.	Active participation of consumers through aggregators in schemes considering energy production, consumption, storage, or energy sales.		
	Finance & funding	Investment incentives for energy efficiency and renewable energy. Information on subsidies and favourable loans for renovations. Targeted investment planning strategies created.	New finance instruments & profitable business cases.		
	Learning & capabilities	Implementation of energy audits in the public sector and businesses. Evaluation of energy use and consumption patterns. Analysis of societal and psychological factors influencing energy consumption.	Examine carbon capture and utilisation and implementation possibilities.		
Mobility & transport	Technology/ infrastructure	Introduction of new bus routes to improve coverage. Increased bus frequency on main routes. Development of a new passenger centre featuring a main bus and train station, serving as the central hub for public transportation. Introduction of passenger	Implementation of dedicated bus lanes to reduce travel times. Smart traffic light management prioritizing public transportation. Introduction of longer vehicles to accommodate more passengers.	Overall GHG emission reduction as a synergistic outcome of implementing all planned measures: **531,723** tCO_2e/year.	Improved public transportation coverage. Improved user experience of public transport. Increased safety for traffic participants. Reduced noise in the city. Improved air

B-1.1: Impact Pathways					
Fields of action	**Systemic levers**	**Early changes (1-2 years)**	**Late outcomes (3-4 years)**	**Direct impacts (Emission reductions)**	**Indirect impacts (co-benefits)**
		transportation by electric boats along the Ljubljanica river. Prolongation of travel time for personal vehicles entering the city centre. Development and management of a public system for renting and sharing electric vehicles and bicycles. Construction of two new Park and Ride facilities. Connection of P+R facilities to new river public transportation stations (Park + Sail concept). Replacement of diesel buses with clean and zero-emission vehicles. Replacement of fossil natural gas with biomethane for all CNG buses. Installation of public charging stations for electric and hydrogen vehicles, including fast-charging centres. Establishment of charging infrastructure for electric and hydrogen-powered public transportation vehicles. Expansion and enhancement of bicycle parking facilities to ensure ample availability and secure storage options. Expansion of bike-sharing systems, incorporating both conventional and e-bikes.	Renovation and electrification of railway tracks. Incorporation of light rail concept with new stations. Enhanced overall reliability of railway transportation within the city. Establishment of shared mobility hubs. Gradual transition of personal vehicles to sustainable alternatives (electricity, hydrogen and biomethane). Gradual transition of light commercial vehicles to sustainable alternatives (electricity, hydrogen and biomethane). Gradual transition of heavy-duty vehicles and intercity buses to sustainable alternatives (electricity, hydrogen and biomethane). Reduction of fossil fuel consumption in agriculture by using alternative energy sources like biomethane or electricity.		quality and public health. Decreased traffic congestion in the city. More space for green areas and other uses. Enhanced quality of life for residents. Enhanced capacity building. Facilitation of Stakeholder Collaboration. Interdisciplinary approach.

B-1.1: Impact Pathways					
Fields of action	**Systemic levers**	**Early changes (1-2 years)**	**Late outcomes (3-4 years)**	**Direct impacts (Emission reductions)**	**Indirect impacts (co-benefits)**
			Reduction of resistance to cycling and walking by 20%, enhancing overall safety and experience. Expansion and improvement of cycling infrastructure and networks. Establishment of green mobility corridors away from main roads. Creation of new pedestrian zones, enhancing walkability and safety. Expansion of pedestrian areas into residential neighbourhoods beyond the city centre. Construction of new bridges prioritizing pedestrian and cycling access.		
	Governance & policy	Updating the legislation to facilitate the implementation of all planned projects to improve public transportation. Introduction of a single ticket for various modes of public transportation. Adjustment of city bus schedules for better integration with other public transportation modes such as trains and intercity buses.	Introduction of a stricter parking policy with increased fees and reduced parking durations. Implementation of a 30 km/h speed limit on most non-main city streets. Establishment of new emission-free zones for		

B-1.1: Impact Pathways					
Fields of action	**Systemic levers**	**Early changes (1-2 years)**	**Late outcomes (3-4 years)**	**Direct impacts (Emission reductions)**	**Indirect impacts (co-benefits)**
		Adoption of regulations and guidelines for decarbonization of vehicles owned by the City of Ljubljana. Establishment of the Sustainable Mobility Department to holistically plan and implement transport policies.	walking and cycling only. Establishment of new restricted traffic areas. Implementation of carpool lanes for vehicles with three or more occupants.		
	Social innovation	Continued development of on-demand transportation services. Expansion or enhancement of transport services for mobility-impaired individuals. Increased promotion and adoption of cycling, walking, renewable energy vehicles, and public transportation. Increased efficiency and sustainability of urban mobility through various mobility options like bike rental and electric car transportation. The comprehensive initiative promotes sustainable certifications and encourages sustainable practices within the relevant sector.	Due to traffic reduction, new spaces for socialization and new activities will be provided in the city. Implementation of measures to address transport poverty through accessible transportation and subsidies. Various promotional campaigns will be carried out to encourage cycling and walking as the primary modes of transportation in the city. Establishment of the Multimodal Route Planner application.		
	Democracy/ participation	A thorough assessment of public transportation user needs will be conducted, and areas requiring improvement will be identified. Active promotion and encouragement of user engagement and participation in	Introduction of pilot projects to test proposed improvements and collect user feedback. Coordination of user needs outside the City of Ljubljana to		

B-1.1: Impact Pathways					
Fields of action	**Systemic levers**	**Early changes (1-2 years)**	**Late outcomes (3-4 years)**	**Direct impacts (Emission reductions)**	**Indirect impacts (co-benefits)**
		pedestrian and cycling infrastructure. Robust citizen engagement and participation will be actively promoted and encouraged.	adjust parking and mobility options accordingly.		
	Finance & funding	Funding will be secured to transition all urban public transport vehicles to cleaner energy sources. Public-private partnerships for the establishment of public charging infrastructure. Ensuring additional funds to promote the transition of road transport to cleaner energy sources.	Enhanced financial support will be pursued through national and international policies, with efforts to explore European funding opportunities.		
	Learning & capabilities	Comprehensive studies to ensure effective planning of public transportation. Conducting studies to define crucial pedestrian and cycling corridors and assess accessibility of public services in urban neighbourhoods. Strategic analysis of cycling needs and infrastructure to accommodate reduced private vehicle usage. Solutions implemented in other cities, which have demonstrated positive outcomes in enhancing cycling and pedestrian infrastructure, will be examined. Research and educational activities to understand and address various aspects of sustainable mobility.	Development of a city logistics management plan to optimize freight transport. Development of a new Sustainable urban mobility plan (SUMP) in collaboration with stakeholders. Comprehensive analysis and planning tool for urban transportation.		

B-1.1: Impact Pathways					
Fields of action	**Systemic levers**	**Early changes (1-2 years)**	**Late outcomes (3-4 years)**	**Direct impacts (Emission reductions)**	**Indirect impacts (co-benefits)**
		Comprehensive understanding of the current transportation situation.			
Waste & circular economy	Technology/ infrastructure	Introduction of separate collection of textiles and electrical equipment. Decreased landfilling of mixed municipal waste, leading to lower methane emissions. Establishment of a supporting online application for managing waste. Increased accuracy in waste collection scheduling through the implementation of fullness sensors.	Utilization of waste for district heating system. Reduced energy consumption and greenhouse gas emissions through efficient waste-to-energy processes. Development and utilization of new technologies for producing synthetic recycled carbon fuels. Construction of collection centres and mini collection centres. Expansion of the collection network for textiles, cooking oil, and electrical appliances.	Overall GHG emission reduction as a synergistic outcome of implementing all planned measures: **19,990** tCO_2e/year.	Increased production of renewable energy sources. Reduced dependence on traditional energy sources. More efficient resource utilization. Higher proportion of recycled waste. Less landfilled waste. Reduction in plastic usage. Financial incentives. Promotion of circular economy. More responsible consumption. Increased awareness. Reduced environmental pollution. Preservation of natural resources. Increased awareness on waste reduction.
	Finance & funding	Co-financing events with less plastic and sustainable waste management.	Financial incentives for circular economy and recycling.		
	Social innovation	Introduction of a Sustainable City Card for vulnerable groups. Conducting communication campaigns targeting waste reduction. Promotion of refill systems and second-hand stores.	Establishment of zero-waste stores, reuse centres, and Sustainable Offices. Establishment of a network of bicycle repair services.		

B-1.1: Impact Pathways					
Fields of action	**Systemic levers**	**Early changes (1-2 years)**	**Late outcomes (3-4 years)**	**Direct impacts (Emission reductions)**	**Indirect impacts (co-benefits)**
		Promotion of home composting and management of construction waste. Communication for waste management awareness. Local competitions encourage innovative sustainability solutions, particularly engaging youth. Sports projects for sustainable development emphasize circular material flows, and sustainable practices in sports events. The comprehensive initiative promotes sustainable certifications and encourages sustainable practices within the relevant sector.	Establishment of repair services for electrical products. Establishment of packaging-free sales points. Introduction of repair cafes and "clothing repair shops". Establishment of clothing exchange points.		Cleaner urban environment. Facilitation of stakeholder collaboration.
	Democracy/ participation	Establishment of a food exchange platform. Enhanced community engagement in waste management practices.	Reducing household mixed municipal waste to below 80 kg per inhabitant per year.		
	Governance & policy	Establishment of food packaging and coffee-to-go return schemes. Priority use of recycled materials in public procurement.	Implementation of deposit systems for glassware and food utensils. Provision of space for local food sales and eco-gardens.		
	Learning & capabilities	Creation of a handbook for sustainable event organization. Review of waste classification from the wood processing industry for energy production.	Establishment of a model for systematic recording of discarded food.		

B-1.1: Impact Pathways					
Fields of action	**Systemic levers**	**Early changes (1-2 years)**	**Late outcomes (3-4 years)**	**Direct impacts (Emission reductions)**	**Indirect impacts (co-benefits)**
		Conducting waste separation analysis for effective waste management strategies. Enhanced waste management efficiency through real-time monitoring.			
Green infrastructure & nature-based solutions	Technology/ infrastructure	Removal of invasive species along the Ljubljanica river and replanting of 10,000 native shrubs and tree saplings. More efficient nitrogen cycling in agriculture. Expansion of water level monitoring systems. Establishment of urban weather observation system. Identifying permanently protected agricultural areas and expanding the agricultural land adapted to climate change.	Installation of new green roofs and facades. Establishment of green mobility corridors and green parking areas. Replacing above-ground parking areas with green spaces. Implementation of flood prevention infrastructure and SuDS systems. Employing permeable surfaces to mitigate flood risks. Restoration of habitats to maintain biodiversity and ensure water resources. Improving water flow through regular cleaning and deepening of riverbeds, employing engineering-biological methods. Enhancing carbon sink and biodiversity	Overall GHG emission reduction in agriculture as a synergistic outcome of implementing all planned measures: **3,634** tCO_2e/year. The goal is to increase the natural sinks of CO_2 for **15,800** tons.	Mitigation of the urban heat island effect. Improved stormwater retention. Increase in biodiversity. Mitigation of environmental impact. Increase in green areas. Adaptation to climate change. Improvement of environmental well-being. Improved public health. Conservation of natural resources. Enhancement of forest resilience. Enhancement of connectivity among farmers. Greater involvement of farmers. Increased food self-sufficiency.

B-1.1: Impact Pathways					
Fields of action	**Systemic levers**	**Early changes (1-2 years)**	**Late outcomes (3-4 years)**	**Direct impacts (Emission reductions)**	**Indirect impacts (co-benefits)**
			through restoration and conservation of hedgerows and riparian buffer strips in the Ljubljana Marshes. Increasing the area of permanent crops to improve city fruit self-sufficiency.		Strengthening local businesses. Strengthening knowledge and skills. Optimisation of agricultural practices. Reduced water pollution. Reduction of nitrogen in water bodies. Restoration of native habitats. Improved soil health. Increased local food production. Enhanced capacity building. Facilitation of stakeholder collaboration. Interdisciplinary approach.
	Finance & funding	Introduction of incentives for implementing advanced farming practices. Eligibility for financial incentives for investments in agricultural efficiency. Incentives for improving feed energy utilization and reducing methane emissions. Incentives for efficient collection of agricultural biomasses near biogas facilities. Incentives for sustainable farming practices to reduce methane emissions.	Increasing the area of forests owned by the City of Ljubljana.		
	Social innovation	Promotion of local vegetable production and organic farming through long-term contracts with producers. Provision of expert support and advice through public agricultural advisory services. Promoting improved forest management on privately owned lands.	Increased public understanding of urban vegetation benefits. Educational and awareness campaigns about climate change engage youth through innovative formats and promote accessibility via the Climate point.		

B-1.1: Impact Pathways					
Fields of action	**Systemic levers**	**Early changes (1-2 years)**	**Late outcomes (3-4 years)**	**Direct impacts (Emission reductions)**	**Indirect impacts (co-benefits)**
		Encouragement of local food production and consumption. Promotion of sustainable farming practices to reduce nitrous oxide emissions via low-ammonia fertilisation. Encouraging improvement in feed quality to reduce methane emissions. Community programs foster ownership, enhance greenery, and biodiversity. Cultural and artistic projects for education, information dissemination, advocating climate neutrality, and raising awareness of climate change impacts. The comprehensive initiative promotes sustainable certifications and encourages sustainable practices within the relevant sector.	Adaptation and mitigation workshops enhance community resilience, especially among vulnerable groups, through collaboration with universities and research institutes. Strengthened collaboration with healthcare for addressing physical and mental health issues due to climate change. Community-level biodiversity projects include wildlife monitoring for ecosystem understanding and campaigns for planting indigenous plants.		
	Democracy/ participation	Analysis of social functions of green areas and people's needs for urban landscapes. Inclusion of farmers in agricultural policies.			
	Governance & policy	Development of a Long-term Urban Greening Plan to increase urban green spaces to 40%. Preparation of a green roof and facade strategy. Introduction of comprehensive river system management to balance human needs	Reduction of emissions from deforestation and maintaining a stable forest area in the long term. Sustainable fertilization practices.		

B-1.1: Impact Pathways					
Fields of action	**Systemic levers**	**Early changes (1-2 years)**	**Late outcomes (3-4 years)**	**Direct impacts (Emission reductions)**	**Indirect impacts (co-benefits)**
		and ecosystem preservation. Improvement of sustainable forest management for enhancement of forest sink. Increasing the number of protected forest areas. Pursuit of a joint breeding program for cattle and small livestock breeds. Formulation of policy promoting sustainable organic farming. Reduction in unauthorized interventions and damage to forests. Effective supervision and monitoring of greening projects. Establishment of the Green Infrastructure and Nature-based Solutions department.	Upgrading agricultural policy. Improving climate change mitigation through CAP measures. Increased self-sufficiency and shortened supply chain in vegetable cultivation and promoting organic farming practices. Development of strategies to mitigate urban heat island effects.		
	Learning & capabilities	Identification of locations prone to flooding for the development of solutions during heavy rainfall. Preparation of expert bases for determining permanently protected agricultural land. Examination of possibilities to increase the area of permanent crops and preparation of expert basis for expanding permanent orchards. The development of educational programs for farmers will be emphasised.	Development of guidelines for transitioning to climate-adapted agriculture. Conducting hydrological and hydraulic studies to reduce vulnerability to climate change.		

B-1.1: Impact Pathways					
Fields of action	**Systemic levers**	**Early changes (1-2 years)**	**Late outcomes (3-4 years)**	**Direct impacts (Emission reductions)**	**Indirect impacts (co-benefits)**
		Establishment of a vegetation cadastre. Modelling of the urban heat islands.			
Built environment	Technology/ infrastructure	Implementation of energy-efficient construction techniques. Creation of social and recreational spaces. Increased green areas, functionality, and aesthetics of urban courtyards. Construction of timber buildings in public infrastructure projects.	Implemented energy retrofits for residential, public, and commercial buildings. Decrease in average energy consumption per square meter for heating to approximately 100 kWh/m^2. Enhanced resilience of buildings to future climate change impacts. Improvement of infrastructure resilience to extreme weather events. Development of energy self-sufficient neighbourhoods.	Overall GHG emission reduction as a synergistic outcome of implementing all planned measures: **120,091** tCO_2e/year.	Energy cost savings. Improved energy security. Job creation. Increased public awareness. Reducing traffic routes. Reducing dependence on individual transportation. Enhancing the visual appeal of the city. Decreasing environmental stressors. Improved urban aesthetics and functionality.
	Governance & policy	Encouragement of investors and residents to build wooden houses. Extend policies to promote NZEB standards in new and existing residential buildings. Preservation of green areas to reduce emissions. Developed guidelines for implementing spatial integration measures.	Existing buildings renovated according to current legislation. Establishment of superblocks with improved quality of living space. Creation of a healthier urban environment conducive to active living and		Enhanced building resilience to climate change. Financial support. Increase in awareness and capacity building. Fostering technological Innovation.

B-1.1: Impact Pathways					
Fields of action	**Systemic levers**	**Early changes (1-2 years)**	**Late outcomes (3-4 years)**	**Direct impacts (Emission reductions)**	**Indirect impacts (co-benefits)**
		Developed guidelines for project tasks for competitions that encourage innovative solutions for challenges related to climate change. Integration of climate objectives into spatial planning for emission reduction, climate adaptation, and ecosystem preservation.	improved well-being for all residents. Ensure the construction of the all of new buildings adheres to NZEB standards.		Reducing time to market Attracting investment. Facilitation of stakeholder collaboration.
	Social innovation	Promotion of wood as a sustainable building material. Exploration of options to encourage timber construction in private projects. Encouragement of innovative solutions for climate challenges. Platform for showcasing advanced concepts in urban sustainability. Increased awareness of local amenities promotes sustainable transportation. Testing and evaluation of new digital solutions in collaboration with residents. The comprehensive initiative promotes sustainable certifications and encourages sustainable practices within the relevant sector. Local challenges in the field of sustainable development: Regulatory sandpits.	Establishing initiatives to make sustainable housing accessible to diverse social groups. Enhanced decision-making, improved communication with residents, and facilitated city management, aided by the "Digital twin" initiative. Pilot testing of digital solutions for neighbourhood improvement and carbon footprint reduction.		
	Democracy/ participation	Collaboration among stakeholders for sustainable projects.	Green and sustainable housing is recognized and		

B-1.1: Impact Pathways					
Fields of action	**Systemic levers**	**Early changes (1-2 years)**	**Late outcomes (3-4 years)**	**Direct impacts (Emission reductions)**	**Indirect impacts (co-benefits)**
		Improved public engagement leading to better decision-making for climate neutrality. Active involvement of residents in shaping urban environments and incorporation of community ideas into final designs.	endorsed within the community. Establishment of a unified point for information dissemination and communication. Active stakeholder engagement platforms facilitate continuous dialogue, contribution collection, and dissemination of information on sustainable initiatives.		
	Finance & funding	Financial support on both the national and international levels is identified.	Enhancing financial incentives for household building energy retrofits.		
	Learning & capabilities	Conduct of educational programs to promote sustainable building practices. Analysing microclimatic conditions in the city to identify and mitigate problematic areas. Preparation of spatial analysis for future land use planning. Spatial data analysis, informed decision-making, and varied functionalities for 3D GIS analysis. Accurate three-dimensional urban imaging enhances urban planning and analysis. Enhanced data modelling and asset management with the	Continued enhancement of environmentally friendly and sustainable construction practices. Accurate monitoring of urban changes over time. Improved management, planning, and implementation of urban policies through the utilization of the digital platform.		

B-1.1: Impact Pathways					
Fields of action	**Systemic levers**	**Early changes (1-2 years)**	**Late outcomes (3-4 years)**	**Direct impacts (Emission reductions)**	**Indirect impacts (co-benefits)**
		creation of geographic data representations.			

B-1.2: Description of impact pathways

The table above describes the impact pathways that have been developed for individual groups of measures within the fields of action and all six systemic levers described in the NZC Theory of Change. Further explanations of the individual measures can be found in the following chapters. The table also shows the cumulative impact on emissions reduction, encompassing both direct and indirect positive effects, along with the listed co-benefits.

The main arguments for choosing the relevant impact pathways in the action plan for Ljubljana are aimed at achieving the goal of climate neutrality by 2030. These include ambitious measures in the areas of energy, mobility, waste management, green infrastructure, and nature-based solutions. The selection of these pathways is based on the shortcomings and lack of ambition of current strategies to achieve the targets set, while reflecting the need for a comprehensive approach to achieving climate neutrality.

The scenario for the pathway to the 2030 target includes measures in all the sectors (fields of action) presented above that contribute to reducing greenhouse gas emissions and achieving climate neutrality. These include a gradual reduction in direct and indirect emissions, increased energy efficiency, a transition to renewable energy sources and the promotion of sustainable mobility, waste management and environmentally friendly practices in the urban environment.

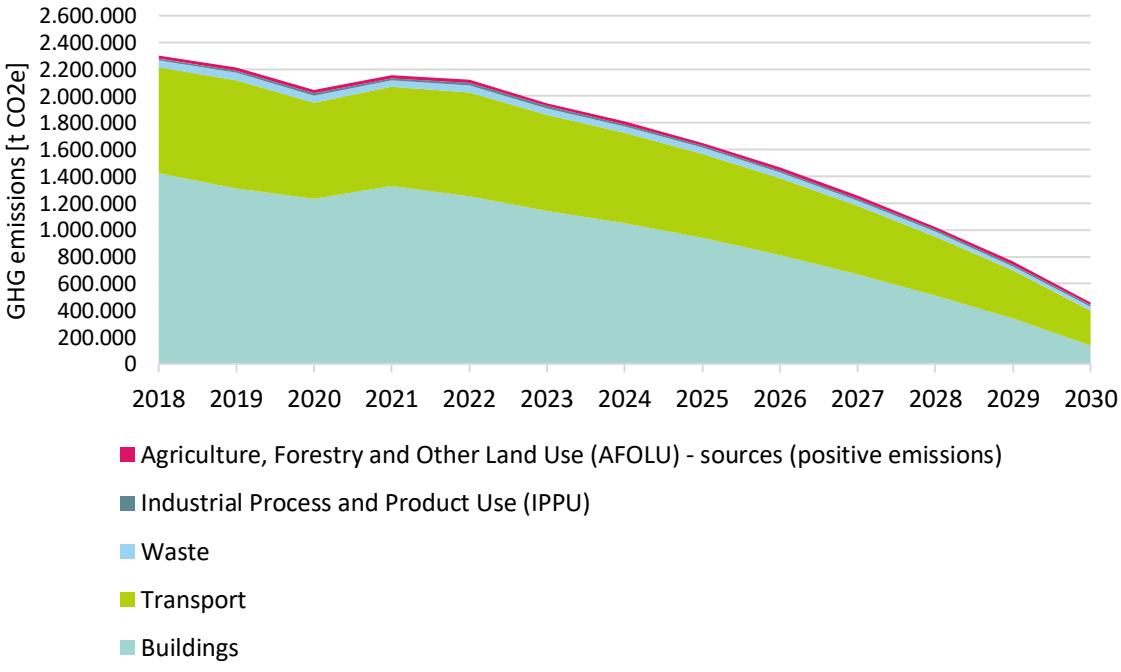

Figure 19: Gradual reduction of GHG emissions due to impact pathways by emission sources until 2030.

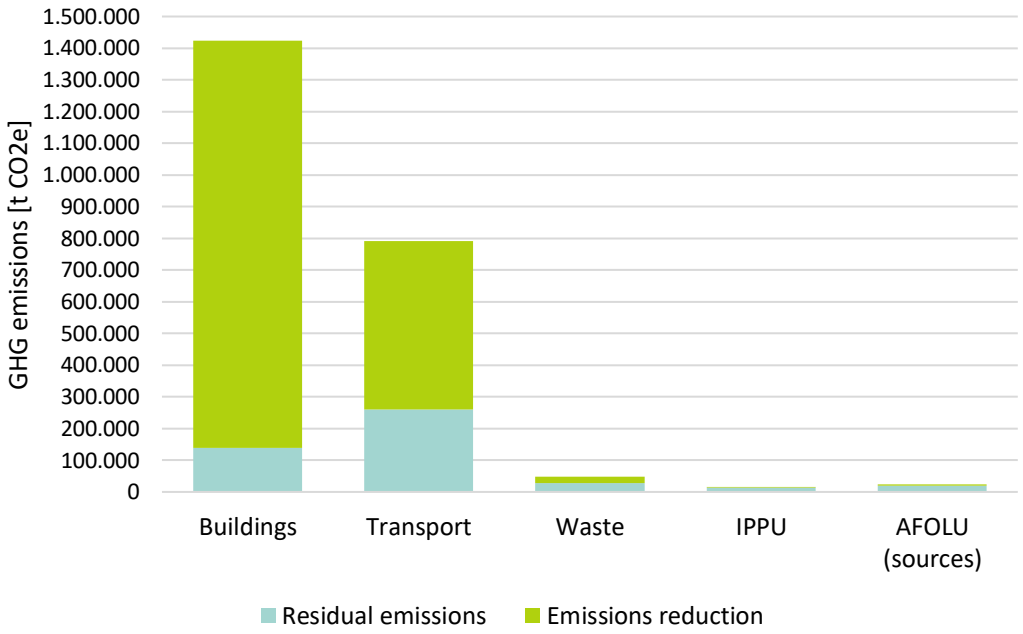

Figure 20: Presentation of emission reductions and residual emissions by sector in 2030.

The impact pathways are closely linked to the strategic priorities set out in the 2030 climate neutrality target. Key challenges addressed by these pathways include the lack of ambition in existing policies, the need for increased investment and action in individual sectors, and overcoming challenges related to infrastructure adaptations, behavioural change, and the introduction of new technologies.

In the following, **impact pathways are presented for each field of action**, starting with a description of the current situation through to the effects of the expected measures to achieve reduction in GHG emissions. An overview of the existing strategies is provided for each area of action and compared with the impact pathways required to achieve climate neutrality by 2030.

ENERGY SYSTEMS

The City of Ljubljana and its public and private sector actors use very different energy systems, which, based on the baseline year 2018, account for 61.8% of all greenhouse gas emissions in the emissions inventory. Ljubljana has two basic energy supply systems: a district heating system and a natural gas supply system, both of which are operated by Energetika Ljubljana (local district heating and gas supply company).

Today, Energetika Ljubljana supplies more than 120,000 customers, or 75% of residential buildings in the City of Ljubljana, with district heating and natural gas, aiming to increase this share to 80% by 2024. The district heating network, which was built in 1966, mainly covers the central part of Ljubljana and supplies over 58,900 residential and over 5,700 commercial customers with hot water for heating and domestic sanitary water. The natural gas pipeline network extends even further to the outskirts of the capital and neighbouring municipalities: Medvode, Dol pri Ljubljani, Dobrova - Polhov Gradec, Škofljica, Brezovica, Ig, Log - Dragomer, Grosuplje. Natural gas for heating, hot water or cooking is supplied to over 60,900 private and over 2,900 commercial users. Together, the two systems comprise over 1,600 kilometres of infrastructure and form one of the largest and most developed and branched energy-efficient supply systems in this part of Europe.

In addition to the current power generation units located within the Energetika Ljubljana facility, several solar and hydropower plants are in operation, both in the public and private sectors. Energy efficiency and energy management are already recognised as important elements of all energy systems in the City of Ljubljana, with investment in system optimisation being encouraged at both local and national level.

The City of Ljubljana will decarbonise its district heating system through the integration of RE technologies (heat pumps, waste heat, solar energy, biomass, and biogas). A cogeneration-based waste-to-energy plant (WtE) connected to Ljubljana's district heating system is also planned. In addition to the centralised district heating system, the installation of two separate smaller district heating systems (4th and 5th generation) in the outskirts of Ljubljana is envisaged. The joint optimisation of the electricity grids and the district heating systems will also lead to a cost reduction in the expansion of the electricity grids, as fewer electrical heating devices will be required that would otherwise be fed into the medium and low-voltage level.

For this purpose, a detailed study on the decarbonization of heating systems in the City of Ljubljana was conducted (Technical Assistance - Preparation of a study on the decarbonization of local production heat sources in the City of Ljubljana, ELES d.o.o, December 2023), which assessed the reduction of emissions through the transition to renewable energy sources and investments in new technologies.

The focus is on new green electricity generation plants, e.g. the installation of biogas and biomass CHP plants (in the central generation plant of Energetika Ljubljana), new rooftop photovoltaic projects (both in the public and private sector) and three small hydropower plants on the Ljubljanica river. The utilisation of waste heat (primarily connected to the district heating network) from industrial plants and the commercial sector will be an important step on the road to sustainability. The production and utilisation of green hydrogen will also become an important element in the energy sector. An increase in electricity consumption is inevitable, so our approach is based on the exclusive use of green electricity, which means that the missing electricity will have to be purchased on the market (with appropriate guarantees of origin) and/or via power purchase agreements (PPAs).

The collected measures in the energy sector will lead to an emission reduction of 1,165,147 t CO_2e/year. In addition, the use of carbon capture and utilisation (CCU) technology will lead to negative emissions (approx. 394,616 t CO_2e/year) to offset emissions in sectors and activities where it will not be possible to completely reduce all emissions through measures, or in activities where the Citi of Ljubljana does not have control over emissions (e.g., transit traffic on motorways).

Direct impacts (emission reductions):

- Total reduction in greenhouse gas emissions as a synergetic result of the implementation of all planned measures: 1,165,147 t CO_2e/year.

Indirect impacts (co-benefits):

- Reduced energy costs.
- Decrease in dependence on fossil fuels.
- Improvement of reliability and resilience of the power grid.
- Reduction in the impact of industry.
- Improved air quality and public health.
- New green jobs.
- Increased energy security.
- Long-term cost stability.

- Community engagement.
- Investment incentives.
- Technological innovation.
- Enhanced capacity building.
- Fostering technological Innovation.
- Reducing time to market.
- Attracting investment.
- Facilitation of stakeholder collaboration.

The existing strategies in Ljubljana's energy sector are not ambitious enough to achieve the climate neutrality targets by 2030. This is also the main argument in favour of choosing these impact pathways, where the measures are more ambitious and show what needs to be done in the energy sector to achieve climate neutrality. The proposed impact pathways envisage a comprehensive and ambitious set of measures, ranging from the installation of renewable energy systems to the gradual replacement of fossil fuel boilers and the development of a reliable and sustainable electricity grid. These pathways also emphasise community engagement, multi-stakeholder collaboration and innovative policy measures that reflect a proactive approach to overcoming barriers and moving the city towards a carbon-neutral future. The proposed measures represent a significant improvement on current strategies and are in line with the city's vision of sustainable energy, economic development, and environmental responsibility.

The selected impact pathways address short and long-term climate protection priorities through a comprehensive approach. Initially, the focus is on understanding barriers, engaging potential users, and fostering collaborations. The city research carbon capture, tests innovative strategies and improves governance networks. Early actions toward climate neutrality also include improving energy efficiency, utilizing waste heat and renewable energy sources, and promoting the purchases of zero-emission electricity. Efforts also focus on optimizing industrial and heating systems, upgrading public lighting, raising awareness, and fostering collaboration across sectors to achieve sustainability goals.

Late outcomes toward climate neutrality involve expanding district heating with renewables, transitioning to green hydrogen, and decarbonizing gas pipelines. Other efforts include upgrading individual heating systems and replacing fossil fuel boilers, enhancing grid reliability, and promoting sustainable energy use through innovation and consumer participation. Emission reduction through decarbonization of energy sources and a carbon capture pilot project are of central importance. Together, these pathways can effectively address climate priorities.

MOBILITY & TRANSPORT

The transport sector represents one of the biggest hurdles to decarbonisation. The current national targets, coupled with financial support, lack the necessary ambition to achieve the targets set.

The impact pathways described in the following chapters form the basis for the decarbonisation of the transport sector. Achieving climate neutrality by 2030 depends crucially on the implementation of a broad range of measures covering private transport, freight transport, public transport, and urban and other institutional vehicle fleets. The development and implementation of this plan requires cooperation between the city, organisations and stakeholders and reflects a shared commitment to sustainable and climate-neutral transport.

In the current situation, the transport sector plays a significant role in emissions, accounting for up to 42% of all greenhouse gas emissions. At 69%, private transport in particular is responsible for most of

these emissions, while freight transport accounts for a significant 26%. Public passenger transport accounts for 4% of total emissions and rail transport for 1%. Other transport segments account for less than 1% of greenhouse gas emissions overall.

This overview illustrates how the various transport sectors contribute to total greenhouse gas emissions. Passenger transport, in particular private transport, is predominant and plays a decisive role in emissions. As a result, measures will primarily focus on reducing private transport and the transition to alternative energy sources. Measures to reduce private transport in the city include new parking regulations, lower speed limits, emission-free zones for walking and cycling, and the promotion of alternative modes of transport through incentives and infrastructure development. Additionally, community mobility infrastructure will be established, and new Park and Ride facilities will be constructed to encourage the use of public transportation. Efforts are also focussed on reducing private car use through a public electric vehicle sharing scheme.

In December 2023, the company PNZ d.o.o. conducted a traffic study that included an assessment of various scenarios for reducing CO_2e emissions. The study was based on three basic scenarios, each addressing key aspects of urban transportation and transport dynamics:

- reducing the resistance to cycling and walking by 20% (improving safety, increasing travel speed...),
- improving public passenger transport (with the upgrade of the rail network already underway, we introduced additional lines and increased travel speeds by introducing priority lanes, priority at junctions and the use of larger vehicles)
- changing accessibility for private cars (speed reduction to 30 km/h on all streets, more expensive accessibility for private cars, such as +10 minutes for the inner city, +5 minutes for the area inside the motorway ring).

It is equally important to tackle the challenges in freight transport, where greenhouse gas emissions need to be reduced. Switching from fossil fuels to environmentally friendly alternatives such as biogas, electricity and hydrogen plays a central role in this reduction. This switch would be a very important step for the freight transport sector, which currently accounts for a significant proportion of total greenhouse gas emissions. By introducing alternative energy sources in freight transport, we will not only reduce emissions, but also contribute to greater energy independence and a reduction in dependence on fossil fuels.

The plan aims to reduce emissions from private transport by 63% and emissions from freight transport by 58% by 2030, with public passenger transport moving towards full decarbonisation. Overall, transport emissions from motor vehicles are to be reduced by 62%. This holistic approach is crucial to successfully achieving sustainable goals and shaping a responsible, environmentally friendly transport system.

One of the most important measures for decarbonising public transport is the transition to alternative and sustainable energy sources and drive technologies. By 2030, all diesel-powered city buses will be replaced by clean, emission-free buses, with 49% of the fleet running on hydrogen or electricity from renewable sources. This switch is expected to reduce greenhouse gas emissions from the vehicle fleet by over 50%. Biomethane, a carbon-neutral fuel, will replace natural gas by 2030 and account for 51% of the bus fleet. The strategy aims to decarbonise 100% of the fleet through a combination of fuel decarbonisation and the introduction of zero-emission vehicles.

To reduce GHG emissions, a comprehensive set of measures focusing on increasing the use of public transport is planned. The expansion of public transport includes new lines, increased bus frequencies and dedicated lanes to reduce travel times, and improved traffic management systems, prioritising

public transport and carrying 250,000 passengers a day. Improvements to railway infrastructure include double-tracking, electrification, the introduction of three new stations, and an integrated timetable to optimize infrastructure, increase efficiency, and reduce delays for seamless travel. Additionally, the establishment of the Ljubljana Passenger Centre aims to centralize public transportation services and promote sustainable urban mobility. The River Public Transport initiative will electrify river transport with 10 electric vessels, the expansion of infrastructure and network connections, and diversify services with a 12 km circular route along the Ljubljanica river. The introduction of a standardised ticketing system will simplify ticket sales, allowing passengers to use a single ticket for different modes of transport, which will improve the accessibility and user-friendliness of public transport.

Direct impacts (emission reductions):

- Total reduction in greenhouse gas emissions as a synergistic result of the implementation of all planned measures: 531,723 t CO_2e/year.

Indirect impacts (co-benefits):

- Improved public transportation coverage.
- Improved user experience of public transport.
- Increased safety for traffic participants.
- Reduced noise in the city.
- Improved air quality and public health.
- Decreased traffic congestion in the city.
- More space for green areas and other uses.
- Enhanced quality of life for residents.
- Enhanced capacity building.
- Facilitation of stakeholder collaboration.
- Interdisciplinary approach.

The main arguments in favour of choosing these impact pathways focus on a holistic approach to transforming public transport. Key measures include the optimisation of routes, the procurement of new electric and hydrogen buses, the development of a charging infrastructure and the creation of a modern passenger centre. Other initiatives such as river passenger transport, park-and-ride facilities and improvements for pedestrians and cyclists contribute to sustainable urban mobility. Other priorities include the gradual transition to clean energy sources, updating legislation and funding strategies to ensure successful implementation in a changing policy environment.

The impact pathways differ significantly from the existing transport strategies in the City of Ljubljana. While the current strategies primarily enforce regulations and focus on improving public transport and environmental compliance, the proposed measures introduce a comprehensive approach to transforming urban mobility. The pathways, such as optimising public transport, reducing individual road traffic, decarbonising transport, and improving pedestrian and cycling infrastructure, overcome identified barriers and address opportunities. This shift reflects a commitment to a sustainable, efficient, and environmentally friendly transport system and goes beyond the scope of current strategies.

The selected impact pathways address both short-term and long-term climate change mitigation priorities in the field of urban sustainability. In the short term, the focus is on optimising public transport, procuring electric and hydrogen buses and securing funding for the transition to clean energy. In the long term, impact pathways include building park-and-ride facilities, improving conditions for pedestrians and cyclists, improving the reliability of rail transport, phasing out fossil fuel vehicles,

introducing stricter parking management, introducing speed limits in the city, and increasing financial support for a sustainable transition to clean energy sources in road transport.

Overall, the impact pathways offer tangible and strategic measures that are fully in line with our city's 2030 climate neutrality commitments and make an important contribution to realising a more sustainable and environmentally friendly transport system.

WASTE & CIRCULAR ECONOMY

In the city of Ljubljana, waste collection and disposal are managed by the public utility company VOKA SNAGA. In 2018, a total of 152,094 tonnes of waste was collected, 67.7% of which was collected separately. The waste is processed at the Ljubljana Regional Waste Management Centre, which includes a landfill and a collection centre spanning around 40 hectares. Three plants for mechanical-biological waste treatment are used to reduce landfill waste, recover recyclable materials, and produce compost.

After treatment in 2018, 18,169 tonnes of waste were disposed of at the landfill site. The landfill generates landfill gas, around 50% of which consists of methane and is captured to reduce emissions. In 2018, 1,207 tonnes of the captured methane were used to operate a cogeneration unit on landfill gas.

Since the waste treatment plant was commissioned in 2015, all collected municipal waste has been processed, minimising the organic carbon in the landfill, and reducing methane formation. Methane generation estimates were calculated using the IPCC method and converted into CO_2 equivalents. Biogenic CO_2 produced at the landfill is absorbed into organic matter and is not included in the total greenhouse gas emissions.

For the waste sector, the aim is to reduce greenhouse gas emissions based on the planned waste management programmes and action plans. The current waste management concept already includes a comprehensive strategy for the sustainable and responsible handling of waste. The focus here is on reducing waste, promoting recycling and efficient waste processing.

Ljubljana's waste management strategy aims to reduce household waste to less than 80kg per inhabitant per year through appropriate measures. With the planned impact pathways, efforts include combating single-use plastics, reducing food waste, and promoting sustainable management of textiles and electronic devices. Initiatives focus on promoting waste reduction, revising regulations, and promoting waste-to-energy projects.

Direct impacts (emission reductions):

- Total reduction of greenhouse gas emissions as a synergetic result of the implementation of all planned measures: 19,990 t CO_2e/year.

Indirect impacts (co-benefits):

- Increased production of renewable energy sources.
- Reduced dependence on traditional energy sources.
- More efficient resource utilization.
- Higher proportion of recycled waste.
- Less landfilled waste.
- Reduction in plastic usage.
- Financial incentives.
- Promotion of circular economy.

- More responsible consumption.
- Increased awareness.
- Reduced environmental pollution.
- Preservation of natural resources.
- Increased awareness on waste reduction.
- Cleaner urban environment.
- Facilitation of stakeholder collaboration.

Investing in advanced waste-to-energy technologies, improving waste collection infrastructure, introducing separate collection of textiles and co-financing sustainable waste management events are the main arguments in favour of these impact pathways. In addition, financial incentives for circular economy practices, the analysis of waste sorting and the establishment of a rental and repair centres for electronic equipment contribute significantly to the promotion of responsible waste management.

The impact pathways outlined in the public utility's 2022-2027 development strategy are in line with the analysis of the status of climate protection measures. The company's focus on waste recycling, reuse and process optimisation is in line with existing strategies. In addition, the strategy is directly in line with the city's 2030 climate neutrality commitments, as evidenced by initiatives such as the construction of a new non-municipal waste recycling plant, the establishment of a mixed packaging centre and the improvement of waste separation. These measures will remove barriers to climate protection and utilise opportunities to generate green energy.

The planned impact pathways address short-term initiatives, which include the introduction of separate collection systems for textiles and electrical equipment, reduced landfilling of mixed municipal waste to lower methane emissions, improved waste management through online applications and fullness sensors, and promotion of sustainable practices such as refill systems, second-hand stores, and home composting. Long-term impact pathways focus on utilizing waste for district heating, developing new technologies for recycled carbon fuels, expanding collection networks, and establishing zero-waste stores, repair services, and packaging-free sales points. Other measures include incentivizing circular economy practices, implementing deposit systems, and encouraging local food sales and eco-gardens.

In line with our city's 2030 commitments to climate neutrality, the impact pathways strategically support sustainable waste management, improve recycling efficiency, and promote environmentally friendly practices. This alignment reflects our commitment to cultivating a circular and environmentally conscious community and contributes significantly to our overarching climate neutrality goals.

GREEN INFRASTRUCTURE & NATURE-BASED SOLUTIONS

Within the broader framework of green infrastructure and nature-based solutions, we also include the agriculture, forestry, and other land use (AFOLU) sector. In 2018, 11,488 hectares of forest land (42%) and 6,001 hectares (22%) of agricultural land were in use in the administrative area of the City of Ljubljana. Most of the remaining land consists of urban areas, suburbs, surrounding rural settlements and transport and other infrastructure. These are mostly built-up urban areas, but also include green spaces such as gardens, parks, lawns, sports fields, and other recreational areas. Green spaces make up around a third of the urban area.

Agriculture continues to be an important steward of natural resources and is one of the most important landscapers in suburban areas. In 2020, there were 791 farms in the City of Ljubljana, 62% of which were engaged in livestock farming. In 2018, the farms in the City of Ljubljana together kept 5,051

cattle, 578 horses, 559 pigs, 927 sheep and goats and 8,770 heads of poultry. On average, each farm has 7 hectares of agricultural land, and in 2020, 134 farms had an area of more than 10 hectares.

The City of Ljubljana is implementing initiatives to reduce greenhouse gas emissions and enhance natural CO_2 sinks. Through the greening plan, urban green spaces are being expanded to 40%, utilizing various greening measures such as green roofs and facades, public orchards, and community gardens, sustainable urban forests, and blue-green corridors.

In December 2023, a study was conducted to assess emissions and carbon sinks for the land use sector, land use change, and forestry (LULUCF) in the City of Ljubljana. The study was carried out by the Slovenian Forestry Institute.

Additionally, essential water management practices are being employed to improve water retention and filtration, as well as enhance water and air quality, contributing to urban liveability. These measures not only promote the well-being of citizens but also mitigate the urban heat island effect, regulate temperatures, and reduce energy consumption, ultimately resulting in a more sustainable and resilient urban landscape.

In the area of forest management, the city promotes responsible practices among private forest owners to maintain the 42% forest cover. Spatial analyses and protection measures as well as the acquisition of socially valuable forests contribute to the long-term preservation of the carbon sink.

Measures in sustainable agriculture are focussed on local food production as part of the "Green Supply Chain" project. Impact pathways include protecting agricultural land, improving self-sufficiency, and introducing climate-resilient agriculture. Collaboration with landowners aims to increase the number of permanent crops while incentivising sustainable farming practices, including an efficient nitrogen cycle and a breeding programme to reduce methane emissions.

Direct impacts (emission reductions):

- Overall reduction of greenhouse gas emissions in agriculture as a synergistic result of the implementation of all planned measures: 3,634 t CO_2e/year.
- The aim is to increase natural CO_2 sinks by 15,800 tonnes.

Indirect impacts (co-benefits):

- Mitigation of the urban heat island effect.
- Improved stormwater retention.
- Increase in biodiversity.
- Mitigation of environmental impact.
- Increase in green areas.
- Adaptation to climate change.
- Improvement of environmental well-being.
- Improved public health.
- Conservation of natural resources.
- Enhancement of forest resilience.
- Enhancement of connectivity among farmers.
- Greater involvement of farmers.
- Increased food self-sufficiency.
- Strengthening local businesses.
- Strengthening knowledge and skills.

- Optimisation of agricultural practices.
- Reduced water pollution.
- Reduction of nitrogen in water bodies.
- Restoration of native habitats.
- Improved soil health.
- Increased local food production.
- Enhanced capacity building.
- Facilitation of stakeholder collaboration.
- Interdisciplinary approach.

The main motive for implementing these measures is to improve environmental sustainability and resilience in urban and natural areas. The implementation of comprehensive measures in Ljubljana, such as the urban greening plan, sustainable forest management and climate-oriented agricultural measures, is crucial for reducing greenhouse gas emissions, strengthening the city's resilience to climate change, preserving vital ecosystems, ensuring food security, and promoting overall environmental sustainability. Together, these measures address environmental challenges, improve quality of life, and contribute to a more sustainable and resilient urban landscape.

The new initiatives are in line with existing climate protection strategies in Ljubljana. The urban greening plan complements the urban spatial plan's focus on climate resilience through urban planning. The focus on green infrastructure, sustainable forests and water management is in line with the strategy for the development of urban forests, which ensure a healthy living environment and the protection of nature. The upcoming forest management measures reinforce existing efforts to conserve forest cover and control encroachment and are in line with broader environmental protection objectives. Climate-orientated CAP interventions in agriculture are in line with the existing focus on food self-sufficiency and farmland protection in the city's strategy. The agricultural policy update includes incentives to reduce emissions and supports the city's commitment to environmentally conscious and climate resilient agricultural practices that reinforce existing strategies.

The selected impact pathways address short-term climate priorities by emphasising the efficient use of animal feed, improved nitrogen cycling in agriculture, expansion of water level monitoring systems, promotion of sustainable farming practices and urban greening for biodiversity and flood protection. Measures such as joint breeding programmes, improvements in agricultural policy and the expansion of community forests contribute to the immediate goals of reducing emissions and enhancing carbon sinks.

In the long term, the emphasis shifts to the installation of new green roofs and facades, the establishment of green mobility corridors, and the implementation of flood prevention infrastructure. Nature-based water solutions and the expansion of green spaces are expected to enhance water management and overall urban sustainability. Additional efforts will focus on habitat restoration, improving riverbed water flow, and expanding permanent crop and forest areas. Strategies for sustainable agriculture, mitigating urban heat islands, and conserving biodiversity are being developed to ensure long-term resilience and environmental sustainability. Emphasizing protected areas, climate-smart agriculture, and forest management aligns with broader sustainable initiatives aimed at reducing emissions, promoting self-sufficiency, and enhancing the urban environment in the long run.

The impact pathways are in line with the strategic priorities set out in the city's 2030 climate neutrality commitments. Initiatives such as urban greening, sustainable forest management and climate-oriented agricultural measures are directly in line with the commitment to reduce emissions, strengthen carbon sinks and promote environmental protection. The focus on efficient resource use, urban sustainability

and the long-term urban greening plan reflects the city's commitment to achieving climate neutrality by 2030. The selected impact pathways thus effectively contribute to fulfilling the outlined commitments and advancing the city's climate agenda.

BUILT ENVIRONMENT

In 2022, there were a total of 72,110 buildings in the city of Ljubljana, including 37,050 residential buildings (51%) and 35,060 non-residential buildings (49%).

The data shows that a large proportion of the buildings have non-renewed roofs (65.7%) and facades (83%). Of the residential buildings, 51% have renovated roofs and 26% have renovated facades. Windows were replaced in 15% of all buildings.

Energy-efficient building renovations and other measures related to the efficient use of energy and renewable energy sources are co-financed by Eco Fund through grants and favourable loans. Eco Fund, the Slovenian public environmental fund, is a state organisation that supports initiatives for environmental sustainability, energy efficiency and sustainable practices.

According to Eco Fund, a total of 12,436 investments were made in improving the energy efficiency of buildings and promoting renewable energy sources between 2009 and 2022. The peak year for investments was 2020 with 1,471 recorded projects. The most important areas of investment between 2009 and 2022 include building joinery (3,871), thermal insulation (3,024), gas condensing boilers (1,965), ventilation (1,926) and heat pumps (387). On average, 957 investments co-financed by Eco Fund were made each year.

The current trend in retrofitting is insufficient and emphasises the need for increased investment and retrofitting - a crucial step in driving energy efficiency and achieving the set targets. The average specific heat consumption of buildings in the city of Ljubljana is 122 kWh/m^2, which indicates a significant potential for savings. Buildings that are energy-inefficient are either comprehensively or partially refurbished. Refurbishment measures include the installation of thermal insulation, the replacement of joinery, the renewal of the heating system and installation of ventilation with heat recovery. Energy renovation of 50% of the heated building stock is envisaged, where feasible. In this case, energy consumption would decrease by 16%, with the average energy figure reduced to approximately 100 kWh/m^2.

Additionally, it involves the use of eco-friendly materials, energy-efficient construction to achieve passive standards, and prioritizing wood as a sustainable building material. The City of Ljubljana is embracing wooden construction for buildings such as schools, kindergartens, sports halls, etc., where feasible. Furthermore, it will explore options to promote wooden construction in private projects, provide education, and encourage its investors and residents to build wooden houses. One of the goals is also to ensure that the new and renovated infrastructure is resilient to extreme weather events and capable of reducing the negative impacts of climate change on the population in accordance with the concept of "Climate proofing".

In addition to the already mentioned measures, other interventions in the built environment are planned, aimed at improving the quality of life in the city. Areas of friendly traffic, also known as "super blocks", will be established to promote sustainable mobility and reduce traffic congestion. In addition, the emphasis will be on revitalizing courtyards, where accessible, green community spaces will be created, serving as centres of social life and recreation for residents.

The establishment of self-sufficient neighbourhoods will promote a high level of autonomy in the supply of energy, water, and food. Additionally, potential locations for creating new public spaces will be identified, their layout and design planned, and projects implemented for their establishment. The goal

is to improve the quality of urban living, provide access to green areas, create social and recreational spaces, and promote public life and activities for residents.

Direct impacts (emission reductions):

- Total reduction in greenhouse gas emissions as a synergistic result of implementing all planned measures: 120,091 t CO_2e/year.

Indirect impacts (co-benefits):

- Improved energy security.
- Creation of jobs.
- Increased public awareness and capacity building.
- Decreasing environmental stressors.
- Improved urban aesthetics and functionality.
- Enhanced building resilience to climate change.
- Reducing traffic routes.
- Reducing dependence on individual transportation.
- Fostering technological Innovation.
- Reducing time to market.
- Attracting investment.
- Facilitation of stakeholder collaboration.

The main arguments in favour of these impact pathways are tackling challenges together, creating business models for energy efficiency, promoting climate-friendly construction, extending policies to NZEB standards, ensuring NZEB compliance in new buildings, renovating existing buildings, providing financial support for sustainable housing, and facilitating thermal renovation. These pathways aim to comprehensively address challenges, promote sustainable practices, and provide financial support for the transition to green building.

The impact pathways are more ambitious compared to existing climate strategies. There is a clear difference between the targets of current strategies, which aim to reduce specific energy consumption in residential buildings by 15%, in public buildings by 40%, and new measures to achieve climate neutrality. The new plans aim to energetically renovate 50% of the building stock, representing a significant advancement compared to the current trend.

The selected impactful measures comprehensively address both short-term and long-term climate protection priorities. In addition to the energy renovation of buildings, sustainable construction and wooden building construction are key pillars of these measures, which will enable a reduction in carbon footprint and increase energy efficiency. Furthermore, construction and renovation are conducted in accordance with the concept of Climate Proofing, which includes measures to increase infrastructure resilience against climate change.

The new initiatives represent an upgrade to existing strategies in the built environment, including spatial planning. The main motive for implementing these measures is to improve the quality of urban living and the environment and to promote sustainable development. With this aim, we will establish areas of friendly traffic, known as "super blocks," which will promote sustainable mobility, reduce greenhouse gas emissions, and create a more pleasant and safe environment for pedestrians and cyclists. At the same time, the urban landscape will be revitalized by creating accessible, green communal spaces in courtyards, which will serve as centres of social life and recreation and contribute to preserving biodiversity and improving air quality. Additionally, self-sufficient neighbourhoods will be established. The new public spaces that we plan to establish will provide access to green and open

areas, promote social connections, and strengthen local communities. Urban planning will also consider microclimate conditions, contributing to the improvement of public health and well-being of residents, and create a sustainable and pleasant living environment for current and future generations.

The impact pathways are in line with our city's wider 2030 climate neutrality commitments and address a range of objectives, such as addressing challenges and scaling up policy measures, at the same time also focusing on priorities such as improved energy efficiency, climate-friendly construction, and spatial planning. These pathways, including specified financial support, serve as a strategic framework to promote and strengthen our city's commitment to achieving climate neutrality by 2030.

3.2 Module B-2 Climate Neutrality Portfolio Design

Module B-2 “Climate Neutrality Portfolio Design” contains a project description for **each action planned** in the CCC Action Plan. This includes interventions targeted at creating/enhancing carbon sinks to address residual emissions.

The Climate Portfolio Design includes actions in field of energy systems, mobility & transport, waste & circular economy, green infrastructure & nature-based solutions, built environment, digitalization, engaging and collaborating with stakeholders.

B-2.1: Description of action portfolios - textual or visual		
Fields of action	Portfolio description	
	List of actions	Descriptions
Energy systems	**Decarbonisation of heat supply energy sources** - Decarbonisation of district heating system - Waste to energy (WtE) plant - Hydrogen integration in industrial processes - Injection of biomethane into the distribution gas pipeline network - Fossil fuels phase out for individual heating systems	**Decarbonisation of heat supply energy sources** The city of Ljubljana will decarbonize its district heating system, which currently provides heat to 60,000 residential buildings (approximately 48% of all buildings). Current energy sources are primarily fossil fuels (brown coal and natural gas - together more than 90% or 1 TWh/year). The plan involves existing infrastructure renovation by integrating RES-based technologies (heat pumps, waste heat, solar energy, biomass, and biogas). After additional processing of municipal waste, approximately 110,000 tons of fuel are produced, which cannot be recycled but are suitable for energy recovery. Plans are underway to establish a facility for energy recovery of this fuel, which will simultaneously generate heat and electricity. Industrial processes currently use mainly fossil fuels, mainly natural gas. The availability of green hydrogen will significantly contribute to the decarbonization of various sectors, including energy-intensive industries. It is planned that by 2030, hydrogen will cover up to 15% of the current energy demand based on natural gas in industry. By 2030, the distribution gas network in Ljubljana will transition to decarbonized operation using green hydrogen (15%), local biomethane, and the purchase of biomethane on the market. Local sources of biomethane, including existing biogas plants, will be directly connected to the gas network,

		with plans for upgrades with purification facilities. Public company Energetika Ljubljana is also in discussions with other potential suppliers from Slovenia, while a smaller portion of quantities would be purchased on the European market. Heating individual buildings outside the distribution gas network relies mainly on heating oils, biomass, LPG, and electricity (611 GWh/year). There is a gradual plan to phase out heating oil nationally by 2027. Heating oil and liquefied petroleum gas will be replaced in the future with wood biomass or electric energy (heat pumps).
	Green energy production - Biogas and biomass cogeneration units - Photovoltaic projects - Waste heat utilization - Hydrogen production - Biogas production - Hydropower production - Purchase of carbon-free electricity	**Green energy production** City of Ljubljana makes strong focus on production of green energy. The integration of combined heat and power (CHP) systems in industrial and commercial sectors optimizes energy usage by utilizing biogas or biomass, promoting efficient resource utilization, and ensuring grid stability and reliable energy supply, especially during winter months. Roof-top photovoltaic projects (on-going and planned) on various buildings will furthermore increase local production of green electricity. 70 GWh/a of waste heat from different industrial and other processes will be integrated into district heating network. Establishing hydrogen production facilities (electrolysis using green electricity) will be important part of city green energy production and decarbonization strategies. By 2030, approximately 350 GWh/year of gas from renewable sources will be injected into the distribution gas pipeline network. Identified sources of biomethane include existing biogas plants and industrial facilities covered by signed bilateral agreements. Furthermore, construction of three small hydropower plants on the Ljubljanica river will diversify power production portfolio. Missing electricity (not produced from local RES sources) will be purchased on the market (with relevant certificated of origin) and through Power purchase agreements (PPA).
	Sustainable electricity grid - Power system flexibility - Energy storage - Power grid reliability	**Sustainable electricity grid** The flexibility of the electricity system is becoming crucial with the increasing share of renewable energy sources, enabling dynamic adjustment of electricity and heat production and/or consumption. Integration of measures and collaboration among relevant stakeholders improve the system's agility and resilience. Implementing energy storage solutions is essential to enhance grid reliability and facilitate the integration of renewable energy sources, storing surplus energy generated during periods of low demand or high production from renewables. The planning of new smaller district heating systems and individual heating systems with heat pumps requires the construction of additional

		local electric transformer stations to meet the increased demand for electric power.
	Energy efficiency - Public street lighting retrofit - Installation of energy efficient individual heating devices (boilers) - Reduction of heat losses in district heating systems - Energy efficiency in the industry sector	**Energy efficiency** Energy efficiency is crucial for achieving the city's climate goals, so we are planning numerous measures across different sectors. This includes replacing inefficient public lighting with LED lamps and smart management. By 2030, we plan to replace heating devices using wood biomass and natural gas with new boilers using wood biomass and new condensing boilers, with the use of biogas. It is also important to reduce heat losses in the district heating network, which will be achieved by optimizing network operation, modernizing heat substations, and improving pipeline insulation. The goal is also to improve energy efficiency in industry, which will be achieved through the modernization and optimization of industrial energy systems.
	Energy Management - Energy management system - Active consumer of thermal and electrical energy	**Energy Management** Energy management is the proactive and systematic approach for monitoring, control, and optimization of energy systems to reduce energy consumption and decrease costs. It includes several measures: utilization of smart energy management systems for monitoring and control, energy audits (in public and private sectors) and create environment for active consumers which will, as a group of jointly acting consumers or through aggregators, participate in schemes considering their energy production, consuming, storing or selling.
	Negative emissions - Implementation of carbon capture and use/utilization (CCU)	**Negative emissions** City of Ljubljana is planning integrate carbon capture and use/utilization (CCU) technology allow reusing captured carbon, thus potentially reducing its emissions to the atmosphere. The capture of CO_2 emissions will be conducted at the main energy production unit (cogeneration, located at the TE-TOL site in Ljubljana-Moste), connected to the district heating system and other industrial facilities, as well as at the new facility for energy recovery from waste. Captured CO_2 will be transported to relevant (local/regional) industrial producers that will re-use CO_2 in their processes - several technologies are currently in use or being developed, including those to make plastics, concrete, chemical reactants, and synthetic fuels.
	Organizational, incentive, and awareness-raising measures - Promotion of energy efficiency and	**Organizational, incentive, and awareness-raising measures** To promote energy efficiency, we will organize events and workshops for awareness-raising and create a website tool to inform about energy and cost savings during home renovations. Collaboration with educational institutions will enable worker

	transition to renewable sources - Creating new jobs in the field of renewable energy and energy efficiency - Energy poverty - Energy communities - Energy consulting office - Research/educational content	training and innovation promotion in the energy sector. Implementation of measures is based on the national Action Plan for Combating Energy Poverty, which includes investment incentives and the establishment of advisory points. Promoting energy communities increases energy self-sufficiency and raises awareness of sustainable energy use. The Energy Advisory Office provides information and advice for a more sustainable energy future. Research topics in energy cover various aspects influencing energy efficiency and analyse social and psychological factors in energy consumption. The aim is to promote sustainable habits and address energy poverty, focusing on a holistic approach to the challenges of sustainable energy in urban environments.
Mobility & transport	**Enhancing public transportation** - Enhancing urban public bus transportation - Improving railway public transport - Renovation of the main bus and train station - Establishment of river public transport - Implementation of a unified ticketing system for all passengers **Improving green mobility and managing accessibility**	**Enhancing public transportation** Various measures will be implemented to significantly improve the overall public transportation system. This includes the introduction of additional urban public transport lines, increasing departure frequencies, adding bus lanes, smart traffic light management and using longer vehicles. Efforts will also focus on optimizing travel times, ensuring more efficient and punctual passenger transport. Improvements in railway public transport will be pursued to provide seamless and integrated travel experiences. Additionally, the renovation of the main bus and train station is planned to modernize and enhance the central public transportation hub. The area will be redesigned with new green spaces and safer traffic zones, aligned with the principles of sustainable mobility. To expand public transportation options in the city centre, a circular route along the Ljubljanica river is planned, offering an alternative and eco-friendly mode of transport. Furthermore, the introduction of a unified ticketing system for all passengers is envisaged to allow the use of a single ticket for various modes of transportation, promoting easy access and enhancing the attractiveness of public transport. These combined initiatives aim to create a more robust, accessible, and sustainable public transportation system for the community. **Improving green mobility and managing accessibility** The main goal of the measure is to reduce personal vehicle traffic in the city centre and areas outside the bypass, thereby alleviating congestion and

	- Managing city accessibility for personal vehicles - Establishing community mobility infrastructure - New Park and Ride (P+R) areas and Park + Sail - Development of alternatives and innovations for better accessibility	encouraging the use of public transportation. These measures will be implemented after improving public transportation services to ensure a fair transition. The establishment of community mobility infrastructure is also planned, involving the development and implementation of transportation solutions tailored to community needs. This approach not only enhances transportation links and accessibility but also strengthens community spirit, cooperation, and contributes to a more sustainable and connected urban environment. Building two new Park and Ride (P+R) facilities will encourage daily commuters to use public transportation, further reducing traffic in the city centre. These parking areas will be connected to new river public transportation stops, enabling travel to the city centre via river e-vessels. Efforts to improve accessibility for all will continue with the development of services facilitating easier and more comfortable sustainable travel, including the expansion and enhancement of transportation services for people with disabilities through the "Kavalir" program. The anticipated effects of the measures are a 28% reduction in kilometres travelled by private cars.
	Decarbonisation of road and other motor vehicles - Modernisation and decarbonization of urban and suburban public bus transportation - Decarbonization of vehicles owned by the City of Ljubljana, public institutions, and public companies - Charging infrastructure for electric and hydrogen vehicles - Decarbonisation of passenger cars - Decarbonisation of freight vehicles and buses - Decarbonisation of agricultural machinery	**Decarbonisation of road and other motor vehicles** These measures include replacing all city buses fuelled by diesel with clean and zero-emission vehicles, reducing CO_2e emissions by over 50%. Simultaneously, there is a plan to replace compressed natural gas with carbon-neutral biomethane, which is expected to represent 51% of the vehicle fleet, resulting in a 100% decarbonization of the fleet. Additionally, there is a proposed modernization and decarbonization of the municipal administration, public companies, and institutions' vehicle fleets, transitioning to environmentally friendly vehicles, including electric ones for personal, light, and medium-duty transportation, as well as biomethane for heavy-duty vehicles such as waste collection trucks. The installation of charging stations for electric and hydrogen vehicles for urban passenger transport, including new charging stations in parking lots and fast-charging centres, is also planned. Furthermore, there will be a significant shift in the fuel structure of personal vehicles, light commercial

		vehicles, heavy-duty vehicles, and other buses (inter-city buses) to further contribute to this goal. It is also necessary to reduce the use of fossil fuels in agriculture by utilizing alternative energy sources such as biomethane or electricity to power agricultural machinery. The aim is to replace at least a third of the current diesel fuel consumption with alternative sources. Electrification, hydrogen, and biomethane will play a significant role in transitioning away from fossil fuels.
	Improving infrastructure for cyclists and pedestrians - Improving conditions for cyclists and pedestrians	**Improving infrastructure for cyclists and pedestrians** The comprehensive measures aim to enhance the urban environment by improving conditions for pedestrians and cyclists. This includes the development of pedestrian-friendly infrastructure and dedicated cycling lanes. In addition, the initiative involves transforming conventional traffic zones into green and recreational spaces, fostering a more sustainable and liveable urban landscape. The promotion of walking and cycling is actively encouraged through awareness campaigns, educational initiatives, and community engagement programs, fostering a culture of environmentally friendly and healthy modes of transportation.
	Organizational, incentive, and awareness-raising measures - Promoting sustainable mobility - Development of a new Sustainable urban mobility plan (SUMP) - Research/educational content - Transport poverty - Establishment of the sustainable mobility department - Coordinating the needs of users who gravitate towards the City of Ljubljana	**Organizational, incentive, and awareness-raising measures** Measures to promote sustainable mobility include promoting cycling, walking, the use of renewable energy sources, and public transport. The preparation of a new comprehensive traffic strategy for the City of Ljubljana will be carried out in collaboration with various stakeholders and will involve defining goals, measures and mechanisms for monitoring and reporting. Research and educational activities focus on technological, infrastructural, social, and psychological aspects of sustainable mobility, aiming to develop strategies to promote sustainable habits in urban environments. City policies already address transport poverty through subsidizing public transport, developing cycling infrastructure, and other measures. The action plan will complement these measures to reduce transport poverty, while the national plan will continue a comprehensive approach at the national and local levels. Establishing the Department of sustainable mobility in the City of Ljubljana follows the global trend of

		many cities recognizing the importance of sustainable mobility for quality of life and the environment. This department enables a comprehensive approach to transport policies and coordinated action across sectors, reducing greenhouse gas emissions and creating a healthier urban environment. Adapting parking options and sustainable mobility in the City of Ljubljana is carried out by analysing and considering the needs of users from other municipalities before their arrival in Ljubljana.
Waste & circular economy	**Waste reduction** - Reducing waste generation, promoting reuse and recycling - Reduction of household mixed municipal waste to less than 80 kg per capita per year - Reduction of single-use plastic - Reduction of food waste - Reduction of textile waste - Reduction of electronic and electrical waste **Waste management** - Implementation of waste-to-energy aspects - Exceeding 75% of separately collected	**Waste reduction** A comprehensive approach is planned to reduce waste, including campaigns, regulations, pricing policies and circular economy goals. Implementing differentiated waste pricing and financial incentives for recycling will further promote sustainable practices. Revamping waste management programs, focusing on innovation and rewarding sustainable practices, is essential for effectively reducing waste and promoting recycling for a more sustainable society. The goal is to reduce household waste to less than 80 kg per inhabitant annually and promote resource efficiency by emphasizing waste prevention, reuse, and recycling for a more sustainable society. To address the issue of single-use plastic, the strategy includes sorting analysis, co-financing for plastic reduction events, packaging-free sales points, and promoting refillable containers. The reduction of food waste involves systematic record-keeping, chef education, sourcing local food, and establishing a food exchange platform to redirect surplus to those in need. Sustainable textile management focuses on separate textile collection, clothing design and exchange, repair shops and prioritizing recycled materials in public procurement. For electrical and electronic equipment, a sharing system is being introduced, promoting lending libraries and service centres, increasing collection points, and prioritizing refurbished equipment in public procurement. **Waste management** Energy production from waste follows Waste management and Waste prevention programs, with a focus on thermal treatment for district heating. New technologies are being developed to synthesize recycled carbon fuels such as synthetic fuels, hydrogen and synthetic gases obtained from waste,

	waste and reaching 80% by 2035	forming a comprehensive approach to sustainable waste-to-energy utilization. Upgrading of the infrastructure for separate collection of municipal waste is planned, which will achieve the goals of separate waste collection by 2030 (75%) and 2035 (80%) and enable users to properly separate waste. Various communication tools target different groups, promoting proper waste management and facilitating effective separate collection. The plan includes building 3 collection centres, expanding collection points, establishing 9 mini-collection centres, specific actions for hazardous waste, promoting home composting, introducing concepts for handling minor construction waste, and conducting waste management strategy analysis.
Green infrastructure & nature-based solutions	**Green and blue-green infrastructure** - Greening of the city - Sustainable water management	**Green and blue-green infrastructure** Urban environment is facing climate change and urbanization along with the need to preserve the quality of life. Therefore, concepts of green and blue-green infrastructure are increasingly established, contributing to sustainable and more pleasant urban environments. Green infrastructure, which includes the greening of urban areas, plays a key role, while sustainable water management is becoming increasingly important due to vulnerability to floods and other water challenges. The concept of blue-green infrastructure, which combines green infrastructure with sustainable water management, improves the aesthetics and biodiversity of urban areas and contributes to better stormwater management and the quality of life of residents. The city greening plan will be linked to measures for sustainable mobility, including greening mobility corridors and parking areas. The development of green corridors, separated from motorized traffic and surrounded by greenery, enables safe and pleasant mobility, reduces traffic noise, and improves air quality. These corridors promote sustainable mobility modes such as cycling and walking, contributing to a greener and healthier urban environment. Comprehensive river system management will be introduced, involving water flow regulation, habitat restoration, sediment removal and the installation of barriers to maintain a balance between human needs and ecosystem preservation. The goal is to prevent floods, ensure water resources, preserve biodiversity, and support socio-economic activities along the river.

	Forest management - Maintaining stable forest area	**Forest management** The goal of this measure is the long-term preservation of a stable forested area, which currently covers approximately 42% of the territory of the City of Ljubljana. With this measure, linked to smart spatial planning, the aim is not only to preserve the land's potential for CO_2 absorption but also to limit and gradually reduce emissions due to deforestation.
	Sustainable agriculture and agricultural policy - Protecting agricultural land and increasing local self-sufficiency - Conservation and restoration of hedges and riparian buffer strips - Increasing the area of permanent crops - Rational fertilization of crops with nitrogen - More efficient nitrogen circulation in agriculture – gross nitrogen balance surplus - Increasing the efficiency of domestic animal breeding - Upgrading agricultural policy - integrating climate policy and climate change adaptation	**Sustainable agriculture and agricultural policy** Sustainable and coordinated spatial development and protection of agricultural land are crucial for high-quality food production and increasing self-sufficiency. The measure includes developing expert bases for determining permanently protected agricultural land and guidelines for adapting agriculture to climate change. The goal is to increase the extent of permanently protected and climate-adapted agricultural land and promote local vegetable production, especially organic farming. Hedgerows and riparian buffer strips are essential for landscape preservation as they contribute to carbon sequestration, biodiversity, erosion prevention and water quality improvement. The measure includes promoting the restoration of field boundaries and riparian zones in the Natura 2000 area on the Ljubljana Marshes in the City of Ljubljana and removing invasive species while replacing them with native plants. Emphasis is placed on rational fertilization of agricultural crops with nitrogen, which is crucial for sustainable farming. Agricultural companies will receive financial incentives for investments in improving activity efficiency and infrastructure projects. Public agricultural advisory services will support farmers in implementing sustainable fertilization practices to preserve the environment. Efficient nitrogen cycling in agriculture is crucial for sustainable management of natural resources, hence various measures and financial incentives are available to promote sustainable practices. The city will follow a cattle breeding program focused on improving feed energy utilization and reducing methane emissions. Financial incentives will be available for investments in increasing agricultural efficiency. The planned overhaul of agricultural policy will aim to reduce greenhouse gas emissions and promote sustainable farming.
	Organizational, incentive, and awareness-raising measures	**Organizational, incentive, and awareness-raising measures** Awareness about the importance of greenery in cities will be raised through campaigns, workshops,

	- Raising public awareness of the importance of green spaces - Promoting sustainable forest management - Enhanced control over logging and timber extraction from forests - Increased control over the implementation of greening measures - Promotion of climate and environment-oriented CAP interventions - Incentives for the implementation of advanced agricultural practices that contribute to the reduction of nitrous oxide emissions - Incentives for the implementation of advanced agricultural practices that contribute to reducing methane emissions - Establishment of the Green Infrastructure and Nature-based Solutions department	distribution of materials and online resources, focusing on the benefits for people and the environment and promoting care for green spaces. A campaign to improve the management of private forests will encourage restoration work, adaptation of tree species and awareness about funding and legislation. The City of Ljubljana will strengthen supervision of the construction of forest roads, logging, timber harvesting and develop a plan to protect sensitive areas. Measures to monitor greening will include regular inspections, technological solutions, stakeholder collaboration for effective project implementation and monitoring of urban environmental impact.
Built environment	**Sustainable building and infrastructure renovation** - Energy retrofit of buildings - Sustainable building and mass-timber buildings - Climate proofing construction and renovation	**Sustainable building and infrastructure renovation** In addition to decarbonizing energy sources, it is important to increase the energy efficiency of buildings. The average energy consumption of heated buildings in the City of Ljubljana is 122 kWh/m2, indicating a significant potential for savings in energy renovation. It is anticipated that energy renovation will cover 50% of the heated building stock, resulting in a 16% reduction in energy consumption. The City of Ljubljana promotes the use of eco-friendly materials and energy-efficient construction, with an emphasis on wood as a sustainable building material. It strives to encourage wooden construction in facilities such as schools, kindergartens, sports halls and explores opportunities to promote wooden construction in private projects. Construction and renovation in line with the "Climate proofing" concept involve the use of resilient materials, adaptable architectural solutions, advanced technologies to enhance the sustainability

		of buildings in urban environments, considering future climate changes. The goal is to create infrastructure that is resilient to extreme weather events and mitigates the negative impacts of climate change on the population.
	Spatial planning - Establishment of pedestrian-friendly areas (superblocks) - Courtyard activation - creating accessible, green community spaces - Establishment of self-sufficient neighbourhoods - Planning and establishment of new public spaces - Spatial planning considering microclimatic conditions to improve public health and well-being	**Spatial planning** The measure of "super blocks" transforms parts of the city into multi-functional zones, closed to motor traffic, thus encouraging pedestrians, cyclists, social interaction, and sustainable mobility. The goal is to improve the living space, reduce traffic issues, emissions and stimulate the local economy. Additionally, a measure is planned to examine all functionalities of urban courtyards, with a focus on preserving or expanding green areas and creating space for socializing, relaxation, and community activities. In the second phase, the measure extends to the surroundings of residential neighbourhoods. Neighbourhoods with a high degree of self-sufficiency in energy, water and food supply are being planned, promoting a sustainable lifestyle, and reducing the ecological footprint of the neighbourhood. Additionally, a measure is envisaged for planning new public spaces, involving the identification of locations, planning and implementation of projects to improve the quality of life in the city, provide access to green areas, create social and recreational spaces. Urban infrastructure planning measures are also being implemented, considering microclimatic conditions such as high temperatures or a lack of green spaces, including tree planting, installation of shading structures and park landscaping, with the aim of creating a pleasant and healthy urban environment.
	Organizational, incentive, and awareness-raising measures - Evaluation of land based on its current use, classification, and future societal needs - Development of guidelines for the implementation of spatial integration measures - Development of guidelines for project tasks for competitions	**Organizational, incentive, and awareness-raising measures** Preparation of spatial analysis and land evaluation based on existing data is crucial for determining priorities and goals in future municipal spatial plans. The main goal of this measure is to preserve green areas outside the urban area of the City of Ljubljana, thereby reducing emissions from deforestation by 50% and emissions from construction by 25% by 2030 compared to 2018. The development of Guidelines for the implementation of spatial integration measures is a strategic step towards promoting sustainable development and reducing the impact of climate change. Project tasks for competitions and proactive land policy represent additional approaches to

	- Proactive land policy for climate change mitigation and adaptation	integrating sustainable practices and mitigating climate change into urban design and land management.
Digitalization	**Energy systems** - Energy-Climate Atlas of the City of Ljubljana - Monitoring measurement systems and other information systems **Mobility & Transport** - Traffic model of the City of Ljubljana - Mobility service providers' applications - Multimodal route planner **Built environment** - Digital twin of the city - 3D model of the city - 15-minute city - Periodic LiDAR scanning - Digitally supported neighbourhoods	**Energy systems** The Energy-Climate Atlas is an advanced information system with an extensive database for the city. As a modern web application, it enables automatic updates, data analysis, report synthesis, scenario simulations, connecting sectors of electricity, heating, and cooling. Additionally, the installation and management of sensors and measuring devices for data collection, serving as a basis for decision-making and urban policy planning, are also planned. **Mobility & Transport** The implementation of a traffic model for the City of Ljubljana is crucial for the analysis and planning of urban transportation and is one of the measures for shaping transportation policies. The goal is to gain a comprehensive understanding of the current situation and to develop strategies for the sustainable development of the transportation system. Additionally, the use of already established services, such as bike sharing, electric car transportation, and parking, contributes to greater efficiency and sustainability of mobility in a modern way. A multimodal trip planner is a tool or application that allows for trip planning using various modes of transportation, such as cars, public transit, bicycles, or walking. This measure promotes sustainable mobility and enables users to choose the most efficient and environmentally friendly way of traveling based on their needs and circumstances. **Built environment** The digital twin will contain models of the built environment, road network, green spaces, and other urban elements, enabling simulations of urban mobility, airflow, pollution, and other factors. Through modern visual representations, it will facilitate more rational city management and easier, more efficient, and better communication with residents. 3D GIS applications combine spatial data from various sources, allowing analysis for informed decision-making and future planning activities.

		The introduction of the "15-minute city" web application will provide residents with access to information about services, shops, green areas, cultural events, and other activities within a 15-minute walk or bike ride from their homes, promoting sustainable transportation methods. LiDAR is a technology used to create accurate three-dimensional scans of the urban environment for various purposes, such as urban planning. The City of Ljubljana will select a pilot neighbourhood to test new digital solutions in collaboration with residents, aiming to improve living quality and reduce carbon footprint.
	Green infrastructure & Nature-based solutions - Information system for monitoring watercourses - Measurement and modelling of the urban heat islands - Vegetation cadastre on public and private land	**Green infrastructure & Nature-based solutions** Currently, there are 10 information systems installed for monitoring water levels on specific watercourses, using radar at 10 locations and 7 information systems using ultrasonic technology for measuring water levels at the same locations. In the future, the information system will be expanded to other locations as needed. Additionally, an observational weather system will be established to create a dynamic model of the urban heat island using data from its own measurement network. This will create a model showing the heating of the urban area at different times of day and under different weather conditions. Also, a vegetation cadastre will be established for private areas, enabling better management of green spaces and preservation of biodiversity.
	Waste & Circular economy - Information about the fullness of waste bins - Web application for waste circulation - Bin fullness sensors in underground containers	**Waste & Circular economy** The application upgrade will provide users with direct information about the locations of waste disposal infrastructure and the fill levels of individual containers at expanded collection points. The measure also includes the installation of an IT solution for recording the incoming quantities of waste deposited by users. The establishment of a supportive web application for the circulation of waste from waste storage is envisaged. Additionally, the installation of fill level sensors in containers in underground and expanded collection points is planned.
	Urban digital platform - Urban digital platform	**Urban digital platform** The Urban Digital Platform is a tool for managing, planning, and implementing urban policies, serving as a unified information and communication hub between municipal authorities, residents and businesses.

Engaging and collaborating with stakeholders	**Integrative approaches to social innovation, collaboration, and inclusion** - Integrated participatory and communication strategy for Climate Neutral Ljubljana by 2030 - Workshops on participatory urban planning - Programs for green communities - Active use of stakeholder engagement platforms - Educational and awareness campaigns about climate change - Local challenges in the field of sustainable development - Adaptation and mitigation training and workshops - Establishment of healthcare services related to climate change - Cultural and artistic projects for sustainable development - Sports projects for sustainable development - Comprehensive initiative for promoting sustainable certifications - Community-level biodiversity conservation projects - The information point on Ljubljana's path to carbon neutrality	**Integrative approaches to social innovation, collaboration, and inclusion** The participatory communication strategy has been developed for the preparation of the Action and Financial Plan to achieve climate neutrality of the City of Ljubljana by 2030. The strategy includes a thorough analysis of stakeholders and continues efforts for comprehensive public involvement and ensuring accessibility to information. Participatory planning workshops enable residents to actively participate in shaping the urban environment, while green community programs promote a sense of ownership and contribute to greening the city. Mobile applications and social channels facilitate ongoing dialogue and dissemination of information about sustainable initiatives. Campaigns focus on interactive and educational formats, including innovative approaches such as hackathons and innovation laboratories. Challenges that promote the search for innovative solutions to local sustainability issues will be addressed using mechanisms such as participatory financing and regulatory sandboxes for testing and implementing innovative solutions. Community resilience-building activities include establishing a catalogue of content, mechanisms for informing about extreme weather events, collaboration with universities and the healthcare sector. The measure also emphasizes the importance of using internationally recognized sustainability certificates and standards in various sectors, promotes education, partnerships, and support to stakeholders in obtaining certificates. The jointly established initiatives and strategies contribute to the active involvement of the community and ensure sustainable and responsible addressing of climate challenges in the City of Ljubljana.

B 2.2. INDIVIDUAL ACTIONS

ENERGY SYSTEMS

B-2.2: Individual action outlines – 1.1		
Action outline	Action name	**Decarbonisation of heat supply energy sources**
	Action type	Technical interventions
	Action description	**Decarbonisation of district heating system:** The district heating system in Ljubljana has a peak heating capacity of 1.2 GW, with over 270 km of heat distribution network. It supplies heat to more than 64,500 users (approximately 48% of all buildings). Current energy sources are mainly based on fossil fuels (brown coal and natural gas - together more than 90% or 1 TWh/year). Decarbonization measures for the district heating system include the following investments: (1) Cogeneration units on woody biomass with an input power of 2x90 MW. (2) Water-to-water heat pumps with a power of 2x20 MW (utilizing the Ljubljanica river as an energy source, electricity from local renewable sources and/or purchased green electricity with certificates). (3) Solar field with solar energy receivers and a seasonal heat storage system with a water-to-water heat pump with a power of 20 MW. (4) Waste-to-energy (WtE) facility with an input heat capacity of approximately 55 MW (more detailed description in the following measure). (5) Combined heat and power units on natural gas or biogas 2x59 MW (the investment has already been completed and is not addressed within this action plan). The measures are in the pre-planning phase, locations are defined, and implementation is planned by 2030. Carbon Capture and Utilization (CCU) technology for capturing and re-using biogenic CO_2 emissions is also envisaged for cogeneration units on wood biomass, biogas, and waste-to-energy plant (see also action “Negative emissions”). In addition to Ljubljana’s main district heating system two new smaller destring heating system will be built (Gameljne – wood biomass, 5 MW, 15 GWh/a and Šmartno-Sneberje – water-to-water heat pump due to its close proximity to the Sava River, 5 MW, 1.9 MWel, 15 GWh/a), using 4th or 5th generation of district heating systems technologies. **Waste to energy (WtE) plant:** At the Regional waste management centre (RCERO) Ljubljana, following additional mechanical-biological treatment of municipal waste, around 110,000 tons of municipal

		waste-derived fuel are generated annually, which cannot be further materially utilized or recycled but is suitable for energy recovery - for heat and electricity production. Currently, this fuel is transported out of Ljubljana. With the aim of closing the material flow of waste management at the municipal level, reducing the carbon footprint, and increasing energy self-sufficiency, we plan to establish a facility for energy recovery from municipal waste, simultaneously producing heat and electricity. The facility will be built using best available techniques (BAT), with high energy efficiency (more than 80%) and in compliance with all strictest environmental and health protection standards. For the energy utilization of fuel from municipal waste, which is currently obtained at RCERO Ljubljana, a facility with a size of 55 megawatts of input thermal power would be needed. With this, we could generate around 225 gigawatt-hours of heat and 65 gigawatt-hours of electricity from this amount of fuel. In the case of a wider contribution area (RCERO and neighbouring regional centres), this would mean 140,000 tons of fuel and therefore a facility with a total thermal power of 73 megawatts, which would produce approximately 373 gigawatt-hours of heat and 80 gigawatt-hours of electricity. The energy recovery of waste is a mandatory state economic public service – state public service can be performed through concession assignment. **Hydrogen integration in industrial processes:** Industrial processes currently rely primarily on fossil fuels (natural gas). When green hydrogen becomes available, it will have a positive impact on decarbonizing various sectors, including energy-intensive industries. It is planned that by 2030, hydrogen will cover up to 15% of the current energy demand based on the use of natural gas in industry. **Injection of biomethane into the distribution gas pipeline network:** The distribution gas pipeline network will be decarbonized by 2030 using green hydrogen (15% injected into the transmission gas network, without requiring significant technological upgrades), locally injected biomethane, and purchases of biomethane on the market.

		Local sources of biomethane production will be directly connected to the gas distribution network via newly built entry points. Potential sources of biomethane include existing biogas plants, which will be upgraded with purification facilities to convert biogas into biomethane, and industrial facilities where biogas is produced as a byproduct. The introduction of biomethane is planned gradually. The public company Energetika Ljubljana is also in negotiations with other potential suppliers from Slovenia for additional quantities of biomethane, while a smaller portion would be purchased on the European market (gradually by 2030). By 2030, it will be necessary to provide 1013 GWh/year of biogas sources for heating, industrial processes, and transportation purposes, with the aim of completely replacing natural gas. **Fossil fuels phase out for individual heating systems:** Heating systems for individual buildings (i.e., those outside the district heating network and gas distribution network) mainly use light fuel oil (heating oil), biomass, LPG, and electricity (totalling 611 GWh/year, with both light fuel oil and LPG accounting for 50%). Light fuel oil will be gradually phased out by 2027 at the national level. Heating oil and LPG will be replaced in the future by wood biomass (321 GWh/year) and electricity for heat pumps (141 GWh/year). By 2030, fossil fuels for individual heating systems will be phased out, eliminating the current import dependency on fossil fuels.
Reference to impact pathway	Field of action	Energy systems
	Systemic lever	Technology/infrastructure, finance & funding, governance & policy
	Outcome (according to module B-1.1)	District heating system using renewable energy sources. Construction of a facility for energy recovery from municipal waste, producing heat and electricity. Construction of smaller district heating systems. Transition from fossil fuels to green hydrogen in energy-intensive industries. Decarbonization of the distribution gas pipeline network through the injection of green hydrogen and locally produced biomethane. Gradual replacement of boilers with fossil fuels in individual heating systems.

		Targeted investment planning strategies created. Policy mechanisms orients market structures to net-zero.
Implementation	Responsible bodies/person for implementation	City of Ljubljana (Energy manager), Energetika Ljubljana (local district heating and gas distribution company), Plinovodi (gas transmission network operator), industrial companies, individual heating systems owners.
	Action scale & addressed entities	Local scale. District heating system, individual heating systems (boilers), transmission and distribution gas pipeline network.
	Involved stakeholders	City of Ljubljana, Energetika Ljubljana (local district heating and gas distribution company), Plinovodi (gas transmission network operator), industrial companies, individual heating systems owners, local biogas producers.
	Comments on implementation – consider mentioning resources, timelines, milestones	RES district heating solutions and WtE in pre-design phase (plan to commence operation by 2030). The financial resources will be provided by the public company Energetika Ljubljana, the City of Ljubljana, and the European Union through cohesion funds. Natural gas substitution with biogas (local production) is on-going project. Funds will be provided by Energetika Ljubljana, biogas producers, and the industry. Green hydrogen is expected to be gradually included into transmission gas pipeline network (approximately 15% vol. by 2030). The funds will be provided by the company Plinovodi and gas consumers. The introduction of hydrogen into industrial processes will be financed by companies. For individual heating systems, light fuel oil will be gradually phased out by 2027 at the national level, while other fossil fuels by 2030. The transition will be financed by heating appliance owners with the help of financial incentives from the Eko Fund (at least 20% of the investment value).
Impact & cost	Generated renewable energy (if applicable)	809 GWh/a of heat
	Removed/substituted energy, volume, or fuel type	Natural gas: 939 GWh/a Light fuel oil: 179 GWh/a Brown coal: 1,799 GWh/a LPG: 41 GWh/a

	GHG emissions reduction estimate (total) per emission source sector	District heating system: 394,400 t CO_2e Gas pipeline network: 134,046 t CO_2e Individual heating systems: 32,564 t CO_2e
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	556,500,427 EUR (CAPEX) 992 EUR/t CO_2e

B-2.2: Individual action outlines – 1.2		
Action outline	Action name	**Green energy production**
	Action type	Technical interventions
	Action description	**Biogas and biomass cogeneration units:** The integration of combined heat and power (CHP) systems within industrial and commercial sectors presents a multifaceted solution to energy optimisation. By leveraging biogas or biomass as primary energy sources, these installations not only bolster the efficient utilisation of resources but also foster a self-reliant provision of both heat and electricity. Implementation of CHP units addresses a critical energy demand, particularly during winter when electricity scarcity tends to peak. This supplementary electricity production during high-demand periods not only stabilises the grid but also mitigates potential shortages, ensuring a more reliable and resilient energy supply. It is planned to install 3 MW_e of new CHP units by 2030. **Photovoltaic projects:** The photovoltaic (PV) projects in the City of Ljubljana embody a comprehensive approach toward sustainable energy generation and infrastructure development. The measure in the field of solar energy utilization includes the following projects: (1) The installation of 51 solar power plants (4.7 MWp) on the roofs of public buildings is underway, representing an important step towards renewable energy sources. (2) The installation of a solar power plant of approximately 2 MWp at the Ljubljana passenger traffic (LPP) Remiza is also planned by 2027. (3) In addition to public buildings, the initiative includes the construction of new solar power plants on private buildings (with a total potential of 462 MWp), with an anticipated 7.5 MWp of photovoltaic capacity (by 2030). (4) Utilization of ground space and degraded areas for solar panel installation is planned (within the next 5 years), with a projected capacity of 8 MWp. (5) A solar power plant with a capacity of 0.9 MW is planned at the renovated main railway station in Ljubljana. (6)

		The industry in the City of Ljubljana will generate 10% of its own electricity consumption through solar power plants on the roofs of industrial facilities, totalling 48 GWh per year. **Waste heat utilisation:** The district heating network's optimisation through the harnessing of waste heat reservoirs represents a significant advancement in sustainable energy utilization. The untapped potential of waste heat, often overlooked and dissipated into the environment, emerges as a prime resource for bolstering the district heating system. By prioritizing the incorporation of this abundant but currently underutilised energy source, the initiative aims to minimise reliance on traditional fuel-based heat production methods. Waste heat usage represents a significant advancement in sustainable energy utilisation. The estimation of using approximately 70 GWh (by 2030) of recoverable waste heat from industries and commercial sectors not only enhances the overall efficiency of the district heating network but also aligns with environmentally conscious practices by reducing unnecessary thermal discharges into the surroundings. The integration of waste heat into the district heating system serves as circular and eco-friendly approach to energy management in the city heating system. This concerted effort not only optimises energy utilisation but also fortifies the district heating network as a model of sustainable urban infrastructure, significantly contributing to the city's environmental and energy independence. **Hydrogen production:** The construction of hydrogen production facilities is crucial for advanced clean energy solutions. This includes the introduction of technologies based on electrolysis (using green electricity). Introducing small-scale projects in the testing phase (by 2030) is essential for assessing the feasibility of large-scale hydrogen production and for integrating hydrogen into the existing energy framework. Pilot projects will serve as practical test sites for evaluating the technical and economic feasibility as well as the environmental aspects of hydrogen deployment. Promoting strategic partnerships between industrial, research, and government sectors is crucial for knowledge exchange, technological advancement, and resource allocation optimization. Collaboration will accelerate innovation in hydrogen production processes.

		Biogas production: Biogas sources include agricultural, household, municipal waste, as well as waste from the food, agricultural and forestry industries, wastewater treatment plants, plant residue and waste biomass from industry. Biogas sources are important for sustainable energy supply at the local level, as they reduce the need for fossil fuels. By 2030, approximately 350 GWh/year of gas produced locally from renewable sources will be injected into the distribution gas pipeline network. Identified (local) sources of biomethane include existing biogas plants (including those with capacities for cleaning biogas to biomethane stage) and industrial facilities where biogas is produced as a by-product (some bilateral agreements have already been signed). **Hydropower production:** It is planned to install (ongoing project activities, construction will begin in 2026) three small hydropower plants (locations: 1-Ambrožev trg, 2-Gruberjev prekop, 3-Sotočje), with a total power capacity of 1.6 MWe on the Ljubljanica river with production of 7 GWh/a. In addition to environmentally friendly electricity production, project would also enable added value in revitalization of the coastal area of Ljubljanica and Grubarjev kanal, thus encourage tourism, river traffic (a closed waterway around Grajski grič) and increased flood safety. **Purchase of carbon-free electricity:** The remaining electricity consumption not produced by local sources in the City of Ljubljana (solar, hydro, waste-to-energy, cogeneration on biogas/biomass) will be obtained from the market or through power purchase agreements. Only renewable or nuclear electricity with origin certificates will be used. The purchase of zero-emission electricity is planned in a total quantity of approximately 1,533 GWh (all remaining electricity consumed in the public sector, public transport, industry, and business sector, as well as 65% of household electricity consumption). As part of decarbonizing the district heating system, heat pumps represent an important source of thermal energy. To achieve emission reduction targets, the electricity used to power heat pumps must be obtained from renewable sources. Although we strive for energy self-

		sufficiency from renewable sources in the city, there may be cases where energy needs cannot be fully met at the local level. According to the projected estimate, we will need approximately 76 GWh/year of green electricity.
Reference to impact pathway	Field of action	Energy systems
	Systemic lever	Technology/infrastructure, finance & funding
	Outcome (according to module B-1.1)	Installed new electricity production facilities using renewable sources (solar power plants, hydropower plants, biomass, and biogas cogeneration units). Utilizing waste heat from industry for integration into the district heating network. Acceleration of innovation in hydrogen production processes. Local biogas production and purification for injection into the distribution pipeline network. Concluded agreements on the purchase of emission-free electricity. Purchases of zero-emission electricity for public sector, public transport, industry, business sector, and households (65% of consumed electricity). Purchases of zero-emission electricity for district heating system. New forms of public-private & community collaborations. New finance instruments & profitable business cases.
Implementation	Responsible bodies/person for implementation	City of Ljubljana (Energy manager), Energetika Ljubljana (local district heating and gas distribution company), Elektro Ljubljana (local electricity distribution grid operator), households (self-sufficiency), public and business sector.
	Action scale & addressed entities	Local scale. Power grid, renewable energy generation facilities, power purchase agreements, sources of waste heat.
	Involved stakeholders	City of Ljubljana, Energetika Ljubljana (local district heating and gas distribution company), Elektro Ljubljana (local electricity distribution grid operator), relevant Ministries, companies, energy service companies, energy producers, households (self-sufficiency).

	Comments on implementation – consider mentioning resources, timelines, milestones	Increased investments by private companies and households in local electricity production from renewable sources, primarily solar energy, are anticipated. The installation of production facilities is planned gradually until 2030 and beyond. Funds for CHP plants will be provided by companies, while rooftop solar power plants owned by the City of Ljubljana and public companies owned by the city (e.g., LPP) will be funded by the city itself. For photovoltaic systems on residential buildings, funding will be provided by owners with the assistance of financial incentives from the Eco Fund (at least 20% of the investment value). The Ministry of Infrastructure will invest in photovoltaics at the new railway station, while hydropower plants on the Ljubljanica river will be financed by Energetika Ljubljana and Elektro Ljubljana. The utilization of waste heat will be funded by Energetika Ljubljana in collaboration with companies. The financial resources for local biogas production will be provided by biogas plants and companies producing renewable gases. The involvement of the economy and households in the purchase of zero-emission electricity (e.g., from renewable sources or nuclear energy) is also expected.
Impact & cost	Generated renewable energy (if applicable)	142 GWh (CHPs on renewable sources for district heating) 98 GWh (solar energy) 25 GWh (hydropower) 29 GWh (CHPs on biomass or biogas) 1,533 GWh (purchased zero-emission electricity)
	Removed/substituted energy, volume, or fuel type	Approximately one-third (585 GWh) of the grid-supplied electricity currently produced from fossil sources will be substituted by renewable/zero-emission electricity.
	GHG emissions reduction estimate (total) per emission source sector	Local energy production: 130.325 t CO_2e Purchase of green electricity: 453.332 t CO_2e
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	107,959,050 EUR (CAPEX)* 828 EUR/t CO_2e*

* The costs of purchasing zero-emission electricity are not included.

B-2.2: Individual action outlines – 1.3		
Action outline	Action name	**Sustainable electricity grid**
	Action type	Technical interventions
	Action description	**Power system flexibility:** With the increasing share of renewable energy sources, the transition to improving the flexibility of the power system is crucial. Flexibility within the system entails the ability to dynamically adjust the production and/or consumption of electricity and heat. By integrating planned measures and collaborating with relevant stakeholders (grid operators, energy producers, and consumers), the power system gains agility and resilience necessary for effectively balancing the dynamics of supply and demand, thereby addressing potential disruptions arising from the potential volatility of renewable energy sources. The flexibility of the power system involves various technical and operational strategies/solutions, such as: (1) advanced energy storage systems, (2) innovative technologies for grid management, (3) development of demand-side management solutions. **Energy storage:** The implementation of energy storage solutions stands as a pivotal strategy in fortifying grid reliability and fostering the seamless integration of renewable energy sources. Deploying cutting-edge technologies, such as battery storage systems or other advanced storage solutions, plays a crucial role in optimising the energy balance within the grid. Storage systems will serve as reservoirs for capturing surplus energy generated during periods of low demand or high renewable energy output. Subsequently, this stored energy can be efficiently discharged during peak demand times or when renewable sources encounter intermittency, ensuring a continuous and stable supply of electricity. In addition, the versatility of energy storage technologies will contribute to grid stability by providing rapid response capabilities to fluctuations in energy generation, thereby mitigating potential disruptions caused by variability in renewable sources, especially for solar power. **Power grid reliability:** Sustainable electricity grids that use digital and other advanced technologies to monitor and manage the transport of electricity from all generation sources to meet the varying

		electricity demands of end users, will help to manage energy transition while reducing the need for costly new grid infrastructure, and help to make grids more resilient and reliable. Planned installation of new smaller district heating systems and many new individual heating systems utilizing heat pumps will require the construction of new local electrical transformer stations to cover increased power demand.
Reference to impact pathway	Field of action	Energy systems
	Systemic lever	Technology/infrastructure
	Outcome (according to module B-1.1)	Improved grid reliability for the integration of renewable energy production sources. Implementation of battery energy storage systems into the electrical power grid. Dynamic adjustment of electricity and heat production/consumption. Effective balancing of electricity supply and demand dynamics. Utilization of digital and advanced technologies for grid management. Provision of continuous electricity supply to meet varying demands.
Implementation	Responsible bodies/person for implementation	Energetika Ljubljana (local district heating and gas distribution company), Elektro Ljubljana (local electricity distribution grid operator), ELES (Electric power organization company) relevant Ministries.
	Action scale & addressed entities	Local and national scale. Power grid and other components of the grid (e.g. transformer substations), energy storage systems.
	Involved stakeholders	City of Ljubljana (Department of economic activities and transportation), Energetika Ljubljana (local district heating and gas distribution company), Elektro Ljubljana (local electricity distribution grid operator), ELES (Electric power organization company), relevant Ministries, energy producers and consumers.
	Comments on implementation – consider mentioning resources, timelines, milestones	Increased investments are expected in advanced energy storage systems, the implementation of innovative grid management technologies, and the development of demand-side management solutions. Investments will

		be implemented gradually until 2030 and beyond. The source of funding for projects in the electrical grid and energy storage facilities will be the distribution company's own funds and European funds.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Not applicable.
	GHG emissions reduction estimate (total) per emission source sector	The effects of these measures on GHG emissions will be indirect, as emission reductions will be reflected in other measures (photovoltaics, electromobility, increased use of heat pumps, etc.).
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	69,333,333 EUR (CAPEX)

B-2.2: Individual action outlines – 1.4		
Action outline	Action name	**Energy efficiency**
	Action type	Technical interventions
	Action description	**Public street lighting retrofit:** City of Ljubljana is upgrading and modernising its public street lighting on regular basis, however, there are still 5,360 non-efficient lamps which need to be replaced. The savings potential is estimated at 2,800 MWh/a. In general, with energy renovations, i.e. switching to LED lighting and smart management system, we can significantly reduce electricity consumption, even up to 80%, and recoup the investment in new lighting within a few years. It is also important to observe the Regulation on limit values of light pollution. All lighting renovations carried out are based on lighting technical calculations that comply with standards and technical guidelines. The implementation of dynamic lighting where appropriate is also planned. **Installation of energy efficient individual heating devices (boilers):** The goal is to replace existing outdated devices with more energy-efficient ones by 2030, both in households and in the business sector. Planned replacements include replacing heating devices using wood biomass and natural gas with new wood biomass boilers and new condensing boilers, where the use of biogas is foreseen. In the City of Ljubljana, according to the latest statistical data, there are 11,434 heating devices using wood biomass, with an average age of 28 years. The number of natural gas heating

		devices in the city is 43,066 (53,235 measuring devices and 55,407 consumption points), with an average age of 26 years. Of these, 18,661 are older than 20 years. To improve outdoor air quality, especially during winter, and increase energy efficiency, all heating devices older than 20 years need to be replaced. **Reduction of heat losses in district heating system:** The district heating system of Ljubljana spans mostly over the central part of Ljubljana, supplying hot water for heating and preparing sanitary hot water to over 58,900 residential and over 5,700 commercial customers. While significant part of district heating network of Ljubljana is over 30 years old, current average thermal losses of the network system are around 14% (seasonal average). Reducing thermal losses in the network is a crucial measure for increasing overall energy efficiency of district heating system. This involves ongoing optimization of network operation, expansion of the low-pressure part of the district heating network, improvement of the insulation of pipelines and distribution systems, thereby minimising heat losses during heat transfer. **Energy efficiency in the industry sector:** The aim of the measure is to improve energy efficiency by upgrading and optimizing industrial energy systems, namely with the following actions: (1) implementing advanced HVAC solutions with intelligent management, (2) introducing energy-efficient drives, (3) improving thermal insulation, (4) CHP plants, (5) introducing low-temperature technologies and processes. For energy-efficient industrial technologies and practices, we estimate annual savings of 0.5% for electricity and 0.25% for heating. Due to the increased use of low-temperature applications, we estimate annual savings of 3% for processes using gaseous fuels and 1% for processes related to district heating networks (steam and/or hot water). With the efficient use of energy-efficient HVAC systems, we estimate annual energy savings of approximately 1%.
Reference to impact pathway	Field of action	Energy systems
	Systemic lever	Technology/infrastructure
	Outcome (according to module B-1.1)	Replacement of non-efficient lamps with energy-saving LED lighting. Implementation of dynamic lighting where appropriate for energy-efficient and smart public lighting.

		Replacement of wood biomass and natural gas (biogas) heating devices with newer energy-efficient boilers. Reduction of heat losses and increase in the overall energy efficiency of the district heating system. Upgrading and optimizing industrial energy systems. Implementation of advanced HVAC solutions with intelligent management. Introduction of energy-efficient drives, thermal insulation, CHP plants, and low-temperature technologies to enhance energy efficiency in industrial processes.
Implementation	Responsible bodies/person for implementation	City of Ljubljana (Department of economic activities and transportation), Energetika Ljubljana (local district heating and gas distribution company), Javna razsvetljava Ljubljana (public lighting concessionaire), public institutions, private companies, industry, households.
	Action scale & addressed entities	Local scale. Public lighting network, individual heating devices running on natural gas and wood biomass, district heating system network, HVAC systems, industrial facilities, and buildings.
	Involved stakeholders	City of Ljubljana (Department of economic activities and transportation), Energetika Ljubljana (local district heating and gas distribution company), Javna razsvetljava Ljubljana (public lighting concessionaire), public institutions, private companies, industry, energy service companies, households.
	Comments on implementation – consider mentioning resources, timelines, milestones	There is a planned increase in investment for replacing inefficient light bulbs and implementing a smart system. The funds will be provided by the City of Ljubljana. Each year, a portion of the lighting is replaced and renovated, with the renovation process being gradual, expected to conclude before 2030. Additional funds are also foreseen to reduce losses in the district heating network, which will be provided by the operator (Energetika Ljubljana). Renovations and improvements to the network are continuously carried out. Funding for replacing old gas and wood biomass heating devices with more efficient

		ones will be provided by owners with the help of financial incentives from the Eco Fund (at least 20% of the investment value). An increase in funding for financial incentives is also planned. Replacements will be carried out based on the age and lifespan of existing heating devices. Increased investments by private companies in energy-efficient heating systems, industrial processes, and heating, ventilation, and air conditioning (HVAC) technology. To implement these measures, it is necessary to obtain subsidies and favourable loans.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Public street lighting retrofit: 2,800 MWh/year Installation of energy efficient individual heating devices (boilers): 37,638 MWh/year Reduction of heat losses in district heating system: 8,900 MWh/year Energy efficiency measures in industry: 33,000 MWh/year
	GHG emissions reduction estimate (total) per emission source sector	Public street lighting: 1,161 t CO_2e Individual heating devices: 4,801 t CO_2e District heating system: 3,208 t CO_2e Industry: 7,551 t CO_2e
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	132,339,000 EUR (CAPEX) 7,915 EUR/t CO_2e

B-2.2: Individual action outlines – 1.5		
Action outline	Action name	**Energy Management**
	Action type	Technical interventions, other interventions
	Action description	**Energy management systems:** Energy management involves oversight and strategic control over energy resources and operations, aimed at maximising efficiency and fostering sustainable energy utilisation. This encompassing approach comprises a spectrum of actions and tools, ranging from monitoring and analysis of energy consumption patterns to conducting thorough energy audits. It also involves setting ambitious targets for optimising energy use, implementing tailored measures to curtail consumption, and assessing the outcomes

		achieved. The outlined measures are projected for implementation across diverse sectors, notably in commercial buildings and facilities, institutional infrastructures, and within the manufacturing and construction industries. These sectors stand as important areas where energy efficiency can be realised through the application of targeted energy management strategies. In projecting the impact of these measures, we estimate conservatively a saving of 0,5% across all energy sources. Organizations, municipalities, and institutions may also choose to certify their operations, for example, with ISO 50001. In accordance with the proposed Energy Efficiency Directive, member states will be required to ensure that companies whose average annual consumption over the last three years exceeds 85 TJ considering all energy sources, implement an energy management system. It will also be required that companies establish an energy management system no later than October 11, 2027. For companies with an average annual consumption exceeding 10 TJ over the last three years and not using an energy management system, an energy audit will be required. An energy audit (for example as per ISO 50002), is a systematic process used to evaluate an organisation's (or building's) energy use and consumption patterns. It's a valuable tool for organisations systematically seeking to reduce energy consumption, lower costs, and enhance their overall sustainability efforts. Energy audit typically involves: (1) planning and preparation, (2) data collection and analysis, (3) on-site inspections and measurements, (4) identifying energy saving opportunities, (5) evaluation and recommendations, (6) follow-up and monitoring. It is assumed that the cumulative annual effect of performing energy audits is 1% of electricity savings and 0.5% of heating energy savings. An energy audit is the initial and essential step in implementing measures for efficient energy use. **Active consumer of thermal and electrical energy:** The goal of the measure is to enable active participation of heat and electricity consumers through collective action via aggregators in schemes that consider their energy production, consumption, storage, or energy sales. Additionally, the introduction of a dynamic tariff system will alter the behaviour of individual

		consumers, e.g., a bonus/penalty system within the tariff structure will incentivize consumers to adopt lower temperature regimes and use energy-efficient equipment. Thus, becoming an "active consumer" will be a strong emphasis of the energy policy of the City of Ljubljana. Under appropriate circumstances, the transition to a climate-neutral energy system will enable many more consumers to actively engage in the energy system by managing their own energy demand, production, and consumption. Active participation in the market can reduce one's carbon footprint and, in many cases, energy costs as well. The more active role of consumers, especially in cooperative models, could also bring significant social benefits. Within the measure, active participation of heat and electricity consumers through aggregators in schemes that consider their energy production, consumption, storage, or energy sales is planned.
Reference to impact pathway	Field of action	Energy systems
	Systemic lever	Technology/infrastructure, governance & policy, democracy/participation
	Outcome (according to module B-1.1)	Requirement for companies to establish energy management systems. Implementation of energy management systems across various sectors (public sector and businesses). Implementation of energy audits in the public sector and businesses. Evaluation of energy use and consumption patterns. Enabling active participation of consumers in energy schemes. Introduction of dynamic tariff system to alter consumer behaviour. Active participation of consumers through aggregators in schemes considering energy production, consumption, storage, or energy sales.
Implementation	Responsible bodies/person for implementation	City of Ljubljana (Energy manager), relevant Ministries, Energy agency, Energetika Ljubljana (local district heating and gas distribution company), Elektro Ljubljana (local electricity distribution grid operator), public institutions, commercial buildings, industry.

	Action scale & addressed entities	Local scale. Business buildings and equipment for measurements and management of energy systems, electrical grid, district heating system network.
	Involved stakeholders	City of Ljubljana (Energy manager), relevant Ministries, Energy agency, Energetika Ljubljana (local district heating and gas distribution company), Elektro Ljubljana (local electricity distribution grid operator), public institutions, commercial buildings, industry.
	Comments on implementation – consider mentioning resources, timelines, milestones	Energy management is provided in buildings owned by the City of Ljubljana, with gradual expansion planned for other buildings as well. Energy audits are carried out gradually according to the building renovation plan. Funding is provided by the City of Ljubljana. Under the new Energy Efficiency Directive, companies with an average annual consumption exceeding 85 TJ over the last three years must implement an energy management system. This requirement must be fulfilled by October 11, 2027. For companies consuming over 10 TJ annually and without an energy management system, an energy audit is mandatory. Funding for the implementation of measures to promote active consumers is provided by Elektro Ljubljana and Energetika Ljubljana (energy distributors), with implementation in the testing phase and planned gradual expansion to other consumers after successful testing. Convincing energy consumers to become active participants, with an emphasis on raising awareness about the benefits of their involvement, is important.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	12,900 MWh/year
	GHG emissions reduction estimate (total) per emission source sector	3,759 t CO_2e
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	4,116,667 EUR (CAPEX) 1,095 EUR/t CO_2e

B-2.2: Individual action outlines – 1.6		
Action outline	Action name	**Negative emissions**
	Action type	Technical interventions
	Action description	**Implementation of carbon capture and use/utilisation (CCU):** These technologies allow reusing captured carbon, thus potentially reducing its emissions to the atmosphere. On the other hand, we cannot use carbon capture and storage (CCS) technologies, as geological structures in Slovenia are not suitable for this. The capture of CO_2 emissions will be conducted at the main energy production unit (cogeneration, located at TE-TOL in Ljubljana-Moste), connected to the district heating system and other industrial facilities (emissions generated from wood biomass and biogas are estimated at 284,466 t CO_2/year), and at a new approximately 55 MW facility for waste-to-energy (WtE) cogeneration plant facility, which is planned to be built in Ljubljana (emissions generated based on fossil fuel from waste are estimated at 110,150 t CO_2/year). At these locations, all emissions will be captured, resulting in negative emissions (based on the bio-component in the input fuel). The captured CO_2 will be transported to suitable (local/regional) industrial producers who will reuse the CO_2 in their processes - currently, several technologies are being used or developed, including technologies for plastic production, concrete, chemical reagents, and synthetic fuels.
Reference to impact pathway	Field of action	Energy systems
	Systemic lever	Technology/infrastructure, learning & capabilities
	Outcome (according to module B-1.1)	Examine carbon capture and utilisation and implementation possibilities. Implementation of a pilot project for carbon capture and utilisation.
Implementation	Responsible bodies/person for implementation	Energetika Ljubljana (local district heating and gas distribution company).
	Action scale & addressed entities	Local scale. Production sources for the district heating system.
	Involved stakeholders	City of Ljubljana (Energy manager), Energetika Ljubljana (local district heating and gas distribution company), relevant industrial companies (chemical, construction materials, etc.).

	Comments on implementation – consider mentioning resources, timelines, milestones	Technologies in the field of CCU are only at the beginning of commercial application (however, many pilot projects in operation across EU). In this regard, we will closely monitor development in relevant technological field and implement the best available technologies. In the next years necessary pre-investment steps will be made. On the other hand, we will establish close cooperation with (local) industrial players who will use captured CO_2. To develop and implement pilot projects, it is necessary to establish partnerships with industry and energy companies and obtain European and national funding.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Not applicable.
	GHG emissions reduction estimate (total) per emission source sector	Not applicable.
	GHG emissions compensated (natural or technological sinks)	394,616 t CO_2e/year
	Total costs and costs by CO_2e unit	51,300,097 EUR (CAPEX) 130 EUR/t CO_2e

B-2.2: Individual action outlines – 1.7		
Action outline	Action name	**Organizational, incentive, and awareness-raising measures**
	Action type	Other interventions
	Action description	**Promotion of energy efficiency and transition to renewable sources:** To encourage households to transition to energy-efficient solutions, we will conduct numerous interactive workshops and events to raise awareness about the importance of energy efficiency. An innovative measure that will enable us to reach a larger number of residents involves creating a web tool that will allow individuals to obtain information about the expected energy and cost savings if they decide to renovate their homes for energy efficiency. Such information or calculations will also be available to those who are not proficient in using computers, through an information point or climate office of the City of Ljubljana (one-stop shop). Users will also have access to advisory services on energy renovation through the Energy advisory office. **Creating new jobs in the field of renewable energy and energy efficiency:**

		In collaboration with educational institutions, we will organize training and education programs for skilled workers in this field and promote research and innovation for the development of new technologies and business models. **Energy poverty:** The measure will be implemented based on the comprehensive national Action plan for reducing energy poverty for a three-year period in Slovenia, November 2023, which includes all measures to alleviate energy poverty, such as investment incentives for energy efficiency and renewable energy measures, project office with regional advisory points, informal information and awareness network, energy counselling, financial assistance, energy literacy, assistance with energy cost payments, expanding the purpose of emergency cash social assistance to reduce energy poverty, as well as other organizational measures, such as the establishment of an energy poverty council. The measure is also addressed in the Local energy concept of the City of Ljubljana. **Energy communities:** Promoting the establishment of energy communities within the framework of demonstrating potentials and feasibility in the Energy-Climate Atlas. The measure enhances energy self-sufficiency and reduces carbon footprint, encourages collaboration and networking among residents, and contributes to greater awareness of the importance of sustainable energy use and climate actions at the local level. **Energy consulting office:** The Energy advisory office is a service offered by the city in collaboration with the state, aimed at informing and advising residents and businesses on energy efficiency, renewable energy sources and other areas of sustainable energy. Services include individual counselling, information on subsidies and favourable loans for energy renovations, educational events, assistance in selecting and installing appropriate energy-saving technologies. The purpose of the energy advisory office is to promote reduced energy consumption, the use of renewable energy sources and contribute to the transition to a more sustainable energy future. **Research/educational content:** Research topics in the field of energy encompass diverse aspects, including

		technological, infrastructural, sociological, and psychological dimensions. This involves studying the impact of technological and infrastructural innovations on energy efficiency and analysing the societal and psychological factors influencing energy consumption. Additionally, strategies are being developed to promote sustainable habits, and the issue of energy poverty is being addressed. These activities aim to take a comprehensive approach to understanding and addressing the challenges of sustainable energy in urban environments.
Reference to impact pathway	Field of action	Energy systems
	Systemic lever	Social innovation, democracy/participation, learning & capabilities
	Outcome (according to module B-1.1)	Increased awareness through workshops and events. Accessible web tool for energy-efficient home renovation information. Collaboration with educational institutions for training programs. Promotion of research and innovation for new technologies. Investment incentives for energy efficiency and renewable energy. Establishment of regional advisory points and energy counselling. Encouragement of collaboration and networking among residents. Greater awareness of sustainable energy use at the local level. Information on subsidies and favourable loans for renovations. Analysis of societal and psychological factors influencing energy consumption. Development of strategies to promote sustainable habits and address energy poverty.
Implementation	Responsible bodies/person for implementation	City of Ljubljana (Energy manager), Energy consulting office (ENSVET), relevant Ministries, private companies, University and research institutes.
	Action scale & addressed entities	National and local scale.

		Residents, vulnerable social groups, government employees, high school and university students, academics, other energy consumers.
	Involved stakeholders	City of Ljubljana, relevant Ministries, public organizations, private companies, University, and research institutes, residents.
	Comments on implementation – consider mentioning resources, timelines, milestones	Although interactive workshops and events to raise awareness about the importance of energy efficiency are already underway, it is essential to increase financial resources for the expansion of educational programs. This would encourage greater investment in energy efficiency measures and renewable energy sources. The energy consulting office has been operating for some time, but it is facing the problem of low attendance. Therefore, it is crucial to increase promotion and inform the public about the offered consultancy in the field of energy efficiency and renewable energy sources. Funds are provided annually by the state, but additional funds can also be contributed by the City of Ljubljana. Funds are allocated for energy-poor households every year, but their amount is limited. To achieve the set goals, it is essential to increase these funds so that more households can apply. In the future, it will be essential to increase funds for worker training and allocate more financial resources for the development of new technologies and business models. Due to the competitiveness of companies, they already invest heavily in education.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Not applicable.
	GHG emissions reduction estimate (total) per emission source sector	Indirect impacts on the reduction of GHG emissions (reductions are already considered in other measures).
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	No investments, the costs of activities are estimated at approximately 200,000 EUR per year.

MOBILITY & TRANSPORT

B-2.2: Individual action outlines – 2.1		
Action outline	Action name	**Enhancing public transportation**
	Action type	Physical/spatial interventions, other interventions
	Action description	**Enhancing urban public bus transportation:** Improvement measures for urban public bus transportation include several steps: (1) Introduction of new routes - new tangential lines such as Šiška-Bežigrad-BTC (along the northern ring corridor), Vič-Šiška, Vič-Rudnik, and Šiška-Bežigrad (along the Drenikova and Topniška corridors). (2) Increasing bus frequency on main routes - during peak hours, the frequency of departures will be 5 minutes or less on all main roads (Dunajska, Celovška, Tržaška, Barjanska, Dolenjska, Zaloška, and Šmartinska). (3) Implementation of additional dedicated bus lanes between the new Ljubljana Passenger Center and the ring on major corridors (Dunajska, Celovška, Tržaška, Barjanska, Zaloška, Šmartinska, and Dolenjska), which will improve travel times by 20%. (4) Smart traffic light management system prioritizing public transportation vehicles at intersections. (5) Introduction of longer vehicles to accommodate more passengers (currently not regulated by law, expected to be addressed in the Integrated National Energy and Climate Plan of the Republic of Slovenia). (6) The option to board through all doors, which will enable shorter stops at stations. (7) Adjustment of bus schedules and timetables for better integration with intercity buses and trains. (8) Conducting comprehensive and individual studies to ensure compliance with public transportation planning, such as introducing new routes, road reconstruction for specific measures, and as a whole. These efforts aim to increase the mileage of urban passenger vehicles by up to 50%, focusing on route rationalization and fleet optimization, resulting in a daily increase in transported passengers to 250,000. The overall goal is to make public transportation more attractive and reduce travel time for passengers. **Improving railway public transport:** The development of railway infrastructure is the responsibility of the state, which in recent years has been intensively renovating and upgrading railway lines throughout Slovenia. State plans for the railway hub in the Ljubljana area include the introduction of double tracking and electrification on all existing railway connections between Ljubljana and other regional centres. These measures aim to

		increase the speed of passenger trains, optimize traffic, and reduce delays. Additionally, the introduction of an integrated timetable is envisaged, based on precise schedules of train arrivals and departures at individual stations. By adding three new stations to the existing railway infrastructure, the concept of light rail will be incorporated, offering improved accessibility, and facilitating travel within the city. These stations will be carefully selected and organized to ensure seamless transfers between different forms of public transport and other modes of mobility. The main goal of coordinated railway transportation in the future is to optimize the use of infrastructure, increase timetable accuracy, and enhance the efficiency and reliability of railway transportation. **Renovation of the main bus and train station:** In the heart of Ljubljana, the Ljubljana Passenger Centre (PCL) will be established as the central hub for passengers using public transportation (the investment is expected to be completed by the end of 2025). The broader area around the main bus and train stations will undergo a complete transformation, with new green spaces and safer traffic zones. The project is fully aligned with the guidelines of sustainable urban mobility, with all road expansions and new configurations designed exclusively for public transit (no roads will be widened for personal vehicles). Plans prioritize cyclists and pedestrians, incorporating new areas to enhance safety for all traffic participants and additional greening of spaces, including tree-lined streets and squares in the surrounding area. **Establishment of river public transport:** To diversify public transport options within the wider city centre, the project includes the establishment of a circular route along the Ljubljanica river. This initiative includes measures to electrify river transport, such as procuring 10 dedicated electric vessels for public transport, developing river infrastructure, and implementing grid connections, electric charging infrastructure (120 kW), and battery storage solutions. The circular route around the city centre area will be approximately 12 km long. **Implementation of a unified ticketing system for all passengers:** The introduction of a unified ticketing system for all passengers enables the use of a single

		ticket for various modes of transportation, promoting easy access and enhancing the attractiveness and user-friendliness of public transportation. The ticketing system will encourage the use of public transport, reduce congestion, promote sustainability, and improve the overall quality of urban mobility.
Reference to impact pathway	Field of action	Mobility & transport
	Systemic lever	Technology/infrastructure, governance & policy
	Outcome (according to module B-1.1)	A thorough assessment of public transportation user needs will be conducted, and areas requiring improvement will be identified. Updating the legislation to facilitate the implementation of all planned projects to improve public transportation. Introduction of new bus routes to improve coverage. Increased bus frequency on main routes. Implementation of dedicated bus lanes to reduce travel times. Smart traffic light management prioritizing public transportation. Introduction of longer vehicles to accommodate more passengers. Comprehensive studies to ensure effective planning of public transportation. Adjustment of city bus schedules for better integration with other public transportation modes such as trains and intercity buses. Renovation and electrification of railway tracks. Incorporation of light rail concept with new stations. Enhanced overall reliability of railway transportation within the city. Development of a new passenger centre featuring a main bus and train station, serving as the central hub for public transportation. Introduction of passenger transportation by electric boats along the Ljubljanica river. Introduction of a single ticket for various modes of public transportation.

Implementation	Responsible bodies/person for implementation	The City of Ljubljana (Department of economic activities and transport, Spatial planning department), LPP Ltd. (Ljubljana Passenger Transport), the Ministry of Infrastructure, Slovenian Railways Ltd.
	Action scale & addressed entities	Local and regional scale. Bus network, buses, traffic safety equipment, railway infrastructure, electric trains, Ljubljana passenger centre, electric boats, public transport tickets, river infrastructure for public transport.
	Involved stakeholders	The City of Ljubljana (Department of economic activities and transport, Spatial planning department), LPP Ltd. (Ljubljana Passenger Transport), the Ministry of Infrastructure, Slovenian Railways Ltd, residents, city visitors and commuting workers, non-governmental organizations, research institutes.
	Comments on implementation – consider mentioning resources, timelines, milestones	The planned increase in investments in improving urban transportation includes the introduction of new lines, increased bus frequency, and travel time improvements. Simultaneously, further investment is anticipated for expanding the fleet with the aim of increasing the number of passengers transported daily. Funds for the implementation of measures have already been allocated by the City of Ljubljana and Ljubljana Passenger Transport for the gradual implementation of measures. Planned is also an investment in upgrading existing single-track lines to double-track and electrification on all existing railway connections between the city of Ljubljana and other suburban centres. The funds are provided by the state and Slovenian Railways Ltd. The renovation of the main bus and train station is in the preparation phase for construction works. To implement the measures, it is necessary to integrate infrastructure into space, which may take a longer time. Some measures are long-term, especially the modernisation of railway infrastructure, and will not be fully implemented by 2030.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Reduction of personal traffic: 278,797 MWh/year

	GHG emissions reduction estimate (total) per emission source sector	Reduction of personal traffic: 73,265 t CO_2e/year
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	554,086,559 EUR (CAPEX) 7,563 EUR/ t CO_2e

B-2.2: Individual action outlines – 2.2		
Action outline	Action name	**Improving green mobility and managing accessibility**
	Action type	Physical/spatial interventions, other interventions
	Action description	**Managing city accessibility for personal vehicles:** The main objective of the measure is to create conditions for less attractive access to the city by personal vehicles, by calming the flow of cars in the city centre and in the areas outside the ring road, thereby reducing congestion and encouraging the use of public transport (reducing accessibility for private traffic in the city centre by 10 minutes, and by 5 minutes in areas outside the ring road). The measures will be implemented after improving public transportation services to ensure a fair transition. The following activities are planned: (1) Introduction and implementation of a new parking policy for personal vehicles in the city centre (higher parking fees, shorter parking times in zone 1, resident permits). (2) Implementation of a 30 km/h speed limit on most non-main city streets. (3) Establishment of new emission-free zones, allowing only walking and cycling. (4) New restricted traffic areas. (5) Carpool lanes, where vehicles with more than three occupants can use lanes designated for public transportation. (6) Development of a city logistics management plan to optimize freight transport. **Establishing community mobility infrastructure:** Establishing community mobility infrastructure involves the development and implementation of transportation solutions focused on community needs and integration. This approach to mobility not only enhances transportation connections and accessibility but also strengthens community spirit and collaboration, contributing to a more sustainable and connected urban environment. The measure includes the following activities: (1) Establishing and managing a public system for renting and sharing electric vehicles and bicycles. (2) Establishing shared mobility hubs. (3) Setting up passenger transfer points (public

		transport hubs, bike storage facilities at Park and Ride stations, bike, and scooter rental, etc.). (4) Implementing mobility plans for institutions. (5) Establishing models for vehicle, technology, and infrastructure sharing and co-use. **New Park and Ride (P+R) areas and Park + Sail:** The "Green Move Ljubljana" project aims to reduce congestion in the city by constructing two new Park and Ride (P+R) facilities, providing parking for up to 800 vehicles. This encourages daily commuters to use public transportation, thus reducing the number of cars in the city centre. The P+R facilities will also be connected to new river public transportation stations, from where it will be possible to travel to the city centre using river e-vessels (the so-called "Park + Sail" concept). **Development of alternatives and innovations for better accessibility:** To improve accessibility for all, including persons with disabilities, we will continue to strive to develop services that will facilitate easier and more comfortable sustainable travel over longer distances. This includes the development of on-demand transportation services in various forms and the expansion or enhancement of the transport service for mobility-impaired individuals, known as "Kavalir".
Reference to impact pathway	Field of action	Mobility & transport
	Systemic lever	Technology/infrastructure, governance & policy, social innovation
	Outcome (according to module B-1.1)	Prolongation of travel time for personal vehicles entering the city centre. Introduction of a stricter parking policy with increased fees and reduced parking durations. Implementation of a 30 km/h speed limit on most non-main city streets. Establishment of new emission-free zones for walking and cycling only. Establishment of new restricted traffic areas. Due to traffic reduction, new spaces for socialization and new activities will be provided in the city. Implementation of carpool lanes for vehicles with three or more occupants.

		Development of a city logistics management plan to optimize freight transport. Development and management of a public system for renting and sharing electric vehicles and bicycles. Establishment of shared mobility hubs. Construction of two new Park and Ride facilities. Connection of P+R facilities to new river public transportation stations (Park + Sail concept). Continued development of on-demand transportation services. Expansion or enhancement of transport services for mobility-impaired individuals.
Implementation	Responsible bodies/person for implementation	The City of Ljubljana (Department of economic activities and transport, Spatial planning department), LPP Ltd. (Ljubljana Passenger Transport), Ministry of Infrastructure, private companies, providers of electric vehicle and bike rental services.
	Action scale & addressed entities	Local and regional scale. Users of personal vehicles, users of public transportation, users of mobility services (e.g. car sharing), new parking lots, parking policy.
	Involved stakeholders	The City of Ljubljana (Department of economic activities and transport, Spatial planning department), LPP Ltd. (Ljubljana Passenger Transport), Ministry of Infrastructure, private companies, providers of electric vehicle and bike rental services, users of mobility services.
	Comments on implementation – consider mentioning resources, timelines, milestones	City of Ljubljana must implement measures to reduce personal road traffic and to increase the use of public transportation. This involves enhancing awareness and promotion to encourage the use of public transportation. The measures will be implemented gradually, along with the improvement of public transportation, as it is necessary to offer people an alternative to personal transportation. Funding for measures related to the City of Ljubljana and LPP Ltd. has been secured, and projects are already underway.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.

	Removed/substituted energy, volume, or fuel type	Reduction of personal traffic: 200,718 MWh/year
	GHG emissions reduction estimate (total) per emission source sector	Reduction of personal traffic: 51,012 t CO_2e/year
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	17,139,344 EUR (CAPEX) 336 EUR/ t CO_2e

B-2.2: Individual action outlines – 2.3		
Action outline	Action name	**Decarbonisation of road and other motor vehicles**
	Action type	Technical interventions
	Action description	**Modernisation and decarbonization of urban and suburban public bus transportation:** By 2030, the replacement of all city buses currently running on diesel fuel with clean and zero-emission vehicles is planned. It is expected that by 2030, 49% of the city bus fleet will operate on hydrogen or electricity generated from renewable energy sources. This measure will contribute to reducing CO_2e emissions in the entire fleet by over 50%. At the same time, by 2030, the replacement of the currently predominant compressed natural gas (a fossil fuel) with biomethane, which is a carbon-neutral fuel, is anticipated. According to the strategy, buses operating on biomethane are expected to represent 51% of the fleet by 2030. With the combination of transitioning from natural gas to biomethane and the introduction of zero-emission vehicles, the complete decarbonization of the fleet is envisioned. **Decarbonization of vehicles owned by the City of Ljubljana, public institutions, and public companies:** The measure involves the modernization and decarbonization of the fleet of the city administration, public companies, and institutions. The plan includes upgrading the existing fleet with environmentally friendly vehicles. Implementation of the measure entails transitioning to electricity for personal, light-duty, and medium-duty vehicles, as well as using biomethane for heavy-duty vehicles (e.g., garbage trucks). **Charging infrastructure for electric and hydrogen vehicles:**

		The measure encompasses the installation of charging stations and centres for electric vehicles, as well as the establishment of charging infrastructure for electric and hydrogen-powered public transportation vehicles. The plan includes the deployment of numerous new charging stations for personal and commercial vehicles with charging power up to 22 kW at existing parking areas, along with high-power charging centres for fast charging (150 and 350 kW). These charging stations will be set up in collaboration with existing charging infrastructure providers. Additionally, a network of electric charging stations for buses with a capacity of 75 kW (charging station 150 kW) will be established. The charging stations are designed to efficiently recharge buses with a daily consumption of up to 390 kWh within a limited time frame. Furthermore, the installation of a hydrogen refuelling station is planned to provide hydrogen at pressure levels of 350 bar and 700 bar (for light-duty vehicles) for hydrogen fuel cell vehicles. The station will supply public transportation buses as well as other personal and commercial vehicles. Green hydrogen production will be enabled by using electricity from small hydropower plants along the Ljubljanica river and solar power, aligning with the environmentally friendly "Hydrogen Valley" project. The charging infrastructure will be primarily designed to support the efficient operation of battery electric buses (BEB) and fuel cell electric buses (FCEB). **Decarbonisation of passenger cars:** To achieve the goals of reducing greenhouse gas emissions by 2030 and beyond, radical changes in the fuel structure of personal vehicles are necessary, in addition to reducing the use of personal cars. It is crucial that personal vehicles transition to sustainable and environmentally friendly alternatives. Electricity is expected to play a key role, with the aim of having at least 35% of kilometres travelled by personal vehicles powered by electricity, while hydrogen is projected to cover 10%. Hybrid vehicles will contribute 10% of kilometres travelled, as will biomethane. Vehicles running on diesel and gasoline together will account for the remaining 35% of

		all kilometres travelled by personal vehicles in the Ljubljana area. The transition to sustainable fuels must be carried out at a broader national level, as municipalities have no direct influence on transit traffic. To promote this transformation, it is crucial for national and regional authorities to implement effective strategies that offer incentives and subsidies. National initiatives, including financial incentives for transitioning to zero-emission energy sources in transportation, as well as the construction of infrastructure for charging electric vehicles, hydrogen, and biomethane, will play a key role in reducing greenhouse gas emissions and shaping a more environmentally friendly personal transportation system. **Decarbonisation of freight vehicles and buses:** To achieve the set goals of reducing greenhouse gas emissions, a significant shift in the fuel composition for light commercial vehicles, heavy-duty trucks, and buses is also important. In the next decade, both freight and passenger transport must transition to sustainable alternatives. The goal by 2030 is to have at least 25% of kilometres travelled by light commercial vehicles based on electricity, while hydrogen is expected to cover 10%. As the transition will be gradual, diesel fuels will continue to play an important role, covering 40% of kilometres travelled, while gasoline will contribute around 1%. The remaining kilometres travelled are expected to be covered by biomethane (24%). For heavy-duty vehicles, diesel fuel is expected to maintain dominance (40%), but biomethane is crucial for transitioning to renewable sources, as it could cover 35% of kilometres travelled, while electricity and hydrogen are projected to represent 25%. In the case of buses, diesel fuel is expected to maintain the largest share (40%), while biomethane could lead the transition to renewable energy sources with 30% of kilometres travelled. Electricity and hydrogen together are expected to contribute 30%. Transitioning solely to alternative energy sources in road transport can effectively contribute to reducing greenhouse gas emissions and achieving the goals of sustainable (carbon-neutral) mobility.

		Decarbonisation of agricultural machinery: The measure focuses on reducing the consumption of fossil fuels in agriculture. It includes the use of alternative energy sources, such as biomethane or electricity, to power agricultural vehicles, tractors, combines, and other agricultural machinery. The goal of the measure is to replace at least 1/3 of the current diesel fuel consumption with alternative sources. Implementing this measure requires financial support mechanisms, raising awareness among farmers about the benefits of using renewable energy sources, and infrastructure measures for charging or supplying these energy sources.
Reference to impact pathway	Field of action	Mobility & transport
	Systemic lever	Technology/infrastructure, finance & funding, governance & policy
	Outcome (according to module B-1.1)	Funding will be secured to transition all urban public transport vehicles to clean energy sources. Replacement of diesel buses with clean and zero-emission vehicles. Replacement of fossil natural gas with biomethane for all CNG buses. Public-private partnerships for the establishment of public charging infrastructure. Installation of public charging stations for electric and hydrogen vehicles, including fast-charging centres. Establishment of charging infrastructure for electric and hydrogen-powered public transportation vehicles. Adoption of regulations and guidelines for decarbonization of vehicles owned by the City of Ljubljana. Gradual transition of personal vehicles to sustainable alternatives (electricity, hydrogen and biomethane). Gradual transition of light commercial vehicles to sustainable alternatives (electricity, hydrogen and biomethane). Gradual transition of heavy-duty vehicles and intercity buses to sustainable alternatives (electricity, hydrogen and biomethane).

		Reduction of fossil fuel consumption in agriculture by using alternative energy sources like biomethane or electricity. Ensuring additional funds to promote the transition of road transport to cleaner energy sources. Enhanced financial support will be pursued through national and international policies, with efforts to explore European funding opportunities.
Implementation	Responsible bodies/person for implementation	The City of Ljubljana, public institutions and companies owned by the city, LPP Ltd. (Ljubljana Passenger Transport), private companies (e.g. charging infrastructure providers, public transportation providers, cargo carriers), residents, city visitors and commuting workers.
	Action scale & addressed entities	Local, regional, and national scale. Passenger cars, buses, trucks, agricultural machinery, charging infrastructure.
	Involved stakeholders	The City of Ljubljana, public institutions and companies owned by the city, LPP Ltd. (Ljubljana Passenger Transport), Eco Fund (Slovenian Environmental Public Fund), private companies (e.g. charging infrastructure providers, public transportation providers, cargo carriers), residents, city visitors and commuting workers.
	Comments on implementation – consider mentioning resources, timelines, milestones	Planned is increased investment in zero-emission vehicles and infrastructure. Adequate incentives and loans are needed for the successful implementation of measures. Funding for measures related to the City of Ljubljana, public institutions, city owned companies, and LPP Ltd. has been secured, and projects are already underway. Every year, funds are also allocated by the Eco Fund for sustainable mobility and zero-emission vehicles. To achieve the goals of sustainable mobility, it is crucial to increase these funds and direct them towards measures to promote the use of environmentally friendly modes of transport and reduce greenhouse gas emissions.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Personal vehicles: 516,167 MWh/year Light commercial vehicles: 69,554 MWh/year

	GHG emissions reduction estimate (total) per emission source sector	Urban and suburban buses: 17,001 t CO_2e/year City-owned vehicles: 4,024 t CO_2e/year Personal vehicles: 242,615 t CO_2e/year Light commercial vehicles: 68,712 t CO_2e/year Heavy-duty vehicles: 71,180 t CO_2e/year Intercity buses: 3,717 t CO_2e/year
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	4,618,430,232 EUR (CAPEX) 11,314 EUR/ t CO_2e

B-2.2: Individual action outlines – 2.4		
Action outline	Action name	**Improving infrastructure for cyclists and pedestrians**
	Action type	Physical/spatial interventions, other interventions
	Action description	**Improving conditions for cyclists and pedestrians:** The main goal of this measure is to reduce resistance to cycling and walking by 20%, thereby improving the overall experience and safety of walking and cycling. The measure includes numerous activities such as: (1) Improving existing cycling infrastructure (capacity, connectivity, safety, maintenance, renewal). (2) Expanding the cycling network (within the city and regionally) and connecting to national cycling routes. (3) Establishing green mobility corridors - away from main roads. (4) Providing bicycle parking facilities and bicycle storage (including secure facilities). (5) Expanding the network of bike-sharing systems (conventional and e-bikes). (6) Extending the network of one-way streets where cycling against the flow of other vehicles is allowed (contraflow). (7) Establishing new pedestrian areas (pedestrian zones). (8) Expanding pedestrian areas outward from the city centre into residential neighbourhoods. (9) Building new bridges, especially for walking and cycling, to shorten routes for non-motorized traffic. (10) Providing safety measures on school routes and in their vicinity. (11) Conducting a study focused on defining corridors that are crucial for pedestrian and cycling routes. (12) Strategic analysis of cycling needs and infrastructure, aiming to accommodate reduced use of private vehicles and increased demand for cycling. (13) Conducting a study to assess the accessibility

		of public services in urban neighbourhoods, to improve pedestrian access to facilities such as shops, post offices, kindergartens, and recreational areas. (14) Further development of themed cycling paths and pedestrian routes.
Reference to impact pathway	Field of action	Mobility & transport
	Systemic lever	Technology/infrastructure, democracy/participation, learning & capabilities
	Outcome (according to module B-1.1)	Solutions implemented in other cities, which have demonstrated positive outcomes in enhancing cycling and pedestrian infrastructure, will be examined. Reduction of resistance to cycling and walking by 20%, enhancing overall safety and experience. Expansion and improvement of cycling infrastructure and networks. Establishment of green mobility corridors away from main roads. Expansion and enhancement of bicycle parking facilities to ensure ample availability and secure storage options. Expansion of bike-sharing systems, incorporating both conventional and e-bikes. Creation of new pedestrian zones, enhancing walkability and safety. Expansion of pedestrian areas into residential neighbourhoods beyond the city centre. Construction of new bridges prioritizing pedestrian and cycling access. Conducting studies to define crucial pedestrian and cycling corridors and assess accessibility of public services in urban neighbourhoods. Strategic analysis of cycling needs and infrastructure to accommodate reduced private vehicle usage. Active promotion and encouragement of user engagement and participation in pedestrian and cycling infrastructure. Introduction of pilot projects to test proposed improvements and collect user feedback. Robust citizen engagement and participation will be actively promoted and encouraged.

Implementation	Responsible bodies/person for implementation	The City of Ljubljana (Department of economic activities and transport, Spatial planning department), Ministry of Infrastructure, private companies (e.g. bicycle rental providers).
	Action scale & addressed entities	Local and regional scale. Cycling and pedestrian infrastructure, pedestrian zones, bike parking and bike shelters, bicycles.
	Involved stakeholders	The City of Ljubljana (Department of economic activities and transport, Spatial planning department), Ministry of Infrastructure, private companies (e.g. bicycle rental providers), cyclists and pedestrians.
	Comments on implementation – consider mentioning resources, timelines, milestones	The planned increased investments are intended to improve the transportation infrastructure for pedestrians and cyclists. To carry out such projects, it is necessary to obtain non-refundable funds (EU funds), which will facilitate and expedite project implementation. Some projects are already in the preparation phase on the side of the City of Ljubljana, and the same applies to the infrastructure managed by the state or the relevant ministry. Measures will be implemented gradually, in accordance with available funds.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	750 MWh/year
	GHG emissions reduction estimate (total) per emission source sector	197 t CO_2e/year
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	60,000,000 EUR (CAPEX) 304,401 EUR/ t CO_2e

B-2.2: Individual action outlines – 2.5		
Action outline	Action name	**Organizational, incentive, and awareness-raising measures**
	Action type	Other interventions
	Action description	**Promoting sustainable mobility:** Measures to promote sustainable mobility include promotion and campaigns to encourage cycling, walking, the use of vehicles powered by renewable energy sources, and public transportation. **Development of a Sustainable urban mobility plan (SUMP):** A new Sustainable urban mobility plan (SUMP) for the City of Ljubljana will be prepared in cooperation with various stakeholders, defining

		objectives and specific actions, as well as monitoring and reporting. **Research/educational content:** Research and educational activities encompass various aspects, including technological, infrastructural, sociological, and psychological aspects. This involves exploring the impact of technological and infrastructural innovations on sustainable mobility, analysing social and psychological factors influencing transportation choices, and developing strategies to promote sustainable habits, as well as aspects such as transport poverty, etc. Through these activities, the aim is to adopt a comprehensive approach to understanding and addressing the challenges of sustainable mobility in urban environments. **Transport poverty:** Current city policies and activities address transport poverty through measures such as accessible public transportation, developed and accessible cycling infrastructure, subsidized tickets, etc. The subject action plan includes additional measures to further reduce transport poverty. The upcoming national action plan to reduce transport poverty will provide an even more comprehensive approach to addressing transport poverty systematically, both at the national and local levels. **Establishment of the sustainable mobility department:** The establishment of the Sustainable Mobility Department in the City of Ljubljana follows the global trend of other cities around the world that recognise the importance of sustainable mobility in improving the quality of life of their citizens and reducing the negative impact of transport on the environment. Such a department allows for a holistic approach to planning and implementing transport policies and facilitates coordinated action between different sectors and stakeholders in the city. This helps to achieve the objectives of sustainable development, reduce greenhouse gas emissions, and create a healthier and more pleasant urban environment for all residents. **Coordinating the needs of users who gravitate towards the City of Ljubljana:** Coordinating the needs of users gravitating to the City of Ljubljana involves analysing and adjusting parking options and other forms of sustainable mobility according to the users' requirements in municipalities before entering

		the City of Ljubljana. The measure includes the following activities: (1) Establishing a working group to coordinate needs. (2) Creating community studies and models that will provide key information to decision-makers, also from the perspective of planning and placing infrastructure outside the borders of City of Ljubljana. (3) Active participation of the City of Ljubljana in broader working groups (Republic of Slovenia, Ljubljana Urban Region, etc.) to determine necessary measures.
Reference to impact pathway	Field of action	Mobility & transport
	Systemic lever	Social innovation, democracy/participation, governance & policy, learning & capabilities
	Outcome (according to module B-1.1)	Increased promotion and adoption of cycling, walking, renewable energy vehicles, and public transportation. Various promotional campaigns will be carried out to encourage cycling and walking as the primary modes of transportation in the city. Development of a new Sustainable urban mobility plan (SUMP) in collaboration with stakeholders. Research and educational activities to understand and address various aspects of sustainable mobility. Implementation of measures to address transport poverty through accessible transportation and subsidies. Establishment of the Sustainable Mobility Department to holistically plan and implement transport policies. Coordination of user needs outside the City of Ljubljana to adjust parking and mobility options accordingly.
Implementation	Responsible bodies/person for implementation	The City of Ljubljana (Department of economic activities and transport, Spatial planning department), Ministry of environment, climate and energy.
	Action scale & addressed entities	Local and regional scale. Traffic participants and traffic infrastructure planners.
	Involved stakeholders	The City of Ljubljana (Department of economic activities and transport, Spatial planning department), Ministry of environment, climate and energy, non-governmental organizations in the field of transportation, cyclists and pedestrians, other interested stakeholders.

	Comments on implementation – consider mentioning resources, timelines, milestones	Developing comprehensive mobility strategies, implementing a traffic model, and establishing new workplaces within city administration to support sustainable mobility require dedicated financial resources. Funds for planned measures, which fall within the jurisdiction of the City of Ljubljana, are secured, and the same applies to measures within the jurisdiction of the respective ministries. Close cooperation between the city and the state will be essential for the successful implementation of the planned measures.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Not estimated.
	GHG emissions reduction estimate (total) per emission source sector	Indirect impacts on the reduction of GHG emissions (reductions are already considered in other measures).
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	No investments, the costs of activities are estimated at approximately 828,000 EUR per year.

WASTE AND CIRCUAR EONOMY

B-2.2: Individual action outlines – 3.1		
Action outline	Action name	**Waste reduction**
	Action type	Technical interventions, other interventions
	Action description	**Reducing waste generation, promoting reuse and recycling:** To reduce waste, a comprehensive approach is planned, which includes campaigns, regulations, pricing policies, and circular economy goals. A key point to be promoted at the national level is the implementation of awareness campaigns about sustainable practices, stricter environmental regulations for waste, and tax incentives for companies that follow environmentally friendly practices. Implementing differentiated waste pricing, financial incentives for recycling, and introducing circular economy goals, especially for construction and industrial waste, will further encourage sustainable waste management. At the same time, waste management programs need to be revamped, including waste prevention programs that focus on innovation and reward sustainable practices. These measures can effectively reduce waste, promote recycling, and create a

		more sustainable and responsible society. The measures include the following: (1) Opening 5 zero-waste stores. (2) Ensuring the operation of 5 reuse centres with Repair Cafes. (3) Launching a Sustainable Office in each neighbourhood community (advisors for societal transformation). (4) All business gifts in city administration, public companies, and city institutions will be sustainable and locally made. (5) Directing hotels and other accommodation facilities to obtain the Zero Waste certificate (3 units per year). (6) Establishing a network of bicycle repair services. (7) Implementing a Sustainable City Card for the socially vulnerable and young, allowing repairs of clothing, bicycles, electronic equipment (e.g., 40 EUR/3 months). **Reduction of household mixed municipal waste to less than 80 kg per capita per year:** The aim of the measure is to reduce the amount of mixed municipal household waste to less than 80 kg per capita annually. At the same time, we focus on the rational use of resources, with the most important aspect being the reduction of their consumption. Emphasis is placed on raising awareness among users about the three key priorities of waste management: waste prevention, reuse, and recycling. To raise awareness among users, we will conduct 4 communication campaigns annually, each targeting a specific theme (food, clothing, etc.). Additionally, a model for the collection and material processing of used diapers will be established (households and public institutions). **Reduction of single-use plastic:** To reduce the use of single-use plastics, several activities will be implemented. (1) The creation of a handbook for organizing sustainable events is planned, providing guidelines for organizing environmentally friendly gatherings. (2) Co-financing of events promoting plastic reduction and sustainable waste management is planned, along with the establishment of packaging-free sales points to encourage waste reduction and the use of reusable packaging. (3) The installation of sales points, beverage vending machines, and bulk dispensers without packaging will be encouraged. (4) The establishment of the Green Laboratory at the Rog Innovation Centre will be initiated. (5) Public procurement will include criteria for reducing plastic. (6) Education on reusable packaging will be provided. (7) Promotion of refill systems to reduce the need for single-use plastics will be

		carried out. (8) Implementation of a deposit system for glassware and food utensils at all sports, music, and public events will be established. (9) Establishment of a food packaging return scheme for home use will be implemented. (10) Establishment of a return scheme for coffee-to-go packaging will be initiated. (11) Provision of glass jars or glass bottles for tap water use to all employees in city administration will be ensured. (12) Installation of an additional 10 water fountains will be carried out. **Reduction of food waste:** The measure includes the implementation of several activities and projects, namely: (1) Establishment of a model for systematic recording of discarded food. (2) Educational workshops on reducing surplus prepared food. (3) Workshops on alternative ways to prepare meals from ingredients that would otherwise end up as waste. (4) Introduction of a meal planning application emphasizing the use of seasonal and locally sourced food. (5) Provision of space for the sale of local food and products in each city district (daily or occasionally). (6) Establishment of a food exchange platform enabling the redirection of food surplus to where it is needed. (7) Establishment of the Rog Culinary Laboratory, serving as a space for innovation and experimentation in the field of food waste. (8) Provision of an office and network of experts for the development of "urban gardening" (balconies, roofs, proximity to residence, seed care, knowledge transfer, equipment, exchange, marketing), as well as further support and promotion of urban beekeeping. (9) Promotion of composting of organic waste. (10) Establishment of eco-gardens in kindergartens and schools. (11) Each year, we will set up a shared refrigerator for surplus food in 10 multi-family buildings and support it with a dedicated organizational application. **Reduction of textile waste:** Sustainable textile management is crucial for waste reduction, so the following activities will be implemented: (1) Introduction of separate collection of textiles. (2) Promotion of clothing design and exchange through the "reči" (things) exchange and textile recycling centre at the Rog Centre, as well as the establishment of additional clothing exchange points. (3) Promotion of second-hand clothing stores. (4) Implementation of communication campaigns for responsible consumption. (5) Workshops at primary and secondary schools on the topic of Fast Fashion. (6)

		Encouragement and planned establishment of a network of "clothing repair shops," where workshops for repairing and extending the lifespan of clothing will be held. (7) Priority use of recycled materials in public procurement, with contracts aimed at promoting sustainable practices in the textile industry. **Reduction of electronic and electrical waste:** The measure involves increasing the sharing of electrical and electronic equipment through the "reči" (things) exchange, focusing on rental and repair centres. The main activities will be: (1) Establishment of a network of repair services for electrical products. (2) Establishment of a network of so-called repair cafes, where users can repair electrical products themselves with the help of mentors. (3) Issuing recommendations for extending the lifespan of products. (4) Introduction of "reči" (things) libraries in each neighbourhood community for renting electrical appliances needed only occasionally. (5) Increase in the number of collection points for used equipment. (6) Priority given to refurbished equipment in public procurement, considering energy efficiency. (7) Encouragement of donating discarded but still functioning used electronic equipment that would otherwise end up as waste.
Reference to impact pathway	Field of action	Waste & circular economy
	Systemic lever	Technology/infrastructure, governance & policy, finance & funding, social innovation, democracy/participation
	Outcome (according to module B-1.1)	Establishment of zero-waste stores, reuse centres, and Sustainable Offices. Introduction of a Sustainable City Card for vulnerable groups. Creation of a handbook for sustainable event organization. Co-financing events with less plastic and sustainable waste management. Establishment of a network of bicycle repair services. Conducting communication campaigns targeting waste reduction. Introduction of separate collection of textiles and electrical equipment. Establishment of packaging-free sales points.

		Establishment of food packaging and coffee-to-go return schemes. Promotion of refill systems and second-hand stores. Implementation of deposit systems for glassware and food utensils. Establishment of a model for systematic recording of discarded food. Establishment of a food exchange platform. Provision of space for local food sales and eco-gardens. Establishment of repair services for electrical products. Introduction of repair cafes and "clothing repair shops." Establishment of clothing exchange points. Priority use of recycled materials in public procurement. Reducing household mixed municipal waste to below 80 kg per inhabitant per year. Financial incentives for circular economy and recycling.
Implementation	Responsible bodies/person for implementation	The City of Ljubljana (Department of environmental protection), Utility company VOKA SNAGA, non-governmental organizations, waste management companies, business and industrial associations, households.
	Action scale & addressed entities	Local and national scale. Citizens, companies, reuse centres, bicycle workshops, zero waste shops, service cafes, sustainable offices, refill systems, water fountains, clothing repair shops, collection points for used equipment.
	Involved stakeholders	The City of Ljubljana (Department of environmental protection), Utility company VOKA SNAGA, Government and regulatory bodies, environmental agencies, businesses and industries, media, waste management companies, educational institutions, non-governmental organisations, research institutions, households.

	Comments on implementation – consider mentioning resources, timelines, milestones	The emphasis is on raising awareness, stricter environmental regulations, and tax incentives for eco-friendly practices, requiring promotion at the national level. Funds for promoting waste reduction are provided by the City of Ljubljana. Such awareness-raising campaigns are already partially underway, but they are planned to be expanded further in the future to reach a larger portion of the public. Funds for measures aimed at reducing the amount of mixed household municipal waste, plastic usage, surplus food, waste textiles, waste electrical and electronic equipment are already provided by the City of Ljubljana, with a portion of the funds also contributed by the company VOKA SNAGA. Although some measures are already being implemented to a limited extent, others will start in 2025 and will be implemented annually thereafter.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Not applicable.
	GHG emissions reduction estimate (total) per emission source sector	Indirect impacts on the reduction of GHG emissions (reductions are already considered in other measures).
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	9,828,000 EUR (CAPEX)

B-2.2: Individual action outlines – 3.2		
Action outline	Action name	**Waste management**
	Action type	Technical interventions, other interventions
	Action description	**Implementation of waste-to-energy aspects:** Implementation of energy production from waste in accordance with the Waste Management Program and Waste Prevention Program. A key aspect involves the thermal treatment of waste for district heating systems. Additionally, there is a pursuit of the development and utilization of new technologies for producing synthetic recycled carbon fuels, such as synthetic fuels, hydrogen, and synthetic gases derived from waste. An important part is also the review of waste classification from the wood processing industry and waste chips, which can serve as fuel or material for further use. Together, these

		constitute a comprehensive approach to efficient and sustainable energy utilization from waste. **Exceeding 75% of separately collected waste and reaching 80% by 2035:** To achieve the goals of separate waste collection, which means 75% of waste separated by 2030 and 80% by 2035, an upgrade of the existing infrastructure for separate collection of municipal waste is necessary. This enables users to properly separate waste. Through various communication tools, we target different groups, with an emphasis on proper waste management. This creates conditions for the effective implementation of separate waste collection and the achievement of set goals. The measure includes the following activities: (1) Construction of 3 collection centres with reuse centres. (2) Establishment of an expanded collection network for collecting waste textiles, waste cooking oil, and small household electrical appliances (150 locations). (3) Establishment of a network of 9 mini collection centres. (4) Special collections of waste electrical and electronic equipment in individual neighbourhood communities once a year. (5) Promotion of home composting. (6) Providing a concept for managing small quantities of construction waste, mainly from the renovation of individual housing units (collection point, separate collection at the source, and processing). (7) Waste separation analysis. This analysis is crucial for understanding the types of waste generated in a specific area or institution and enables the planning of appropriate waste management, recycling, and reducing environmental impacts strategies.
Reference to impact pathway	Field of action	Waste & circular economy
	Systemic lever	Technology/infrastructure, governance & policy, learning & capabilities, democracy/ participation
	Outcome (according to module B-1.1)	Utilization of waste for district heating system. Reduced energy consumption and greenhouse gas emissions through efficient waste-to-energy processes. Decreased landfilling of mixed municipal waste, leading to lower methane emissions. Development and utilization of new technologies for producing synthetic recycled carbon fuels.

		Review of waste classification from the wood processing industry for energy production. Construction of collection centres and mini collection centres. Expansion of the collection network for textiles, cooking oil, and electrical appliances. Promotion of home composting and management of construction waste. Conducting waste separation analysis for effective waste management strategies. Enhanced community engagement in waste management practices. Communication for waste management awareness.
Implementation	Responsible bodies/person for implementation	Utility company VOKA SNAGA, Energetika Ljubljana (local district heating and gas distribution company).
	Action scale & addressed entities	Local and regional scale. Waste, infrastructure for waste-to-energy, collection centres.
	Involved stakeholders	The City of Ljubljana, Utility company VOKA SNAGA, Energetika Ljubljana (local district heating and gas distribution company), companies and residents.
	Comments on implementation – consider mentioning resources, timelines, milestones	Funds for implementing the waste thermal treatment measure for the district heating system are provided by Utility company VOKA SNAGA and Energetika Ljubljana. In this regard, both companies will allocate part of their own funds, while the remaining investment is planned to be provided by the EU. Funds for achieving the set goal of separately collected waste are already provided by Utility company VOKA SNAGA. This will involve a gradual upgrade of the existing infrastructure for separate collection of municipal waste.
Impact & cost	Generated renewable energy (if applicable)	Already considered in the measure "Decarbonisation of heat supply energy sources" (1.1).
	Removed/substituted energy, volume, or fuel type	Already considered in the measure "Decarbonisation of heat supply energy sources" (1.1).

	GHG emissions reduction estimate (total) per emission source sector	Reduction of waste disposal: 19,990 t CO_2e/year
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	58,870,000 EUR (CAPEX) 2,945 EUR/ t CO_2e

GREEN INFRASTRUCTURE & NATURE-BASED SOLUTIONS

B-2.2: Individual action outlines – 4.1		
Action outline	Action name	**Green and blue-green infrastructure**
	Action type	Physical/spatial interventions, nature-based solutions
	Action description	**Greening of the city:** The City of Ljubljana is one of the greenest cities in the EU, which was recognised in 2016 by the European Green Capital Award. The share of total green infrastructure within the city borders is 67% and the share of urban tree cover is 50%, according to data from the Green infrastructure dashboard (EEA, 2021). However, if forests and agricultural land are excluded, the proportion of green space in urban areas (i.e. built-up and related land) is estimated at 33.8%. The aim of this measure is to develop a Long-term Urban Greening Plan to increase the proportion of green spaces to 40% over the next 15 years. Following the guidelines for cities (EC, 2021), the City of Ljubljana will set up an appropriate working structure, develop long-term objectives, set targets, priorities, and timetables, and establish an MRE system. The Long-term Urban Greening Plan for greening the city and managing green areas will include numerous measures and activities: (1) Greening new and existing flat roofs. (2) Establishment of green vertical ecosystems. (3) Implementation of rainwater harvesting, storage, and utilization systems for water recycling within buildings or their surroundings. (4) Conversion of paved (impermeable) surfaces into permeable green surfaces. (5) Establishment of new urban parks and green areas. (6) Creation of new public orchards and community urban gardens. (7) Greening of mobility corridors. (8) Activation and greening of courtyards and atriums. (9) Implementation of the concept of Ljubljana as a sponge city, which functions like a sponge, absorbing and retaining water during rainfall and storms, and releasing it gradually. (10) Establishment of rain gardens. (11) Greening of existing and new parking areas. (12) Establishment of

		control over private parking lots, which emerge in former courtyards and transition from temporary to permanent use. (13) Conducting a study on the social functions of green areas and people's needs (cityscape). (14) Installation of new drinking fountains and fountains in public spaces and recreational areas. The listed measures will contribute to increasing green areas in urban environments, helping to mitigate the effects of urban heat islands and climate change, and increasing human well-being. As part of the Long-term Urban Greening Plan, the green roof and facade strategy will be prepared to significantly increase the green roof area in Ljubljana by 2035. Green roofs and facades enhance energy efficiency by providing natural insulation, reducing heating and cooling costs. These green installations also mitigate urban heat island effects, creating a more comfortable and sustainable urban environment. Furthermore, they contribute to improved air quality by capturing pollutants and fostering biodiversity, promoting a healthier and greener living space. Additionally, green roofs and facades help manage stormwater runoff, reducing the risk of flooding and enhancing overall water management in urban areas. The greening plan will be connected and coordinated with sustainable mobility measures, as it will involve greening mobility corridors and parking areas. Establishing green corridors involves developing dedicated paths for cyclists and pedestrians, separated from motorized traffic, and surrounded by greenery. These corridors enable safe and pleasant mobility while also contributing to reducing traffic noise and improving air quality in cities. Green corridors promote sustainable mobility, such as cycling and walking, and contribute to a greener and healthier urban environment. The number of parking spaces in the City of Ljubljana will not increase. Measures will focus on reducing above-ground parking areas by arranging underground parking lots (redirecting parking capacities underground), thus freeing up surface space for other purposes such as squares, green areas, parks, pedestrian paths, or bicycle lanes. This reduces visual pollution in urban spaces, improves environmental quality, and promotes sustainable land use and mobility.

		An analysis of the social functions of green areas and people's needs for urban landscapes (cityscape) will also be conducted to identify the impact of the urban environment on the well-being of residents and the social dynamics of the city. The analysis of the social functions of green areas focuses on understanding how parks, gardens, and other green areas contribute to the quality of life, social interaction, and community health. On the other hand, exploring people's needs for urban landscapes involves analysing how various elements of the urban environment, including green spaces, influence residents' perception, use, and satisfaction with urban space. Both approaches are crucial for planning that considers the human dimension of the city and promotes sustainable urban development. **Sustainable water management:** The measure of sustainable water management includes the following activities: (1) Flood prevention infrastructure aimed at preventing floods in populated areas and agricultural lands. (2) Water flow regulations. (3) Habitat restoration. (4) Sediment removal. (5) Barrier installation. (6) Conducting a study and developing solutions for locations in the city prone to waterlogging during heavy rainfall. (7) Planning SuDS systems (Sustainable Drainage Systems). (8) Hydrological-hydraulic studies with a hydraulic-hydrological model of flood events. Comprehensive river system management will be introduced, which includes regulating water flow, habitat restoration, sediment removal, and the installation of barriers to ensure a balance between human needs and ecosystem preservation. The goal is to prevent floods, ensure water resources, maintain biodiversity, and support socio-economic activities along the river. A study will be conducted to identify locations in the city where water stagnation occurs during heavy rainfall, with the aim of establishing Sustainable Drainage Systems (SuDS). SuDS are drainage solutions that provide an alternative to the direct channelling of surface water through networks of pipes and sewers to nearby watercourses. The aim of SuDS is to reduce direct runoff from urban areas, thereby reducing the risk of flooding. This is achieved by retaining and storing water, slowing its flow, and increasing infiltration into the soil. SuDS systems include various elements such as green roofs, retention ponds,

		gravel trenches, and other permeable surfaces that absorb, filter, and retain water. Hydrological and hydraulic studies will also be conducted using flood event models to reduce the area's vulnerability to climate change, including longer drought periods and extreme rainfall. The studies will involve rainfall simulation, flow analysis, and an assessment of the hydrological and hydraulic conditions in all watersheds of the “Tivoli, Rožnik, and Šišenski hrib” Landscape Park. The task will be used to identify measures for developing blue-green infrastructure in the climate change adaptation process and to design conceptual plans for these measures based on an assessment of necessity.
Reference to impact pathway	Field of action	Green infrastructure & nature-based solutions
	Systemic lever	Technology/infrastructure, governance & policy, learning & capabilities, social innovation, democracy/participation
	Outcome (according to module B-1.1)	Development of a Long-term Urban Greening Plan to increase urban green spaces to 40%. Preparation of a green roof and facade strategy. Installation of new green roofs and facades. Establishment of green mobility corridors and green parking areas. Replacing above-ground parking areas with green spaces. Analysis of social functions of green areas and people's needs for urban landscapes. Implementation of flood prevention infrastructure and SuDS systems. Employing permeable surfaces to mitigate flood risks. Introduction of comprehensive river system management to balance human needs and ecosystem preservation. Conducting hydrological and hydraulic studies to reduce vulnerability to climate change. Restoration of habitats to maintain biodiversity and ensure water resources. Identification of locations prone to flooding for the development of solutions during heavy rainfall.

		Improving water flow through regular cleaning and deepening of riverbeds, employing engineering-biological methods.
Implementation	Responsible bodies/person for implementation	City of Ljubljana (Environmental protection department, Spatial planning department), Ministry of natural resources and space, Water directorate, Slovenian environment agency, building owners and planners.
	Action scale & addressed entities	Local scale. Parking areas, recreational areas, flood protection infrastructure, habitats, riverbeds, green roofs and facades, paved areas, urban parks, urban orchards, urban gardens, mobility corridors, courtyards, rain gardens, fountains.
	Involved stakeholders	City of Ljubljana (Environmental protection department, Spatial planning department), Ministry of natural resources and space, Water directorate, private companies, citizens.
	Comments on implementation – consider mentioning resources, timelines, milestones	Investments are planned in measures to improve the urban environment, water, and air quality, as well as to reduce flood risk, promote the restoration of underground water resources and strengthen the city's resilience to water hazards. Planned measures fall under the jurisdiction of both the City of Ljubljana and responsible services, as well as state authorities. Such measures are already underway, but there are plans for increased investment in this area in the future. Besides city authorities, the state or relevant services are also responsible for this area. Funding for implementing the measures is provided by both the city and the state, with the latter adjusting funds based on the urgency of implementing such measures. Additionally, it is necessary to promote the implementation of measures for greening both new and existing flat roofs and to provide financial resources or subsidies to accelerate the implementation.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Not applicable.
	GHG emissions reduction estimate (total) per emission source sector	Not applicable.
	GHG emissions compensated (natural or technological sinks)	2,800 t CO_2e/year

	Total costs and costs by CO_2e unit	142,182,150 EUR (CAPEX) 50,785 EUR/ t CO_2e

B-2.2: Individual action outlines – 4.2		
Action outline	Action name	**Forest management**
	Action type	Nature-based solutions, other interventions
	Action description	**Maintaining stable forest area:** The aim of this measure is the long-term preservation of a stable forest area, which, according to current land use data, covers around 42% of the territory of the City of Ljubljana. With this measure, which is linked to spatial planning, we not only want to preserve the potential of the land for sink conservation, but also limit and gradually minimize emissions from deforestation. In pursuit of this objective, the City of Ljubljana will conduct a spatial analysis to expand the coverage of protected areas. In addition, the city will purchase 100 ha of forests that have an important social function (e.g. recreational function) or other important benefits.
Reference to impact pathway	Field of action	Green infrastructure & nature-based solutions
	Systemic lever	Governance & policy, finance & funding
	Outcome (according to module B-1.1)	Improvement of sustainable forest management for enhancement of forest sink. Increasing the number of protected forest areas. Reduction of emissions from deforestation and maintaining a stable forest area in the long term. Increasing the area of forests owned by the City of Ljubljana.
Implementation	Responsible bodies/person for implementation	The City of Ljubljana (Department for spatial planning, Department for environmental protection), Slovenia forest service, Ministry of agriculture, forestry and food, forest owners.
	Action scale & addressed entities	Local scale. Forest (private owners).
	Involved stakeholders	The City of Ljubljana (Department for spatial planning, Department for environmental protection), Slovenia forest service, Ministry of agriculture, forestry and food, forest owners.
	Comments on implementation – consider mentioning resources, timelines, milestones	Consent and cooperation with local forest owners will need to be ensured to promote sustainable forest management. In the coming years, the City of Ljubljana will also be able to

		provide funds for the implementation of the measure of purchasing private forests.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Not applicable.
	GHG emissions reduction estimate (total) per emission source sector	Considered in the value of emissions compensated.
	GHG emissions compensated (natural or technological sinks)	10,000 t CO_2/year
	Total costs and costs by CO_2e unit	695,000 EUR (CAPEX) 70 EUR/ t CO_2e

B-2.2: Individual action outlines – 4.3		
Action outline	Action name	**Sustainable agriculture and agricultural policy**
	Action type	Nature-based solutions, other interventions
	Action description	**Protecting agricultural land and increasing local self-sufficiency:** Ensuring sustainable and coordinated spatial development and protecting agricultural land are crucial for producing high-quality food and achieving a higher level of self-sufficiency. The activities of this measure include (1) preparing expert bases for determining permanently protected agricultural land and (2) developing guidelines for transitioning to climate-adapted agriculture with the aim of improving food quality and self-sufficiency. The objective of the measure is to designate areas of permanently protected agricultural land and increase the areas of agricultural land adapted to climate change. Within the measure, plans are in place for (3) increasing the area of permanently protected arable land by at least 5 hectares, (4) expanding the area of orchards with anti-hail nets by at least 2 hectares, and (5) increasing the area of irrigation systems by 35 hectares. Self-sufficiency and reducing the length of supply chains will be supported by promoting local vegetable production, with an emphasis on encouraging organic farming. To ensure sustainability and supply stability, (6) long-term contracts will be concluded with producers for the supply of organic produce, available for direct purchase at farms. **Conservation and restoration of hedges and riparian buffer strips:** Hedgerows and riparian buffer strips are important landscape elements that contribute to carbon sequestration, biodiversity, soil erosion reduction, and water quality

		improvement. The activities of the measure include: (1) Encouraging landowners to restore hedgerows and riparian strips in the Ljubljana Marshes, which fall under the Natura 2000 area in the City of Ljubljana, with financing from agri-environmental and climate measures (measure "Preservation of Hedgerows"). (2) Removal of invasive species along the Ljubljanica river (e.g., Japanese knotweed) and replanting 10,000 native shrubs and tree saplings (e.g., willow). **Increasing the area of permanent crops:** There are currently around 200 hectares of permanent crops in the City of Ljubljana, which is relatively little in terms of the local fruit supply. In cooperation with the landowners, we will examine the possibilities of increasing the area of permanent crops, e.g. extensive and intensive fruit orchards. For this purpose, an expert basis for the expansion possibilities of permanent orchards will be prepared in collaboration with landowners, aiming to increase local fruit supply. The aim is to increase the area of permanent crops by at least 100 hectares by 2030. **Rational fertilization of crops with nitrogen:** Rational fertilization of agricultural crops with nitrogen is a key element of sustainable farming. Various initiatives, including incentives for implementing advanced farming practices actively contributing to the reduction of nitrous oxide emissions, have been introduced to promote responsible fertilization practices. Agricultural enterprises are eligible for financial incentives to invest in essential assets aimed at improving overall efficiency in agricultural activities. Simultaneously, there is encouragement to invest in infrastructure related to the development and adaptation of agriculture to modern standards. Public agricultural advisory services operate to provide expert support and advice, assisting farmers in implementing sustainable fertilization practices and contributing to the preservation of environmental quality. **More efficient nitrogen circulation in agriculture – gross nitrogen balance surplus:** Efficient nitrogen circulation in agriculture is crucial for the sustainable management of natural resources. Various measures, such as financial incentives for implementing advanced farming practices that actively contribute to reducing nitrous oxide emissions and improving the gross nitrogen balance, are available to promote the adoption and

		implementation of advanced nitrogen cycling practices. Additionally, financial incentives for investments in essential assets that enhance the overall efficiency of agricultural enterprises are also available. Investments in infrastructure related to the development and adaptation of agriculture to modern standards are crucial for the sustainable management of agricultural resources. Public agricultural advisory services play a key role in providing expert support and advice to farmers, contributing to better nitrogen cycling management in agricultural practices. Continuous investment in research and innovation in agriculture is essential for the development of new methods and technologies that will further increase the efficiency of nitrogen cycling while reducing negative impacts on the environment. **Increasing the efficiency of domestic animal breeding:** A joint basic breeding program for cattle and small livestock breeds will be actively pursued by the city, with an emphasis on improving the efficiency of feed energy utilization. In this context, greater emphasis is placed on selection for more efficient feed energy utilization, while efforts are made to develop options for direct selection with the aim of reducing methane emissions - a significant contribution to the mitigation of greenhouse gas effects in animal farming. A crucial role will be played by public agricultural advisory services in providing farmers with expert support and advice, thereby enhancing conditions for animal husbandry. In addition, incentives will be implemented by the city to encourage the adoption of advanced farming practices, with a specific focus on reducing methane emissions. Agricultural enterprises will be eligible for financial incentives, promoting investments in essential assets to enhance overall agricultural efficiency. This will include the development and adaptation of infrastructure to meet modern standards, ensuring a holistic approach to advancing animal farming sustainability. **Upgrading agricultural policy - integrating climate policy and climate change adaptation:** The upgrade of agricultural policy, which involves the integration of climate policy and

		adaptation to climate change, requires a comprehensive approach to reducing greenhouse gas emissions in agriculture. Measures need to be taken for the long-term reduction of greenhouse gas emissions in agriculture, with a particular emphasis on improving efficiency in livestock farming and its restructuring, as livestock farming contributes the most to greenhouse gas emissions in agriculture. Additionally, it is necessary to formulate a policy that promotes sustainable organic farming while simultaneously reducing environmental impact and natural resource consumption. Providing incentives for the efficient collection of agricultural biomasses, such as crop residues and manure, at locations near larger biogas facilities, is also crucial.
Reference to impact pathway	Field of action	Green infrastructure & nature-based solutions
	Systemic lever	Technology/infrastructure, finance & funding, governance & policy, social innovation, learning & capabilities
	Outcome (according to module B-1.1)	Preparation of expert bases for determining permanently protected agricultural land. Development of guidelines for transitioning to climate-adapted agriculture. Identifying permanently protected agricultural areas and expanding the agricultural land adapted to climate change. Promotion of local vegetable production and organic farming through long-term contracts with producers. Enhancing carbon sink and biodiversity through restoration and conservation of hedgerows and riparian buffer strips in the Ljubljana Marshes. Removal of invasive species along the Ljubljanica river and replanting of 10,000 native shrubs and tree saplings. Examination of possibilities to increase the area of permanent crops and preparation of expert basis for expanding permanent orchards. Increasing the area of permanent crops to improve city fruit self-sufficiency. Introduction of incentives for implementing advanced farming practices.

		Eligibility for financial incentives for investments in agricultural efficiency. Provision of expert support and advice through public agricultural advisory services. Sustainable fertilization practices. More efficient nitrogen cycling in agriculture. Pursuit of a joint breeding program for cattle and small livestock breeds. Incentives for improving feed energy utilization and reducing methane emissions. Formulation of policy promoting sustainable organic farming. Incentives for efficient collection of agricultural biomasses near biogas facilities.
Implementation	Responsible bodies/person for implementation	The City of Ljubljana (Department of environmental protection), Department for agricultural consultancy (KGZS), Ministry of agriculture, forestry and food, farmers.
	Action scale & addressed entities	Local and national scale. Agricultural land, fertilizers, domestic animals, agricultural policy, irrigation systems, orchards.
	Involved stakeholders	The City of Ljubljana (Department of environmental protection), Department for agricultural consultancy (KGZS), Ministry of agriculture, forestry and food, farmers, academic and scientific communities.
	Comments on implementation – consider mentioning resources, timelines, milestones	Adequate financial resources for the implementation of planned measures are ensured both by the City of Ljubljana and the state. Some measures are already being partially implemented, but more attention and effort will be needed to expedite their implementation.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Not applicable.
	GHG emissions reduction estimate (total) per emission source sector	2,675 t CO_2e/year
	GHG emissions compensated (natural or technological sinks)	3,000 t CO_2e/year
	Total costs and costs by CO_2e unit	7,270,000 EUR (CAPEX) 1,281 EUR/ t CO_2e

B-2.2: Individual action outlines – 4.4		
Action outline	Action name	**Organizational, incentive, and awareness-raising measures**
	Action type	Other interventions
	Action description	**Raising public awareness of the importance of green spaces:** Public awareness about the importance of vegetation in urban environments will be raised through campaigns, workshops, and the distribution of informative materials and online tools (e.g.,"Invazivka") among others. The goal is to emphasize the benefits of vegetation for human well-being and the environment and to encourage active involvement in the preservation and nurturing of green areas in the city. **Promoting sustainable forest management:** Sustainable forest management is the key to maintaining or increasing the sink and providing other ecosystem services. With this measure, we particularly want to improve the management of privately owned forests, as they strongly dominate (more than 90%) the forest land of the City of Ljubljana. In cooperation with the Slovenia Forest Service, we will carry out a campaign to encourage private forest owners to increase the scope of restoration and protection work, including the adjustment of tree species composition (e.g. vulnerable spruce forests in lowlands) in accordance with forest management plans. With this measure, we want to encourage forest owners who do not carry out management to make them aware of the possibilities of obtaining funds from the state financial program for investments in forests and from tenders of the new CAP strategic plan and other funds. In addition, the city will examine options and make proposals to improve forestry legislation. **Enhanced control over logging and timber extraction from forests:** With this measure, we want to reduce the number of unauthorized interventions in the forest and at the same time reduce forest damage that can be caused by improper management. Damage to the forest can also be caused by non-compliance with standards when building forest roads, which can result in damage to the forest floor, erosion, and the like. In the forests within the administrative area of the city, we will step up controls on the construction of forest roads and tracks and on logging and timber harvesting. In cooperation with the public forestry service and inspectors, we will examine which are the critical areas

		and determine where violations occur more frequently. **Increased control over the implementation of greening measures:** These are measures aimed at improving the supervision of greening implementation, including the introduction of regular and systematic inspections and assessments of green areas in the city, the use of technological solutions for monitoring and recording progress, and the establishment of mechanisms for collaboration among various stakeholders in monitoring and reporting on the implementation of measures. The goal is to ensure the effective implementation of greening projects and to monitor and evaluate their impact on the urban environment. For the example of roof greening, rules are already established in the municipal spatial plan, but in practice, it is evident that investors do not always adhere to them. According to the municipal spatial plan, all buildings with a flat roof and a net area greater than 400 m^2 are required to have a green roof covering at least 75% of the net roof area. In the case of new buildings in shopping centres with a roof area exceeding 100 m^2, the buildings must be entirely covered with a green roof or have at least two facades designed in the form of vertical green ecosystems. This measure ensures stricter control of projects, ensuring compliance with regulations, particularly concerning the percentage of green areas and the implementation of green roofs. **Promotion of climate and environment-oriented CAP interventions:** In the City of Ljubljana, the local production of food and animal feed is promoted, which shortens the distance from the field to the consumer. With the "Green Supply Chain" project, we are promoting organic and integrated production as well as the cultivation of local and domestic varieties and their seasonal consumption. With this action, we want to encourage farmers to participate in CAP measures that are known to help mitigate climate change. These measures are, for example, agri-environmental climate payments, organic farming, eco-schemes, conservation of permanent grassland, etc., which we assume will be implemented through the Slovenian 2023-2027 CAP Strategic Plan. **Incentives for the implementation of advanced agricultural practices that**

		contribute to the reduction of nitrous oxide emissions: Incentives for implementing advanced farming practices are aimed at reducing nitrous oxide emissions. As part of the future rural development programme, there is a particular emphasis on promoting low-ammonia emission fertilization. This approach prioritizes the use of innovative fertilization practices, actively contributing to the reduction of harmful gas emissions while ensuring efficient and sustainable agricultural activities. **Incentives for the implementation of advanced agricultural practices that contribute to reducing methane emissions:** Incentives for implementing advanced farming practices are aimed at reducing methane emissions. As part of the future rural development programme, there are plans to provide incentives to improve the quality of feed and feed rations for cattle and small livestock. This approach encourages farmers to adopt innovative practices in animal nutrition, thereby reducing methane emissions, a significant contributor to greenhouse gases. These measures aim to enhance the quality of feed rations, positively impacting emission reduction and improving conditions for livestock farming. **Establishment of the Green Infrastructure and Nature-based Solutions department:** Establishing a department for green infrastructure and nature-based solutions is recognized in many cities worldwide as key to improving the environmental sustainability of urban areas. This department focuses on the development and management of green spaces, promoting biodiversity, integrating natural elements into urban infrastructure, and encouraging innovative solutions to climate change adaptation. Its operation strengthens the natural environment in the city and creates conditions for a healthier and more sustainable living environment for residents. The establishment of a department for green infrastructure and nature-based solutions is specifically focused on the ecological and sustainable aspects of urban areas that go beyond traditional spatial or environmental management.
Reference to impact pathway	Field of action	Green infrastructure & nature-based solutions
	Systemic lever	Finance & funding, governance & policy, social innovation, democracy/participation
	Outcome (according to module B-1.1)	Increased public understanding of urban vegetation benefits.

		Promoting improved forest management on privately owned lands. Reduction in unauthorized interventions and damage to forests. Effective supervision and monitoring of greening projects. Encouragement of local food production and consumption. Promotion of sustainable farming practices to reduce nitrous oxide emissions via low-ammonia fertilisation. Incentives for sustainable farming practices to reduce methane emissions. Encouraging improvement in feed quality to reduce methane emissions. Inclusion of farmers in agricultural policies. Upgrading agricultural policy. Improving climate change mitigation through CAP measures. Increased self-sufficiency and shortened supply chain in vegetable cultivation and promoting organic farming practices. The development of educational programs for farmers will be emphasised. Establishment of the Green Infrastructure and Nature-based Solutions department.
Implementation	Responsible bodies/person for implementation	The City of Ljubljana (Department of environmental protection), Department for agricultural consultancy (KGZS), Ministry of agriculture, forestry and food.
	Action scale & addressed entities	Local and national scale. Inhabitants, owners of agricultural land and forests, livestock breeders.
	Involved stakeholders	The City of Ljubljana (Department of environmental protection), Department for agricultural consultancy (KGZS), Ministry of agriculture, forestry and food, research institutions and academic bodies, inhabitants, owners of agricultural land and forests, livestock breeders.
	Comments on implementation – consider	Currently, funds are secured for implementing advanced agricultural practices that contribute

	mentioning resources, timelines, milestones	to reducing nitrous oxide emissions and for implementing advanced agricultural practices that contribute to reducing methane emissions. In the future, the remaining funds will need to be provided by the City of Ljubljana or the state or the relevant ministry for the implementation of the remaining measures. Funding from the EU is also expected, which would enable faster implementation of the measures.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Not applicable.
	GHG emissions reduction estimate (total) per emission source sector	Indirect impacts on reducing GHG emissions, which has already been considered in other measures within the "Green infrastructure & nature-based solutions" group.
	GHG emissions compensated (natural or technological sinks)	Indirect impacts on the natural CO_2 sinks, which have already been considered in other measures within the "Green Infrastructure & Nature-Based Solutions" group.
	Total costs and costs by CO_2e unit	No investments, the costs of activities are estimated at approximately 2,797,686 EUR per year.

BUILT ENVIRONMENT

B-2.2: Individual action outlines – 5.1		
Action outline	Action name	**Sustainable building and infrastructure renovation**
	Action type	Technical interventions
	Action description	**Energy retrofit of buildings:** In addition to decarbonizing energy sources, a significant step must be taken to increase energy efficiency in buildings (on the demand side). The average energy consumption of heated buildings in the City of Ljubljana is 122 kWh/m2, indicating a significant potential for savings in the case of energy renovations. In this way, we make a significant contribution to reducing energy consumption (in the best cases by more than 30%) and consequently reducing emissions. The energy saving potential of the existing building stock in the City of Ljubljana, which has not yet been energetically renovated and excluding buildings of cultural heritage, amounts to 552 GWh. Out of a total of 42,535 heated buildings in the City of Ljubljana (including already renovated

		buildings and buildings of cultural heritage), the number of buildings considered for renovation potential is 39,270, with a total heated area of 16,054,683 m^2. Energy renovation of 50% of the heated building stock, where feasible, is envisaged. In this case, energy use would be reduced by 16%, with the average energy consumption per square meter decreasing to approximately 100 kWh/m^2. **Sustainable building and mass-timber buildings:** The measure entails the use of eco-friendly materials, energy-efficient construction to achieve passive standards, and the preferential selection of wood as a sustainable building material. The City of Ljubljana will engage in the construction of timber buildings (schools, kindergartens, sports halls, etc.) where feasible from a construction perspective. The city will also explore options to promote timber construction in private projects, conduct educational programs, and encourage its investors and residents to build wooden houses. **Climate proofing construction and renovation:** Construction and renovation in accordance with the "Climate proofing" concept involves implementing construction and renovation projects while considering future climate change and its impacts on infrastructure. This includes the use of resilient materials, adaptable architectural solutions, and the integration of advanced technologies to reduce vulnerability and increase the sustainability of buildings in urban environments. The goal is to ensure that new and renovated infrastructure is resilient to extreme weather events and capable of mitigating the negative impacts of climate change on the population.
Reference to impact pathway	Field of action	Built Environment
	Systemic lever	Technology/infrastructure, governance & policy, social innovation, learning & capabilities, finance & funding
	Outcome (according to module B-1.1)	Financial support on both the national and international levels is identified. Enhancing financial incentives for household building energy retrofits. Existing buildings renovated according to current legislation.

		Implemented energy retrofits for residential, public, and commercial buildings. Decrease in average energy consumption per square meter for heating to approximately 100 kWh/m^2. Implementation of energy-efficient construction techniques. Promotion of wood as a sustainable building material. Construction of timber buildings in public infrastructure projects. Exploration of options to encourage timber construction in private projects. Conduct of educational programs to promote sustainable building practices. Encouragement of investors and residents to build wooden houses. Enhanced resilience of buildings to future climate change impacts. Improvement of infrastructure resilience to extreme weather events. Extend policies to promote NZEB standards in new and existing residential buildings. Ensure the construction of the all of new buildings adheres to NZEB standards. Establishing initiatives to make sustainable housing accessible to diverse social groups. Green and sustainable housing is recognized and endorsed within the community. Continued enhancement of environmentally friendly and sustainable construction practices.
Implementation	Responsible bodies/person for implementation	City of Ljubljana, relevant ministries, business sector and industry, households, spatial planners and architects, construction companies.
	Action scale & addressed entities	Local scale. Building stock in the City of Ljubljana.
	Involved stakeholders	City of Ljubljana, relevant ministries, business sector and industry, households, spatial planners and architects, construction companies.

	Comments on implementation – consider mentioning resources, timelines, milestones	The implementation of the measure involves increasing investments, with a key focus on providing appropriate subsidies and favourable loans for investors. While measures are already being implemented, they're currently in insufficient numbers, hence the necessity to increase their quantity each year. Currently, subsidies and EU funds are available, but more funds need to be allocated for the business and residential sectors. The City of Ljubljana allocates significant funds for the renovation of its buildings, and in the future, renovations will be carried out based on available financial resources and EU funds, which would accelerate the implementation of the measures.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Energy retrofit of buildings: 322.056 MWh/year
	GHG emissions reduction estimate (total) per emission source sector	Energy retrofit of buildings: 120,091 t CO_2e/year
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	1.460.213.377 EUR (CAPEX) 12.159 EUR/ t CO_2e

B-2.2: Individual action outlines – 5.2		
Action outline	Action name	**Spatial planning**
	Action type	Physical/spatial interventions, nature-based solutions
	Action description	**Establishment of pedestrian-friendly areas (superblocks):** The measure of establishing pedestrian-friendly areas (so-called "superblocks") involves transforming parts of the city (neighbourhoods) into multi-purpose spaces that are closed to motor traffic (except for access and emergency services), focused on the needs of pedestrians and cyclists, promote social interaction, green infrastructure, and sustainable mobility. The purpose of this measure is to improve the quality of living space, reduce traffic congestion and emissions, stimulate local economy and community activities. In the strict city centre (e.g., Parliamentary Quarter) and in residential areas of the city (e.g., Koseze, Savsko naselje). **Courtyard activation - creating accessible, green community spaces:**

		Urban courtyards represent a significant potential in creating urban spaces that can combine functionality, aesthetics, and social dynamics. Urban courtyards promote interaction among communities, offer peaceful oases in urban bustle and contribute to improving the quality of urban life. Within the measure, all functionalities offered by such courtyards will be examined with a focus on preserving or increasing green areas and creating space dedicated to encounters, relaxation, and social activities for residents. The measure includes the following activities: (1) Inventory of all urban courtyards and examination of their current functionality. (2) Examining the possibility of revitalizing city courtyards. (3) Implementation of the urban courtyard revitalization project. In the second phase, the measure is expanded to the area around residential neighbourhoods. **Establishment of self-sufficient neighbourhoods:** The measure combines the principles of sustainable construction, energy efficiency and mixed land use for the development of comprehensive and self-sufficient urban neighbourhoods. It includes planning neighbourhoods that are energy-neutral or positive, with a high degree of autonomy in energy, water, and food supply. It may involve solar panels, rainwater harvesting systems, community gardens and local markets designed to promote sustainable lifestyles among residents and reduce the neighbourhood's ecological footprint. **Planning and establishment of new public spaces:** The measure in the planning and establishment of new public spaces involves (1) identifying potential locations for creating new public spaces, (2) planning their arrangement and design, with the involvement of the community and local stakeholders in the planning process to ensure that the spaces reflect the needs and desires of the local population and (3) implementing projects for their establishment. The goal is to improve the quality of urban living, ensure access to green areas, create social and recreational spaces, and promote public life and activities for residents. **Spatial planning considering microclimatic conditions to improve public health and well-being:**

		Measures in the field of urban infrastructure planning considering microclimatic conditions to improve public health and well-being include analysing microclimatic conditions in the city, which involves studying local climate conditions in a small area. This includes temperature, humidity, air movement, wind, solar exposure, and similar factors. Based on this analysis, problematic areas are identified, such as excessive heat, air pollution or lack of green spaces and infrastructure adjustments are planned and implemented, such as tree planting, installation of shading devices, development of parks and green areas, air ventilation and proper positioning of buildings and roads. The goal is to create a pleasant and healthy urban environment that promotes active living and well-being for all residents. Special attention is paid to the analysis and measures for locations with the most vulnerable population: the medical area of Vodmat (University medical centre + Institute of Oncology), areas with dense construction and limited green spaces.
Reference to impact pathway	Field of action	Built Environment
	Systemic lever	Technology/infrastructure, governance & policy, democracy/participation, learning & capabilities
	Outcome (according to module B-1.1)	Establishment of superblocks with improved quality of living space. Increased green areas, functionality, and aesthetics of urban courtyards. Development of energy self-sufficient neighbourhoods. Creation of social and recreational spaces. Creation of a healthier urban environment conducive to active living and improved well-being for all residents. Analysing microclimatic conditions in the city to identify and mitigate problematic areas. Improvement of well-being for all residents, particularly in vulnerable locations.
Implementation	Responsible bodies/person for implementation	City of Ljubljana (Department of economic activities and transport, Landscaping department).
	Action scale & addressed entities	Local scale. Urban neighbourhoods and courtyards, residential areas, urban infrastructure.

	Involved stakeholders	City of Ljubljana (Department of economic activities and transport, Landscaping department), landowners, non-governmental organizations, research institutes.
	Comments on implementation – consider mentioning resources, timelines, milestones	The mentioned measures fall under the responsibility of the relevant departments at the City of Ljubljana. Currently, funds for their implementation are not guaranteed. In the coming years, it will be necessary to allocate or obtain funds for their implementation.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Not applicable.
	GHG emissions reduction estimate (total) per emission source sector	Indirect impacts on the reduction of GHG emissions (reductions are already considered in other measures).
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	There are no additional investments or costs planned, as these are already included in other measures or within the scope of existing activities.

B-2.2: Individual action outlines – 5.3		
Action outline	Action name	**Organizational, incentive, and awareness-raising measures**
	Action type	Other interventions
	Action description	**Evaluation of land based on its current use, classification, and future societal needs:** Preparation of spatial analysis with land evaluation based on existing data. This will serve as a basis for determining priorities and goals for future land use in the municipal spatial plan. The purpose of the measure is primarily to preserve green areas outside the urban area of the City of Ljubljana (in rural areas), thereby reducing emissions resulting from changes in land use: emissions from deforestation by 50% and emissions from construction by 25% by 2030 compared to 2018. **Development of guidelines for the implementation of spatial integration measures:** The development of guidelines for the implementation of spatial integration measures is a strategic measure aimed at promoting sustainable development and reducing the impact of climate change. The guidelines provide a framework for planning and developing urban and rural areas that reduce carbon footprint, improve resilience to climate change, protect natural habitats and

		biodiversity, and promote sustainable mobility and efficient land use. The aim of the guidelines is to ensure that all new construction and development projects are carried out in a manner that supports ecological balance, reduces the need for fossil fuels, and enhances urban greenery. The implementation of the guidelines involves collaboration among various stakeholders, public education and awareness, the introduction of legislative and financial incentives for sustainable projects and regular monitoring and evaluation of the effectiveness of measures. **Development of guidelines for project tasks for competitions:** The project tasks for competitions represent a specific approach to incorporating principles of sustainable development and climate responsibility into the process of design and architecture. Competition tasks are designed to encourage innovative solutions to challenges related to climate change, such as energy efficiency, use of renewable energy sources, reduction of GHG emissions, water resource management and integration of green areas into urban fabric. Through the competition process, creative and practical solutions are sought, which can serve as models for future projects, while also highlighting the importance of multidisciplinary collaboration and the use of sustainable materials and technologies. Competitions thus become a platform for the development and presentation of advanced concepts that can contribute to reducing the environmental footprint of cities and improving the quality of life of their residents. **Proactive land policy for climate change mitigation and adaptation:** Proactive land policy for climate change mitigation is thus a fundamental measure to ensure that land use is directed towards sustainability, preserving natural resources, and enhancing ecosystem services necessary for climate change mitigation and adaptation. This approach emphasises the need for comprehensive and coordinated action at various levels of governance to protect land crucial for ecological stability and the well-being of future generations. The measure includes the following activities: (1) Protecting agricultural and undeveloped land: putting in place legislative and regulatory frameworks to protect land that is important for maintaining ecological balance, preventing

		urban sprawl, and ensuring sustainable food supplies. (2) Preserving green wedges: ensuring that green spaces that penetrate the urban fabric are protected from development. This includes preserving and developing parks, nature reserves and other green spaces that serve as the "lungs" of cities and contribute to improving air quality, reducing heat islands, and promoting recreation and well-being for residents. (3) Priority land acquisition for the development and preservation of green spaces: active search and acquisition of land by the city with a view to preserving it as green space or converting it into public parks, gardens, and other forms of urban green space. (4) Promotion of sustainable land use: Encouraging agricultural practices that reduce greenhouse gas emissions, increase carbon sequestration, and support biodiversity. This includes supporting organic farming, agroecology, and permaculture. (5) Integrating climate objectives into spatial planning: integrating climate objectives into spatial planning processes to ensure that urban and rural development considers the need to reduce emissions, adapt to climate change and preserve natural ecosystems.
Reference to impact pathway	Field of action	Built Environment
	Systemic lever	Governance & policy, democracy/participation, social innovation
	Outcome (according to module B-1.1)	Preparation of spatial analysis for future land use planning. Preservation of green areas to reduce emissions. Developed guidelines for implementing spatial integration measures. Developed guidelines for project tasks for competitions that encourage innovative solutions for challenges related to climate change. Collaboration among stakeholders for sustainable projects. Encouragement of innovative solutions for climate challenges. Platform for showcasing advanced concepts in urban sustainability. Integration of climate objectives into spatial planning for emission reduction, climate adaptation, and ecosystem preservation.

Implementation	Responsible bodies/person for implementation	City of Ljubljana (Department of economic activities and transport, Landscaping department).
	Action scale & addressed entities	Local scale. Land in the City of Ljubljana, urban and rural areas.
	Involved stakeholders	City of Ljubljana (Department of economic activities and transport, Landscaping department), landowners, private companies, citizens, non-governmental organization.
	Comments on implementation – consider mentioning resources, timelines, milestones	The mentioned measures fall under the responsibility of the relevant departments at the City of Ljubljana. Currently, funds for their implementation are not guaranteed. In the coming years, it will be necessary to allocate or obtain funds for their implementation.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Not applicable.
	GHG emissions reduction estimate (total) per emission source sector	Indirect impacts on the reduction of GHG emissions (reductions are already considered in other measures).
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	No investments, the costs of activities are estimated at approximately 220,000 EUR.

DIGITISATION

B-2.2: Individual action outlines – 6.1		
Action outline	Action name	**Energy systems**
	Action type	Technical interventions, other interventions
	Action description	**Energy-Climate Atlas of the City of Ljubljana:** The Energy-Climate Atlas is a comprehensive energy-climate information system that enables efficient and rapid access to information in the field of energy and climate. As a modern web application, it provides a comprehensive database for the city, automatic data updates and allows for analysis, data synthesis, and user-defined reports. It also includes simulations of scenarios and displays the economic effects of proposed technical solutions. An interactive web application, functioning as a GIS tool, connects the electricity, heating and cooling sectors, allowing for scenario simulations and analyses, and displaying results in the form of interactive graphical representations.

		Monitoring measurement systems and other information systems: The measure involves the installation and management of various sensors and measuring devices. These systems enable the collection and analysis of data on parameters that serve as the basis for decision-making and city policy planning. Such systems are present in Energetika Ljubljana, LPP, LPT, VOKA SNAGA. Supervisory measurement systems also monitor advanced geographic information systems (GIS) for real-time monitoring and visualization of this data and for long-term urban development planning.
Reference to impact pathway	Field of action	Digitization
	Systemic lever	Technology/infrastructure
	Outcome (according to module B-1.1)	Efficient and rapid access to information in the field of energy and climate. Collection and analysis of data for decision-making and city policy planning.
Implementation	Responsible bodies/person for implementation	City of Ljubljana, public companies. Energetika Ljubljana, Ljubljana passenger transport, Public company for Ljubljana's Parking facilities and marketplaces, Utility company VOKA SNAGA.
	Action scale & addressed entities	Local scale. Information system, sensors and measuring devices.
	Involved stakeholders	City of Ljubljana, public companies. Energetika Ljubljana, Ljubljana passenger transport, Public company for Ljubljana's parking facilities and marketplaces, Utility company VOKA SNAGA, citizens.
	Comments on implementation – consider mentioning resources, timelines, milestones	In the City of Ljubljana, the Energy-climate information system, managed by the energy manager, is already in use. Plans for upgrading the system in the future are underway to enhance its functionality. Funds for further development are also allocated for the upcoming years. Funds are also planned for the implementation of the measure of installing and managing various sensors and measuring devices by the City of Ljubljana and its companies. The measure will be implemented gradually in multiple steps.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Indirect impacts.

	GHG emissions reduction estimate (total) per emission source sector	Indirect impacts on the reduction of GHG emissions (reductions are already considered in other measures).
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	No investments, the costs of activities are estimated at approximately 5,020,916 EUR per year.

B-2.2: Individual action outlines – 6.2		
Action outline	Action name	**Mobility & Transport**
	Action type	Other interventions
	Action description	**Traffic model of the City of Ljubljana:** The implementation of a traffic model for the City of Ljubljana is a crucial tool for the analysis and planning of urban transportation and is one of the measures for shaping traffic policies. The goal is to gain a comprehensive understanding of the current situation and formulate strategies for the sustainable development of the transportation system. **Mobility service providers' applications:** The measures include services such as Easypark, Avant2go, Urbana, BicikeLJ, etc., which are already established in Ljubljana and some other cities as well. These services offer residents and visitors various options such as bike rental, electric car transportation and parking, thereby contributing to greater efficiency and sustainability of mobility in a modern way. **Multimodal route planner:** A multimodal route planner is a tool or application that enables trip planning using various modes of transportation such as cars, public transport, bicycles, or walking. This measure promotes sustainable mobility and allows users to choose the most efficient and environmentally friendly mode of travel based on their needs and circumstances. The aim is to reduce traffic congestion, carbon dioxide emissions and improve air quality in cities.
Reference to impact pathway	Field of action	Digitization
	Systemic lever	Social innovation, learning & capabilities
	Outcome (according to module B-1.1)	Comprehensive analysis and planning tool for urban transportation. Increased efficiency and sustainability of urban mobility through various mobility options like bike rental and electric car transportation.

		Establishment of the Multimodal Route Planner application.
Implementation	Responsible bodies/person for implementation	City of Ljubljana (Department of economic activities and transport, Department of spatial planning), Ljubljana public transport, transportation service providers.
	Action scale & addressed entities	Local scale. Traffic model, mobility application.
	Involved stakeholders	City of Ljubljana (Department of economic activities and transport, Department of spatial planning), Ljubljana public transport, Transportation service providers, residents, city visitors and working migrants.
	Comments on implementation – consider mentioning resources, timelines, milestones	Funds for establishing a traffic model and multimodal route planner are secured. Implementation is scheduled for the coming years. Additionally, funds are allocated for the maintenance and upgrade of existing mobility service provider applications.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Not applicable.
	GHG emissions reduction estimate (total) per emission source sector	Indirect impacts on the reduction of GHG emissions (reductions are already considered in other measures).
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	100.000 EUR (CAPEX) The costs of activities are estimated at approximately 8,410,000 EUR per year.

B-2.2: Individual action outlines – 6.3		
Action outline	Action name	**Built environment**
	Action type	Technical interventions, other interventions
	Action description	**Digital twin of the city:** The digital twin of the City of Ljubljana will encompass models of the built environment, road networks, green areas, and other urban elements. These models will enable the simulation of urban mobility, airflow, pollution, etc. Based on them, decision-making will be facilitated, along with faster and more precise information dissemination. With modern visualizations (e.g., augmented reality), the digital twin will enable more rational city management and easier, more efficient, and better communication with residents.

		3D model of the city: 3D GIS applications combine spatial data from various sources, such as satellite imagery, aerial photographs, field data and CAD models, to generate a three-dimensional portrayal of the actual world. They enable spatial data analysis to facilitate informed decision-making and future activity planning. Depending on user requirements, different applications and software tools provide varying functionalities for 3D GIS analysis and visualization. Laying the foundations for the further creation of different representations of geographic data: 1. Terrain, building and infrastructure models. 2. 3D measurements. 3. Development of transportation networks. 4. Monitoring natural resources. 5. Land-use planning and assessing the environmental impacts of different activities. 6. Emergency response and management of natural disasters or emergencies - evacuation planning, damage assessment and resource allocation. 7. Navigation and location services - management and maintenance of infrastructure assets such as water and sewerage systems, electricity networks and transport networks. 8. Asset tracking and maintenance planning. 9. Simulations and forecasting of environmental change: climate modelling, flood modelling and ecosystem analysis. **15-minute city:** The City of Ljubljana is already a 15-minute city, although the general public may not fully perceive it. The measure includes establishing a modern web application called "15-minute city," which provides residents with access to information about various services, shops, green areas, cultural events, and other activities available within a 15-minute walk or bike ride from their home. The purpose of the measure is to increase residents' awareness of the opportunities offered by their immediate environment and to promote sustainable modes of transportation, such as walking and cycling.

		Periodic LiDAR scanning: LIDAR is a technology for transmitting and receiving laser beams to produce extremely accurate three-dimensional images of the urban environment. These images are used for various purposes, such as urban planning, analysis of green areas, identification of infrastructural deficiencies, planning of security and environmental measures in cities. The City of Ljubljana will perform periodic LiDAR scanning, enabling the detection of changes over time. **Digitally supported neighbourhoods:** In the City of Ljubljana, we will select a neighbourhood within the City of Ljubljana to serve as a pilot neighbourhood for testing and evaluating new digital solutions in collaboration with residents. The central aim of the solutions will be to improve the quality of living in the neighbourhood and reduce the neighbourhood-level carbon footprint while transferring best practices to the city level.
Reference to impact pathway	Field of action	Digitization
	Systemic lever	Social innovation, learning & capabilities
	Outcome (according to module B-1.1)	Enhanced decision-making, improved communication with residents, and facilitated city management, aided by the "Digital twin" initiative. Spatial data analysis, informed decision-making, and varied functionalities for 3D GIS analysis. Accurate three-dimensional urban imaging enhances urban planning and analysis. Enhanced data modelling and asset management with the creation of geographic data representations. Accurate monitoring of urban changes over time. Pilot testing of digital solutions for neighbourhood improvement and carbon footprint reduction. Increased awareness of local amenities promotes sustainable transportation. Testing and evaluation of new digital solutions in collaboration with residents.
Implementation	Responsible bodies/person for implementation	City of Ljubljana (Department of economic activities and transport, Urban planning department, Environmental department).

	Action scale & addressed entities	Local scale. Built environment applications.
	Involved stakeholders	City of Ljubljana (Department of economic activities and transport, Urban planning department, Environmental department), service providers, residents, city visitors.
	Comments on implementation – consider mentioning resources, timelines, milestones	Funds for almost all planned measures have been secured. In the coming year, it will be necessary to seek financial resources for the remaining projects and then prepare an implementation plan. It is also necessary to assess the scope and timeline of implementation.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Not applicable.
	GHG emissions reduction estimate (total) per emission source sector	Not applicable.
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	1,040,000 EUR (CAPEX) The costs of activities are estimated at approximately 1,850,000 EUR per year.

B-2.2: Individual action outlines – 6.4		
Action outline	Action name	**Green infrastructure & Nature-based solutions**
	Action type	Nature-based solutions, other interventions
	Action description	**Information system for monitoring watercourses:** 33 critical locations with different priorities have been identified (I., II., III. priority or not important). Currently, 10 information systems are established for monitoring water levels in selected watercourses, using radar technology water level gauges at 10 locations (priority I) and 7 information systems for monitoring water levels in selected watercourses, utilising ultrasonic water level gauges (priority II). In the future, the information system for monitoring water levels on selected watercourses will be expanded to other locations if necessary. **Measurement and modelling of the urban heat islands:** Installation of an urban weather observation system by establishing our own measurement

		network and database, aimed at preparing a dynamic model of the urban heat island. Modelling of the heat island will involve the use of data from the measurement network, which will enable the collection of real-time temperature data at various locations in the city. This will create a model that illustrates the heating of the urban area at different times of the day and under different weather conditions. This model will feed into the planning of measures to reduce the impact of the heat island and its negative effects on the residents' quality of life, such as strategies for green infrastructure, urban afforestation, and space redesign for improved air flow. **Vegetation cadastre on public and private land:** The city of Ljubljana has established a cadastre of vegetation on public areas. As part of the project, a cadastre of vegetation will also be established on private areas. This will enable better management of green spaces, planning their maintenance and preserving biodiversity.
Reference to impact pathway	Field of action	Digitization
	Systemic lever	Technology/infrastructure, learning & capabilities
	Outcome (according to module B-1.1)	Expansion of water level monitoring systems. Establishment of urban weather observation system. Modelling of the urban heat islands. Development of strategies to mitigate urban heat island effects. Establishment of a vegetation cadastre.
Implementation	Responsible bodies/person for implementation	City of Ljubljana (Digitalization service, Department of environmental protection).
	Action scale & addressed entities	Local scale. Watercourses, heat islands, cadastre of vegetation.
	Involved stakeholders	City of Ljubljana (Digitalization service, Department of environmental protection), service providers.
	Comments on implementation – consider mentioning resources, timelines, milestones	Funds for the implementation of all three measures are already secured. Development and implementation of these measures will commence in the coming years. They are planned to be implemented gradually.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.

	Removed/substituted energy, volume, or fuel type	Not applicable.
	GHG emissions reduction estimate (total) per emission source sector	Not applicable.
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	194,824 EUR (CAPEX) The costs of activities are estimated at approximately 4,000 EUR per year.

B-2.2: Individual action outlines – 6.5		
Action outline	Action name	**Waste & Circular economy**
	Action type	Other interventions
	Action description	**Information about the fullness of waste bins:** Upgrade of the application, enabling users to receive direct information about the locations of waste disposal infrastructure and the fullness of individual containers at expanded collection points. The measure also includes the installation of an IT solution for recording the incoming quantities of waste deposited by users. **Web application for waste circulation:** Establishment of a supporting online application for waste circulation from the waste - materials warehouse. **Bin fullness sensors in underground containers:** Installation of fullness sensors in containers in underground collection points and in expanded collection points.
Reference to impact pathway	Field of action	Digitization
	Systemic lever	Technology/infrastructure, learning & capabilities
	Outcome (according to module B-1.1)	Enhanced waste management efficiency through real-time monitoring. Establishment of a supporting online application for managing waste. Increased accuracy in waste collection scheduling through the implementation of fullness sensors.
Implementation	Responsible bodies/person for implementation	City of Ljubljana (Department of environmental protection), waste management company.
	Action scale & addressed entities	Local scale. Waste in the City of Ljubljana.

	Involved stakeholders	City of Ljubljana (Department of environmental protection), waste management company, residents and other waste generators.
	Comments on implementation – consider mentioning resources, timelines, milestones	Funds for the implementation of all three measures have already been secured by the waste management company, and these measures will begin to be implemented in the coming years. Gradual implementation is planned.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Not applicable.
	GHG emissions reduction estimate (total) per emission source sector	Not applicable.
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	535,000 EUR (CAPEX)

B-2.2: Individual action outlines – 6.6		
Action outline	Action name	**Urban digital platform**
	Action type	Other interventions
	Action description	**Urban digital platform:** The Urban digital platform is a tool for managing, planning, and implementing urban policies, as well as a unified information and communication point between city administration, residents, and businesses. Urban mobility and services integration: 1. Integration of Urbana functionalities (travel by public transport, SMS parking payment, funicular, use of BicikeLJ bike rental system, use of car parks, journey planning). 2. Obtaining a parking permit. 3. Service information system and alert system: In the first phase, the platform will allow the display of information such as weather conditions, air pollution, notifications on airborne allergen levels, flood risks, hail risks, road conditions, etc. 4. Rent a garden. Sustainable energy solutions: 1. Demonstration of the potential for photovoltaics. 2. Potential for the deployment of micro district heating systems. 3. Automation of GHG emissions calculation. 4. Interactive energy calculator - energy consulting.

		5. Demonstrating the potential for establishing energy communities. Solutions for vulnerable groups: 1. Establishment of a content point where vulnerable groups can express their concerns, share their experiences, and actively participate in shaping solutions for their specific challenges, while also providing solutions/offering for the issues they face (e.g., heatwaves, traffic, and energy poverty). 2. Establishment of a mechanism for informing about extreme weather events. 3. Establishment of a map for mitigating heatwaves (locations of cool areas, shaded paths, drinking fountains, mist showers, pools...).
Reference to impact pathway	Field of action	Digitization
	Systemic lever	Social innovation, democracy/participation
	Outcome (according to module B-1.1)	Improved management, planning, and implementation of urban policies through the utilization of the digital platform. Establishment of a unified point for information dissemination and communication.
Implementation	Responsible bodies/person for implementation	City of Ljubljana (Digitalization department), platform developer.
	Action scale & addressed entities	Local scale. The City of Ljubljana digital platform.
	Involved stakeholders	City of Ljubljana (Digitalization department), platform developers, platform users.
	Comments on implementation – consider mentioning resources, timelines, milestones	Funds for the implementation of the measure are already provided by the responsible digitalization department of the City of Ljubljana. The implementation of the application is divided into individual phases to be carried out over the years.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Not applicable.
	GHG emissions reduction estimate (total) per emission source sector	Not applicable.
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	4,200,000 EUR (CAPEX) The costs of activities are estimated at approximately 300,000 EUR per year.

ENGAGING AND COLLABORATING WITH STAKEHOLDERS

B-2.2: Individual action outlines – 7.1		
Action outline	Action name	**Integrative approaches to social innovation, collaboration, and inclusion**
	Action type	Other interventions
	Action description	**Integrated participatory and communication strategy for Climate Neutral Ljubljana by 2030:** The comprehensive participatory and communication strategy for "Climate neutral Ljubljana by 2030" represents a key measure that combines the development and implementation of an extensive, open, and inclusive approach to engaging residents in decision-making processes, policy formulation and project implementation aimed at achieving climate neutrality. This strategy emphasizes the importance of transparency and accessibility of information, strengthens dialogue, collaboration among municipal authorities, local communities, businesses, the academic sphere, and civil society. To develop the Action and Financial plan for achieving climate neutrality in the City of Ljubljana by 2030, a Participatory communication strategy has been developed, which includes a detailed analysis of stakeholders. The measure represents a continuation of efforts to develop a comprehensive and transparent approach to public involvement and access to information. **Workshops on participatory urban planning:** Workshops for participatory planning enable the local population to actively participate in shaping the urban environment. For example, the renovation of a city park, where ideas from the local population are incorporated into the final design that meets the community's needs. Workshops are conducted on-site in the city location under discussion and provide an opportunity for the gradual introduction of measures and testing their suitability. **Programs for green communities:** Green community programs include initiatives such as urban gardening, tree planting and community clean-up efforts. Such programs promote a sense of ownership among residents and contribute to the greening and biodiversity of the city. These activities not only provide space for urban farming but also serve as integrative social hubs where people from different backgrounds can come together, exchange ideas and learn from one another.

		The measure includes the establishment of a mechanism for managing green spaces and collaboration between the city and individual property owners. **Active use of stakeholder engagement platforms:** The measure includes establishing mobile applications and social channels, etc., that enable continuous dialogue, collection of contributions, dissemination of information on sustainable initiatives and reporting on progress towards achieving common action goals. **Educational and awareness campaigns about climate change:** The campaigns will involve various interactive and educational formats, including workshops, seminars, school programs and media campaigns. Innovative formats such as hackathons, boot camps, maker fairs, technology meetings, think tanks and innovation laboratories will actively engage participants, especially young people, in the development and understanding of models aligned with the city's goals. Additionally, the Climate point of the City of Ljubljana, acting as a "one-stop shop," will play a significant role in climate awareness and education activities, ensuring accessibility and inclusivity of various community needs, with an emphasis on the involvement and collaboration of all stakeholders. Identification of specific goals for city residents: Incorporating sustainable materials? Changing mobility and consumption habits? Supporting urban measures? What is most important on the path to climate neutrality? **Local challenges in the field of sustainable development:** Challenges that encourage residents, especially young people, to seek innovative solutions for local sustainability issues. This includes everything from challenges for local sustainable food production and waste reduction to innovation competitions for sustainable technologies, such as new technologies for bike-sharing or environmentally friendly mobility apps in cities, etc. Within these activities, we will examine the implementation of mechanisms such as participatory financing, which allows residents to directly participate in financing and decision-making on projects addressing local sustainability challenges, and the regulatory sandbox mechanism, which enables the

		testing and introduction of innovative solutions without direct regulatory barriers. **Capacity building on climate neutrality Training and workshops on adaptation and mitigation:** This set of activities emphasizes the involvement of communities most affected by climate change (vulnerable groups), particularly in areas such as a just transition to energy and mobility. Activities to strengthen community resilience and adaptation include: • Establishment of a catalogue of relevant content for stakeholders (addressing concerns, sharing experiences) and active participation in shaping solutions for their specific challenges. • Collaboration in organizing workshops and training sessions to enhance resilience in cooperation with universities and research institutes focusing on resilience-building to climate change impacts, such as how to build, renovate and prepare for floods or heatwaves. Establishment of an educational partnership for enhancing cities workforce capacities in the area of climate objectives, including active participation in education and training processes aimed at developing and employing experts specialized in supporting and implementing measures to achieve set climate goals. **Establishment of healthcare services related to climate change:** Enhanced collaboration with the healthcare sector, which provides services such as health screenings, counselling and support groups focusing particularly on addressing physical and mental health issues resulting from climate change. Establishment of new mechanisms. **Cultural and artistic projects for sustainable development:** Incorporating art and culture for education, information dissemination and promotion of the importance of achieving climate neutrality, for example, by increasing the promotion and organization of art exhibitions, performances, and festivals, or creating public art installations that raise awareness about climate change and its impacts. **Sports projects for sustainable development:**

		Sports projects represent an important part in the field of education, information dissemination and promotion of the importance of achieving climate neutrality. When organizing these events, special attention will be paid to establishing circular material flows and sustainable use of materials. **Comprehensive initiative for promoting sustainable certifications:** The measure is aimed at raising awareness and promoting the use of internationally recognized sustainable certificates and standards in various sectors, including construction, energy, agriculture, tourism, circular economy, etc. The initiative aims to increase awareness of the importance of sustainable practices in achieving climate neutrality and sustainable development through education, partnerships, and support to stakeholders in obtaining certifications (e.g., ISO 50001, LEED, BREEAM, DGNB, Cradle to Cradle Certified™, Zero Waste Certification, Green Globe Certification, Travelife, Envision™ and Greenroads®, Green Infrastructure Certification Program, Digital Accessibility Certifications, and B Corporation, etc.). **Community-level biodiversity conservation projects:** Such initiatives include wildlife migration monitoring programs, campaigns for planting indigenous plant species or community-managed green spaces. For instance, local wildlife monitoring programs enable residents to track and document the presence of wild animals in their environment, fostering a better understanding of ecosystems and contributing to biodiversity conservation. Campaigns for planting indigenous plant species promote the use of local plants adapted to climatic conditions and contribute to preserving natural habitats. Community-managed green spaces allow the local community to actively participate in the planning, maintenance, and use of green areas in their environment, creating pleasant and sustainable public spaces. **The information point on Ljubljana's path to carbon neutrality:** The Info Point on climate change (one stop shop) serves as a central source providing comprehensive information to residents, non-governmental organizations, company representatives, educational and research institutions, government authorities and other visitors about various steps and approaches

		that can contribute to achieving the city's goal of climate neutrality.
Reference to impact pathway	Field of action	Social innovation
	Systemic lever	Social innovation, democracy/participation
	Outcome (according to module B-1.1)	Improved public engagement leading to better decision-making for climate neutrality. Active involvement of residents in shaping urban environments and incorporation of community ideas into final designs. Community programs foster ownership, enhance greenery, and biodiversity. Active stakeholder engagement platforms facilitate continuous dialogue, contribution collection, and dissemination of information on sustainable initiatives. Educational and awareness campaigns about climate change engage youth through innovative formats and promote accessibility via the Climate point. Local competitions encourage innovative sustainability solutions, particularly engaging youth. Enhanced capacity building on climate neutrality with universities and research institutes. Strengthened collaboration with healthcare for addressing physical and mental health issues due to climate change. Cultural and artistic projects for education, information dissemination, advocating climate neutrality, and raising awareness of climate change impacts. Sports projects for sustainable development emphasize circular material flows, and sustainable practices in sports events. The comprehensive initiative promotes sustainable certifications and encourages sustainable practices within the relevant sector. Community-level biodiversity projects include wildlife monitoring for ecosystem understanding and campaigns for planting indigenous plants. The information point serves as a central hub providing comprehensive information to various stakeholders.

Implementation	Responsible bodies/person for implementation	City of Ljubljana (Service for development projects and investments, Digitization service, Department of economic activities and transport, Department of preschool education and training, Department of culture, Landscaping department, Department of environmental protection, Department of protection and rescue, Department of health and social care, Department of sports).
	Action scale & addressed entities	Local scale. Non-governmental organizations, educational institutions, environmental organizations, residents, sports organizations, companies.
	Involved stakeholders	City of Ljubljana, non-governmental organizations, educational institutions, environmental organizations, residents, sports organizations, companies.
	Comments on implementation – consider mentioning resources, timelines, milestones	Securing funds for all planned measures is not guaranteed. In the upcoming year, there will be a need to source financial resources for these projects and subsequently formulate an implementation plan. Additionally, it is crucial to assess and broaden the scope and timeline of implementation.
Impact & cost	Generated renewable energy (if applicable)	Not applicable.
	Removed/substituted energy, volume, or fuel type	Not applicable.
	GHG emissions reduction estimate (total) per emission source sector	Not applicable.
	GHG emissions compensated (natural or technological sinks)	Not applicable.
	Total costs and costs by CO_2e unit	No investments, the costs of activities are estimated at approximately 161,667 EUR per year.

B-2.3: Summary strategy for residual emissions

The highest residual emissions, which cannot be fully contained, are still in the transport sector, as most of this sector currently depends on the use of fossil fuels. The transport sector contributes around one-third to baseline emissions. Despite very optimistic and ambitious measures, 259,881 tonnes of CO_2e or 56.5% of the total residual emissions would remain in the transport sector. Residual emissions in the buildings sector would amount to 138,029 tonnes (30.0%), emissions from waste management to 28,510 tonnes (6.2%), in agriculture, forestry, and other land use (AFOLU) to 20,058 tonnes (4.4%) excluding natural carbon removals, and in the industrial processes and product use (IPPU) sector to 13,838 tonnes (3.0%). In total, the remaining emissions will amount to 460,316 tonnes of CO_2e and will be offset by natural carbon sinks in forests and other areas and by carbon capture and utilization (CCU) technologies to achieve climate neutrality.

Areas in the city of Ljubljana that contribute to carbon sinks include forest land, grassland, settlements, and cropland. In the base year 2018, with unchanged land use, these categories together contributed to a net carbon sink of -54,449 tonnes (-46,398 tonnes on forest land, -6,768 on settlements, -898 on grassland and -385 tonnes on cropland). The most important category is the forest land remaining forest land, which account for up to 85% of net sinks. Remaining settlements (green spaces in urban areas) and land converted to forest are also important carbon sinks. Changes in land use, including activities such as deforestation for agricultural expansion, conversion of agricultural land to settlements and for the construction of other infrastructure, have resulted in a net source of CO_2 emissions of 5,349 tonnes. The total net emissions/removals of CO_2 in 2018 amounted to -49,100 tonnes.

To achieve the set target, measures are planned to increase the natural carbon sinks in the City of Ljubljana to reach the target value of 65,700 tonnes of CO_2. With a focus on forest areas, grassland, urban green areas and cropland, measures will be implemented to further strengthen efforts to increase natural carbon sinks. This will strengthen the role of forests and other natural ecosystems as efficient carbon sinks and contribute to more sustainable land management in the urban environment.

The introduction of carbon capture and utilisation (CCU) technologies enables the reuse of captured carbon, which can lead to a reduction of emissions into the atmosphere. However, carbon capture and storage (CCS) technologies cannot be used in Slovenia due to unsuitable geological structures. The main energy production unit (cogeneration at the TE-TOL site in Ljubljana-Moste), which is connected to the Ljubljana district heating system, will use biogas and biomass. We assume that a significant part of the generated CO_2 emissions will be captured using carbon capture technologies, resulting in negative emissions. The same principle of carbon capture will be applied to a new 55 MW waste-to-energy plant. As the waste incineration plant will generate greenhouse gas emissions based on both fossil and non-fossil components of waste (approx. 110,150 t CO_2e/year), we assume that carbon capture technology will be used to capture all (100%) emissions, resulting in negative emissions (based on the proportion of bio-components in the waste-derived fuel). For both sites, considering the projected use of wood biomass, biogas and municipal waste for energy use, CO_2 capture is expected to be 394,616 tonnes per year. The CO_2 captured at both sites will be transported to suitable (local/regional) industries that will reuse it in their processes. Various technologies, including those for producing plastics, concrete, chemical reagents, and synthetic fuels, are in use or under development.

The costs of projects to increase urban green areas (green roofs and facades, surface unsealing, establishing new green areas, tree planting, etc.), forest management and conservation, and other measures to enhance natural carbon sinks are estimated at 143,447 million EUR, while the cost of implementing CCU technologies is estimated at over 51 million EUR.

3.3 Module B-3 Indicators for Monitoring, Evaluation and Learning

Module B-3 “Indicators for Monitoring, Evaluation and Learning” contains a selection of indicators to monitor and evaluate progress along the selected impacts pathways and fields of action described in Module B-1. as well as a monitoring and evaluation plan, i.e., metadata on each indicator selected, in addition to milestones and timeline.

B-3.1: Impact Pathways							
Outcomes/ impacts addressed	**Action/ project**	**Indicator No.** (unique identified)	**Indicator name**		**Target values**		
					2026	2028	2030
Gradual replacement of boilers with fossil fuels in individual heating systems. Upgrading and optimizing industrial energy systems. Reduction of heat losses and increase in the overall energy efficiency of the district heating system. District heating system using renewable energy sources. Construction of a facility for energy recovery from municipal waste, producing heat and electricity. Transition from fossil fuels to green hydrogen in energy-intensive industries. Decarbonization of the distribution gas pipeline network through the injection of green hydrogen and locally	Decarbonisation of heat supply energy sources Green energy production Energy efficiency Energy Management Sustainable building and infrastructure renovation	1	GHG emission from stationary energy (t CO_2 equivalent)		813,671	511,840	138,029

produced biomethane. Installed new electricity production facilities using renewable sources. Implemented energy retrofits for residential, public, and commercial buildings.							
Replacement of diesel buses with clean and zero-emission vehicles. Replacement of fossil natural gas with biomethane for all CNG buses. Renovation and electrification of railway tracks. Enhanced overall reliability of railway transportation within the city. Gradual transition of motor vehicles to sustainable alternatives (electricity, hydrogen and biomethane). Expansion and improvement of cycling infrastructure and networks. Introduction of a stricter parking policy with increased fees and reduced parking durations. Implementation of dedicated bus	Enhancing public transportation Improving green mobility and managing accessibility Decarbonisation of road and other motor vehicles Improving infrastructure for cyclists and pedestrians	2	GHG emission from transport (t CO_2 equivalent)		572,450	438,208	259,881

lanes to reduce travel times. Prolongation of travel time for personal vehicles entering the city centre. Installation of public charging stations for electric and hydrogen vehicles, including fast-charging centres. Establishment of green mobility corridors away from main roads.							
Decreased landfilling of mixed municipal waste, leading to lower methane emissions. Utilization of waste for district heating system. Construction of collection centres and mini collection centres.	Waste reduction Waste management	3	GHG emission from waste (t CO_2 equivalent)		43,315	36,531	28,510
More efficient nitrogen cycling in agriculture. Sustainable fertilization practices. Encouraging improvement in feed quality to reduce methane emissions.	Sustainable agriculture and agricultural policy	4	GHG emission from AFOLU (t CO_2 equivalent)		21,532	20,848	20,058
Installed new electricity production facilities using renewable sources (solar	Green energy production	5	Local RES energy production (GWh)		175	230	294

power plants, hydropower plants, biomass and biogas cogeneration units).							
Purchases of zero-emission electricity for public sector, public transport, industry, business sector, and households (65% of consumed electricity).	Purchase of carbon-free electricity	6	GHG emission from grid supplied energy (t CO_2 equivalent)		369,634	210,463	5,396
Implementation of a pilot project for carbon capture and utilisation.	Negative emissions	7	Amount of permanent sequestration of GHG within city boundary (t CO_2 equivalent)		0	0	394,616
Development of a Long-term Urban Greening Plan to increase urban green spaces to 40%. Installation of new green roofs and facades. Removal of invasive species along the Ljubljanica river and replanting of 10,000 native shrubs and tree saplings. Enhancing carbon sink and biodiversity through restoration and conservation of hedgerows and riparian buffer strips in the Ljubljana Marshes. Increasing the number of	Green and blue-green infrastructure Forest management Sustainable agriculture and agricultural policy	8	Negative emissions through natural sinks (t CO_2 equivalent)		56,600	61,200	65,700

protected forest areas. Reduction of emissions from deforestation and maintaining a stable forest area in the long term.							

B-3.2: Indicator Metadata - 1	
Indicator Name	GHG emission from stationary energy
Indicator Unit	t/CO_2 equivalent/year
Definition	Greenhouse gas emissions from the operations of buildings.
Calculation	Calculation based on consumption and emission factor.
Indicator Context	
Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	yes
If yes, which emission source sectors does it measure?	Stationary energy
Does the indicator measure indirect impacts (i.e., co- benefits)?	yes
If yes, which co-benefit does it measure?	Reduced energy costs, decrease in dependence on fossil fuels, reduction of the industry's impact, improved air quality and public health, new green jobs, increased energy security, long-term cost stability.
Is the indicator useful for monitoring the output/impact of action(s)?	yes
If yes, which action and impact pathway is it relevant for?	Decarbonisation of heat supply energy sources, energy efficiency, energy retrofit of buildings, decarbonisation of heat supply energy sources, decarbonisation of heat supply energy sources.
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	yes
Data requirements	
Expected data source	Energy distributor database, national reports, Statistical office of the Republic of Slovenia.
Is the data source local or regional/national?	Combined local and national
Expected availability	Available
Suggested collection interval	On a yearly basis
References	
Deliverables describing the indicator	National statistics and local data, annual report of the energy distributor.
Other indicator systems using this indicator	-

B-3.2: Indicator Metadata - 2	
Indicator Name	GHG emission from transport
Indicator Unit	t/CO_2 equivalent/year
Definition	Greenhouse gas emissions from the operations of vehicles.
Calculation	Calculation of energy consumption in MWh from the use of various types of fuels and their calorific values.
Indicator Context	

Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	yes
If yes, which emission source sectors does it measure?	Transport and mobility
Does the indicator measure indirect impacts (i.e., co- benefits)?	yes
If yes, which co-benefit does it measure?	Improved user experience of public transport, increased safety for traffic participants, reduced noise in the city, improved air quality and public health, Decreased traffic congestion in the city, more space for green areas and other uses.
Is the indicator useful for monitoring the output/impact of action(s)?	yes
If yes, which action and impact pathway is it relevant for?	Decarbonising road and off-road means of transport, Reducing personal road traffic, enhancing public transportation, improving pedestrian and cyclist traffic infrastructure.
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	yes
Data requirements	
Expected data source	Ljubljana Passenger Transport (LPP), Traffic counters, registered vehicle database, traffic model.
Is the data source local or regional/national?	Combined local and national
Expected availability	Available
Suggested collection interval	On a yearly basis
References	
Deliverables describing the indicator	Annual report of the Ljubljana Passenger Transport, results of the traffic model.
Other indicator systems using this indicator	-

B-3.2: Indicator Metadata - 3	
Indicator Name	GHG emission from waste
Indicator Unit	t/CO_2 equivalent/year
Definition	Greenhouse gas emissions from waste treatment and landfills.
Calculation	Calculation based on data obtained from the city utility company.
Indicator Context	
Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	yes
If yes, which emission source sectors does it measure?	Waste and waste water
Does the indicator measure indirect impacts (i.e., co- benefits)?	yes
If yes, which co-benefit does it measure?	Higher proportion of recycled waste, less landfilled waste, reduction in plastic usage, promotion of circular economy, reduction of e-waste, more efficient resource utilisation, reduced environmental impact, more responsible consumption, increased awareness.
Is the indicator useful for monitoring the output/impact of action(s)?	yes
If yes, which action and impact pathway is it relevant for?	Waste reduction, waste management.
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	yes
Data requirements	

Expected data source	Public utility company VOKA SNAGA
Is the data source local or regional/national?	Local
Expected availability	Available
Suggested collection interval	On a yearly basis
References	
Deliverables describing the indicator	Annual report of the city utility company.
Other indicator systems using this indicator	-

B-3.2: Indicator Metadata - 4	
Indicator Name	GHG emission from AFOLU
Indicator Unit	t/CO_2 equivalent/year
Definition	IPCC guidelines divide AFOLU emission activities into three categories: Livestock, Land, Aggregate sources and non-CO_2 emissions sources on land. The cumulative of these emissions forms the sectoral emissions.
Calculation	Calculations based on the IPCC Guidelines for National Greenhouse Gas Inventories.
Indicator Context	
Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	yes
If yes, which emission source sectors does it measure?	Agriculture, forestry, and other land use (AFOLU)
Does the indicator measure indirect impacts (i.e., co- benefits)?	no
If yes, which co-benefit does it measure?	-
Is the indicator useful for monitoring the output/impact of action(s)?	yes
If yes, which action and impact pathway is it relevant for?	Sustainable agriculture
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	yes
Data requirements	
Expected data source	Agricultural Institute of Slovenia, Agency for Agricultural Markets and Rural Development, Statistical Office of the Republic of Slovenia
Is the data source local or regional/national?	Combined national and local
Expected availability	Available
Suggested collection interval	On a yearly basis
References	
Deliverables describing the indicator	National statistics, reports, and publications.
Other indicator systems using this indicator	-

B-3.2: Indicator Metadata - 5	
Indicator Name	Local RES energy production
Indicator Unit	GWh/year
Definition	Annual local renewable electricity production.
Calculation	Calculations based on acquired data of the electrical distribution company.
Indicator Context	
Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	yes
If yes, which emission source sectors does it measure?	Energy generation
Does the indicator measure indirect impacts (i.e., co- benefits)?	yes

If yes, which co-benefit does it measure?	Decrease in dependence on fossil fuels, increased energy security.
Is the indicator useful for monitoring the output/impact of action(s)?	yes
If yes, which action and impact pathway is it relevant for?	Green energy production
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	yes
Data requirements	
Expected data source	Distribution company Elektro Ljubljana d.d.
Is the data source local or regional/national?	Local
Expected availability	Available
Suggested collection interval	On a yearly basis
References	
Deliverables describing the indicator	Database of the distribution company.
Other indicator systems using this indicator	-

B-3.2: Indicator Metadata - 6	
Indicator Name	GHG emission from grid supplied energy
Indicator Unit	t/CO_2 equivalent/year
Definition	GHG emissions occurring because of the use of grid supplied electricity. This includes the purchase of zero-emission electricity for households (50%), business sector (50%), the public sector, and industry (100%).
Calculation	Calculations based on acquired data from electricity suppliers.
Indicator Context	
Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	yes
If yes, which emission source sectors does it measure?	Grid supplied energy
Does the indicator measure indirect impacts (i.e., co- benefits)?	yes
If yes, which co-benefit does it measure?	Long-term cost stability
Is the indicator useful for monitoring the output/impact of action(s)?	yes
If yes, which action and impact pathway is it relevant for?	Purchase of renewable energy
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	yes
Data requirements	
Expected data source	Electricity supply companies.
Is the data source local or regional/national?	Local
Expected availability	Available
Suggested collection interval	On a yearly basis
References	
Deliverables describing the indicator	Database of the electricity suppliers.
Other indicator systems using this indicator	-

B-3.2: Indicator Metadata - 7	
Indicator Name	Amount of permanent sequestration of GHG within city boundary
Indicator Unit	t/CO_2 equivalent/year
Definition	This indicator supports the reporting of carbon sequestration through “Technological sinks”, such as

	Biomass Energy with Carbon Capture and Storage (BECCS) and Direct Air Carbon Capture and Storage (DACCS) technologies. This includes the implementation of a pilot project for carbon capture and utilisation in the City of Ljubljana.
Calculation	Assessment based on emissions measurements.
Indicator Context	
Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	yes
If yes, which emission source sectors does it measure?	Carbon removal and residual emissions
Does the indicator measure indirect impacts (i.e., co- benefits)?	no
If yes, which co-benefit does it measure?	-
Is the indicator useful for monitoring the output/impact of action(s)?	yes
If yes, which action and impact pathway is it relevant for?	Negative emissions
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	no
Data requirements	
Expected data source	Public company for the production and distribution of heat Energetika Ljubljana d.o.o.
Is the data source local or regional/national?	Local
Expected availability	Available
Suggested collection interval	On a yearly basis
References	
Deliverables describing the indicator	Monitoring report
Other indicator systems using this indicator	-

B-3.2: Indicator Metadata - 8	
Indicator Name	Negative emissions through natural sinks
Indicator Unit	t/CO_2 equivalent/year
Definition	“Natural sinks” refer to e.g. the planting of trees or other conversion of land use. These carbon sinks are included in the 'AFOLU' sector of the greenhouse gas inventory and can be independently monitored as an indicator of progress to show negative emissions.
Calculation	Calculations based on the IPCC Guidelines for National Greenhouse Gas Inventories.
Indicator Context	
Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	yes
If yes, which emission source sectors does it measure?	Carbon removal and residual emissions
Does the indicator measure indirect impacts (i.e., co- benefits)?	yes
If yes, which co-benefit does it measure?	Increase in green areas, adaptation to climate change, biodiversity conservation
Is the indicator useful for monitoring the output/impact of action(s)?	yes
If yes, which action and impact pathway is it relevant for?	Forest Management
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	yes

Data requirements	
Expected data source	Slovenia forest service, Slovenian forestry institute, Ministry of agriculture, forestry, and food.
Is the data source local or regional/national?	Combined national and local
Expected availability	Available
Suggested collection interval	On a yearly basis
References	
Deliverables describing the indicator	National statistics, reports, and publications.
Other indicator systems using this indicator	-

4 Part C – Enabling Climate Neutrality by 2030

Part C "Enabling Climate Neutrality by 2030" aims to outline any enabling interventions, i.e., regarding organisational setting or collaborative governance models or related to social innovations – designed to support the climate action portfolios (Module B-2) as well as aiming to achieve co-benefits outlined in the impact pathway (Module B-1). These interventions also address the identified opportunities, gaps and barriers identified Module A-2 and A-3.

4.1 Module C-1 Governance Innovation Interventions

This module details the city´s governance innovations for achieving city climate neutrality by 2030, describing innovations in institutional design, in leadership, and in collaborative and outreach processes, whether they are inter-organisational or internal to the key organisations responsible for the city´s climate neutrality target. It also describes expected outcomes, for example how these governance innovations enable climate actions and their co-benefits (outlined in Modules B-1 and B-2), and how they address the opportunities, gaps and barriers identified in Modules A-2 and A-3.

C-1.1: Description or visualisation of the participatory governance model for climate neutrality

COORDINATION OF THE CLIMATE AGENDA & CITY'S GOVERNANCE APPROACH

The large city family of Ljubljana consists of 12,000 employees in the administration, in public companies (Public Holding Ljubljana) and in institutions and is headed by a mayor.

The mayor makes the final decisions following consultations in a committee made up of the heads of the individual organisational units and the director of the local regional agency of the Ljubljana region. Six deputy mayors are appointed, each of whom is responsible for a specific area: One of them is specifically responsible for the areas of environmental protection, climate change and spatial planning.

All strategies and important guidelines are adopted by the city council. In the area of climate change, a uniform policy is pursued within the city administration, public companies, and institutions.

Within the city's jurisdiction, the city has the legal authority over urban infrastructure and the resources, in line with legal requirements, to take policy measures and act in various critical areas. These include buildings and construction, waste and wastewater management, water resource management, public health, energy management in neighbourhood systems, environment, urban land use, disaster risk, public transport, urban green spaces and green infrastructure, and oversight of financial matters and investments. The CCC is led by the Head of the city's Environmental Protection Department who reports to the deputy mayor responsible for Environmental Protection department, Climate Change and Spatial planning Department.

The commitment to achieve climate neutrality by 2030 is supported by Ljubljana's leadership and is firmly anchored in the city's entire organisational structure.

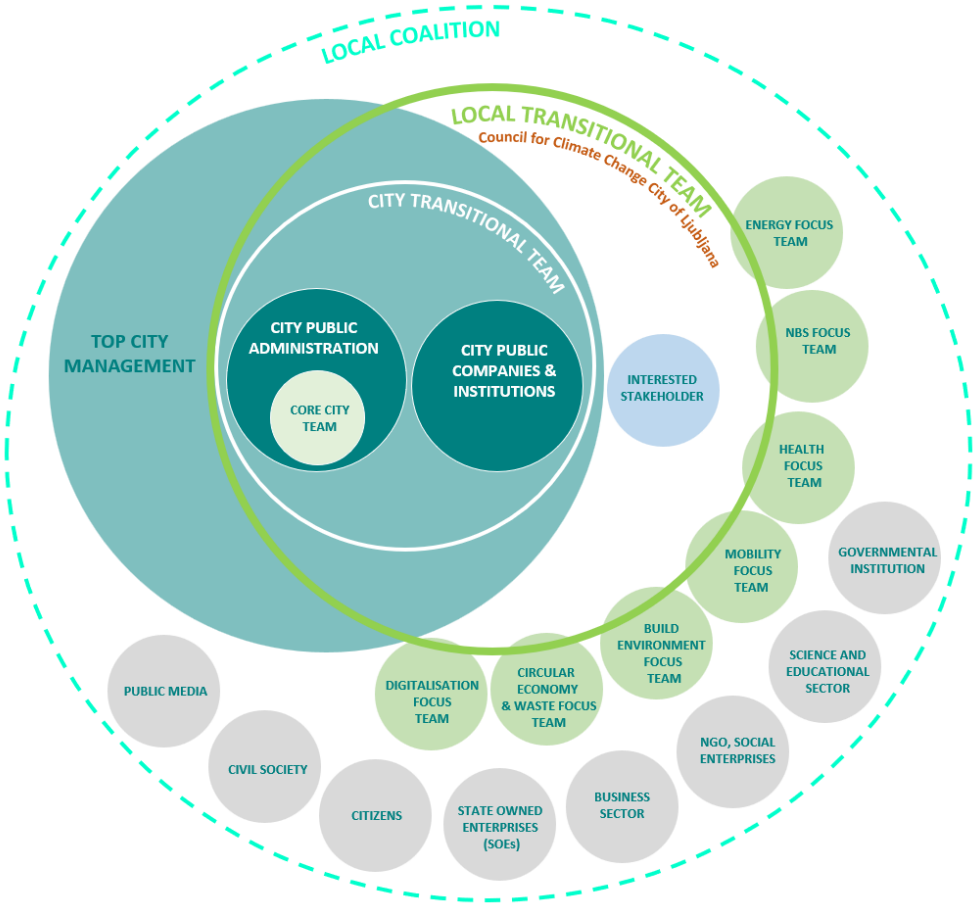

Figure 21: Transition Team Model Ljubljana.

Figures demonstrated Transition Team Model Ljubljana, formed in Local coalition, composing of several components (Top city management, City transitional team, Local transitional team and Council for Climate Change City of Ljubljana).

In the first months of 2023, the mayor took the decisive step of appointing a project manager on the city side (head of the city's environmental protection department). At the same time, a Core City Team (CCT) was formed, consisting of five prominent heads of various public administration departments (Head of the City's Environmental Protection Department (coordinating the city's climate neutrality goals), the Energy Manager, the Head of the City Planning Department, the Head of the Commercial Activities and Transport Department and a representative of the Development Projects and Investment Office). This strategic formation of the CCT was a significant step towards a coordinated and effective approach to climate protection measures. The CCT is entrusted with the operational tasks, day-to-day implementation, and ongoing monitoring of the project.

At the same time, the mayor appointed the City Transitional Team (CTT). This team, which is made up of twenty-three different representatives from both the city administration and public companies and institutions, embodies the city's comprehensive and integrative strategy for achieving climate neutrality. The establishment of the CTT reflects Ljubljana's commitment to a holistic approach that

incorporates different perspectives and expertise to effectively address the challenges and opportunities of the transition to a climate-neutral future.

Ljubljana attaches great importance to involving all relevant stakeholders in the process, from planning to implementation. In January 2023, the city developed a CCC Participatory-Communication Strategy a strategy for participatory communication of the CCC. This strategy, which aims to promote a structured, transparent, and inclusive process, is based on a variety of initiatives, events, and activities. It reflects a broad range of perspectives, needs, and interests and focuses on key areas that are essential for the transformation of the city (more detailed in sections A-3.2of the action plan).

In 2022, the City of Ljubljana invited all stakeholders living and working in the city, including experts from various fields, non-governmental organisations and active individuals with the knowledge, ideas, and willingness to co-create a common future in mitigating the effects of climate change and decarbonising the city. An interest group (ISG) (34 members) was formed as one of the city's most important new organisational formations. The formation of this group was an important step in bringing a broad range of perspectives and expertise to Ljubljana's climate strategy.

Building on the foundation laid by the City Transition Team (CTT) and the Interested Stakeholder Group (ISG), the Local Transition Team (LTT) was formed in January 2023, additionally comprising Specialised Focus Teams (SFT) in seven key areas: Energy, nature-based solutions, health, mobility, built environment, circular economy and waste, and digitalisation. The groups include citizens, non-governmental organisations, governmental organisations, social enterprises, the science and education sector, the municipal administration, municipal enterprises, state-owned enterprises, the business sector, civil society, vulnerable groups, and the public media (see Chapter A 3-2). The team is important because it represents a group of stakeholders who have been identified as key stakeholders for a precisely defined area through stakeholder mapping.

In February 2023, the CTT convened for its first meeting - an important milestone on Ljubljana's path to climate action. The agenda included a comprehensive assessment of current policies and the identification of systemic barriers and opportunities. The Basecamp platform was used for this purpose, which proved helpful in optimising communication and joint assessment.

INVOLVEMENT OF RELEVANT STAKEHOLDERS AND CITIZENS

Since the decision to join the CCC, Ljubljana has experienced a surge of activity characterised by a series of **collaborative and interactive events**. These have included workshops, meetings, presentations, public invitations, the establishment of an **Info Point on climate change (one stop shop)** etc., all aimed at fostering a common **understanding and partnership** on the city's path to climate neutrality.

In October 2022, an initial meeting was held with **the stakeholder group** (ISG) to inform them about the procedures for preparing the documentation and to jointly assess the importance of their participation. Subsequently, their participation was diversified and included bilateral meetings, the submission of written contributions, active participation in workshops and events and the signing of agreements during the preparation of the action plan.

Since the beginning of 2023, the new city of Ljubljana has set up **new channels for citizen participation**, such as the website "On the Path to a Carbon-Neutral Ljubljana 2030" Na poti v brezogljično Ljubljano 2030 » Mestna občina Ljubljana, which provides comprehensive information about the activities on the path to climate neutrality: The website contains all the information on the activities planned or carried out on the city's path to carbon neutrality.

October and November 2023 were the crucial months in which the first five comprehensive workshops on "Energy", "Mobility", "Nature-Based Solutions", "Waste and Circular Economy" and "Build environment" took place. These workshops brought together stakeholders from different

backgrounds and fostered an environment for joint planning and action. The workshops were very well attended and attracted 195 participants from different stakeholder groups, including residents, NGO representatives, ministries, government institutions, private companies, youth, elderly people, and others.

Figure 22: Participation process.

The three additional workshops in November 2023 on the topics of "City of good accessibility", "Appearance of the city and urban landscape" and "Resilience to climate change" served as an extension and improvement of the existing five workshops and supported the overall goal of developing the city's climate neutrality action plan. The workshops were very well attended with 90 participants from various stakeholder groups.

The CCT also organised and chaired numerous meetings with the Specialised Focus Teams (SFT) over several sessions to ensure coherent planning and effective implementation of the climate change strategies. As the topics are interlinked, members of certain focus groups also participated in the meetings of other groups, e.g. on integrating digitalisation into nature-based solutions (NBS) or addressing health aspects in the energy sector.

The City of Ljubljana demonstrated the importance of accessibility of information for all stakeholders by opening an **Info Point on climate change (one stop shop) (November 2023** dedicated to the path to climate neutrality in November 2023. This central innovation hub serves as a testing ground for shared ideas that are essential to achieving the common goal of climate neutrality. The Info Point acts as a central resource that provides citizens, NGOs, business representatives, educational and research institutions, government administration and other visitors with comprehensive information and guides them towards various steps and approaches that can contribute to achieving the city's climate-neutral goal.

In October 2023, the City of Ljubljana hosted an international event on "Climate Neutral and Smart Cities by 2030", which focused on future paths, visions and strategies that are important for the further development of urban development in order to achieve the goals of climate neutrality and the smart city.

For more information on the timeline for all participatory activities and the co-design process, please see the two figures below:

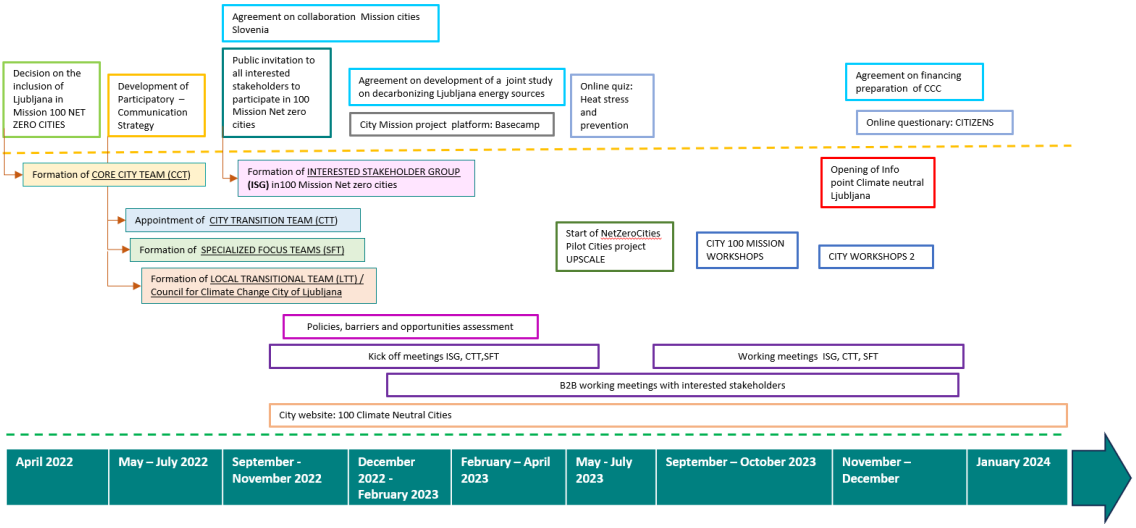

Figure 23: Timeline of co-design process.

Figure demonstrates the activities that took place from April 2022 when the City of Ljubljana received Decision on inclusion of the City of Ljubljana in Mission 100 NET ZERO CITIES and till March 2024 when submitting CCC to NZC.

STAKEHOLDER GROUPS	Preparation of Participatory – Communication Strategy	Meetings	Workshops	Questionaries/ Quiz	Focus teams	Info point Climate neutral Ljubljana	Agreement on collaboration	Public events	Web page	Public invitation to all interested stakeholders
GENEERAL STAKEHOLDERGROUPS										
Citizens										
City public administration										
Governmental institutions										
City Public companies										
State-owned enterprises (SOEs)										
Science and educational sector										
Business sector										
Non-Governmental Organizations, social enterprises										
Civil society										
Socially vulnerable groups - youth										
Socially vulnerable groups - elderly										
Socially vulnerable groups - children										
People with Disabilities and Special Needs										
Socially Vulnerable Groups - populations facing health disparities										
Socially Vulnerable Groups - populations facing health disparities										
Socially Vulnerable Groups - refugees										
Socially vulnerable groups - Low-income households										
Stakeholders with Higher Purchasing Power										
Public media										
FIELDS OF ACTION STAKEHOLDER GROUPS										
Energy										
Mobility										
Waste and Circular economy										
IPPU										
AFLOU										
Built environment										
Health										
Digitalisation										
Nature-based solutions										
Founding										

Figure 24: Stakeholder involvement.

Figure demonstrates identified stakeholder groups and method of inclusion for each stakeholder groups as inclusion while preparing CCC Participatory- Communication Strategy, inclusion in Focus meetings, public events, etc.

Engaging citizens through the existing platforms such as the **Citizens' initiatives office** established in 2003, the **Citizens' initiatives web,** the **mayor's open day** and the **65+ Information Point** supporting seniors and people with disabilities were as well the mechanisms used in preparation of CCC. The direct communication with citizens, namely enables deeper understanding of their perspectives and challenges on climate change and provided valuable insights.

Beyond the urban ecosystem, participation at regional, national, and international levels is ensured through well-established formations: (1) The Mayor of Ljubljana is a member of the Council of the Ljubljana City Region, which comprises 25 member municipalities. (2) The City of Ljubljana actively

participates in the Association of Municipalities of Slovenia, the largest association of municipalities representing municipal interests at national and international level, (3) Involvement in the Territorial Investment Programme (ITI), an important initiative at national level that enables Ljubljana to use EU funds.

C.1.2: Relations between governance innovations, systems, and impact pathways						
Intervention name	Description	Systemic barriers / opportunities addressed	Responsible entity/ dept./*	Leadership and stakeholders involved	Enabling impact	Co-benefits
(Indicate name of intervention)	(Describe the substance of the intervention)	(Refer to barriers and opportunities identified in Module A-3)	(Indicate responsible)	(List leaders and all stakeholder involved and affected)	(Describe how intervention enables climate neutrality)	(Indicate how intervention helps achieve impact listed in Module B-1)
Local coalition of the City of Ljubljana for climate neutrality - management and collaboration among various stakeholders	The governance for implementation, management, and monitoring of city's CCC is defined by Transition team Model Ljubljana (TEM Ljubljana) and Local coalition. Local coalition encompasses: - Top city management. - City transitional team (Core city team, City public administration and City public companies and institutions). - Local transitional team (Interested stakeholder group, Specialized Focus teams). - Council for Climate Change City of Ljubljana. This coalition represents an innovative approach to management and collaboration among various stakeholders aimed at achieving climate neutrality at the local level.	*Barriers:* - Scarcity of skilled employees in the city and on the market. - A lack of understanding of the coherence and interdependence between fields of action. - Diminished inclination for cooperation among stakeholders external to the city administration and city institutions, mainly national level. *Opportunities:* - Enhanced capacity building on climate neutrality. - Enhancing interdisciplinary collaboration and integrated planning. - Enhancing communication, building strategic alliances, joint	Top city management. Core City Team. City Transitional team.	Citizens, non-governmental organisations, social enterprises, science and educational sector, governmental institutions, city public administration, city council, city public companies, state-owned enterprises (SOEs), business sector, civil society, socially vulnerable groups – youth, elderly, children, socially vulnerable groups , low-income households, population facing health disparities, refugees, people with disabilities and special needs, stakeholders with higher purchasing power, public media.	Structured governance model – effective coordination, accountability and transparency, adaptability, and flexibility. Facilitates clear and efficient decision-making processes by defining roles, responsibilities, and hierarchies. Interdisciplinary collaboration, stakeholder engagement, strategic alliances.	Enhanced capacity building. Sustained commitment at institutional and policy level. Enhanced capacity building. Improved social cohesion and community well-being. Enhanced innovation and sustainability. Community engagement.

C.1.2: Relations between governance innovations, systems, and impact pathways						
Intervention name	Description	Systemic barriers / opportunities addressed	Responsible entity/ dept./*	Leadership and stakeholders involved	Enabling impact	Co-benefits
		planning and projects, recognition and incentives, policy advocacy.				
Institutional Strengthening - enhancing cities workforce capacities	Establishment of an educational partnership for enhancing cities workforce capacities in the area of climate objectives, including active participation in education and training processes aimed at developing and employing experts specialized in supporting and implementing measures to achieve set climate goals.	*Barriers:* - Existing organizational structures may not fully support interdisciplinary collaboration or lack the necessary knowledge in key areas of climate action. There's also a potential shortage of professionals with the expertise required to navigate the complexities of achieving climate neutrality. Opportunities: Implementing targeted educational programs and developing a culture of continuous learning and innovation within city departments can significantly enhance the effectiveness of climate action initiatives.	Core City Team HR department.	non-governmental organisations, science and educational sector, governmental institutions, city public administration.	Strengthening institutional capacities ensures that the city's workforce is well-equipped to implement and support ambitious climate neutrality goals. Enhanced expertise and collaboration across departments lead to more innovative and effective climate solutions.	Enhanced Capacity Building: By providing ongoing education and training, the city enhances its workforce's ability to contribute meaningfully to climate neutrality goals. Creation of Jobs: New roles and opportunities emerge within the city administration and in the broader community as a result of heightened focus on sustainability and climate action. Increased Public Awareness and Capacity Building: As city employees become more knowledgeable about climate issues, they can play a vital role in raising awareness and educating the public, leading to wider community engagement in sustainability efforts. Technological Innovation: With a more skilled

C.1.2: Relations between governance innovations, systems, and impact pathways						
Intervention name	Description	Systemic barriers / opportunities addressed	Responsible entity/ dept./*	Leadership and stakeholders involved	Enabling impact	Co-benefits
		Fostering partnerships with academic institutions and other cities can facilitate knowledge exchange and capacity building.				workforce, the city is better positioned to implement and leverage the latest sustainable technologies and practices.
Institutional Strengthening	The establishment of the Sustainable Mobility Department and the Green Infrastructure and Nature-Based Solutions Department in the City of Ljubljana is not merely strategic but essential in intensifying the city's commitment to achieving climate neutrality. These departments are pivotal in orchestrating interdisciplinary strategies across various facets of urban development and environmental stewardship, underscoring Ljubljana's proactive stance on climate action.	Barriers: - Existing organizational structures may not fully support interdisciplinary collaboration or lack the necessary knowledge in key areas of climate action. - A potential shortage of professionals with the expertise to navigate the complexities of achieving climate neutrality. Opportunities: - Implementing targeted educational programs and fostering a culture of continuous learning within city departments to enhance the effectiveness of	Top city management Heads of relevant administrative departments.	City public administration employees, NGOs focused on environmental protection and sustainable development, representatives from the business sector, academic and research communities, and citizens.	The workforce is not only equipped but also specialized in implementing and advancing climate neutrality goals. This strategic enhancement of institutional capacities fosters: - Interdisciplinary collaboration across various city departments, ensuring that strategies for sustainable mobility and green infrastructure are well-integrated with broader urban development and environmental initiatives. Holistic Climate Action: - The nucleus for comprehensive climate action planning, facilitating a city-	Enhanced capacity building. Creation of jobs. Increased public awareness and capacity building. Interdisciplinary approach.

C.1.2: Relations between governance innovations, systems, and impact pathways						
Intervention name	Description	Systemic barriers / opportunities addressed	Responsible entity/ dept./*	Leadership and stakeholders involved	Enabling impact	Co-benefits
		climate action initiatives. - Fostering partnerships with academic institutions and other cities to facilitate knowledge exchange and capacity building.			wide approach that incorporates sustainability into all aspects of urban life.	
Regulatory sandpits	Regulatory approach that provides a "testing ground" for new construction technologies and urban solutions in a controlled environment, where regulations can be temporarily adjusted or suspended to experiment with new ideas without the usual bureaucratic constraints. This initiative aims to foster innovation in sustainable building, etc practices and urban development, directly contributing to climate neutrality efforts.	Barriers: - Slow regulatory acceptance in adopting new construction technologies, material's, etc. - Absence of regulation. - Long coordinating procedures, bureaucratic hurdles, and slow processes. *Opportunities:* - Acceleration of the adoption of innovative and sustainable urban solutions; improvement in regulatory processes to	City Transitional team.	Science and educational sector, governmental institutions, city public administration, business sector.	Facilitates the rapid prototyping and implementation of innovative solutions that contribute to climate neutrality, by creating a more flexible regulatory environment.	Fostering technological Innovation. Reducing time to market. Capacity Building. Attracting investment.

C.1.2: Relations between governance innovations, systems, and impact pathways						
Intervention name	Description	Systemic barriers / opportunities addressed	Responsible entity/ dept./*	Leadership and stakeholders involved	Enabling impact	Co-benefits
		support climate goals.				
Policy Reforms	Updates of policy are critical for accelerating Ljubljana's journey towards climate neutrality: - Local Energy Concept of the City of Ljubljana 2022-2030: This action plan needs to be revised to include more ambitious measures, especially in social innovation activities and interdisciplinary perspectives, such as agriculture, to align with the more aggressive targets set by the climate action plan (AP). - Strategic Plan of Energetika Ljubljana d.o.o. for the period 2022-2027: This strategic plan requires an update to incorporate new measures and projects, such as CCU and the decarbonization of the district heating system. Additionally, efforts should be made to streamline the lengthy procedures for obtaining necessary permits.	*Barriers*: - Lengthy preparatory processes for some strategies, plans (e.g. Spatial plan), complexity of cross-sectoral collaboration, challenges in data acquisition, rapidly changing legislation, lack of personnel, changes in political leadership. *Opportunities:* - Developing standardized procedure, establishing collaborative platforms, or working groups to enhance cooperation. - Establish collaborative frameworks and advocacy channels with higher-level authorities and	Heads of relevant administrative departments.	Citizens, non-governmental organisations, social enterprises, science and educational sector, governmental institutions, city public administration, city council, city public companies, state-owned enterprises (SOEs), business sector, civil society, socially vulnerable groups – youth, elderly, children, socially vulnerable groups , low-income households, population facing health disparities, refugees, people with disabilities and special needs, stakeholders with higher purchasing power, public media.	Strengthens the city's ability to implement climate actions in alignment with national strategies, ensuring cohesive progress towards set climate goals.	Regulatory flexibility. Decision-making. Transparency. Stakeholder involvement. Acceleration of green transition. Strengthening local economies. Enhancement of urban resilience. Greater social equity.

C.1.2: Relations between governance innovations, systems, and impact pathways						
Intervention name	Description	Systemic barriers / opportunities addressed	Responsible entity/ dept./*	Leadership and stakeholders involved	Enabling impact	Co-benefits
	- Sustainable Energy Climate Plan 2022-2030: To ensure the 2030 climate neutrality target is met, this plan must be aligned with the AP, particularly in areas like CCU and the decarbonization of the energy sector. - Spatial Plan of the City of Ljubljana: The next revision of this plan must include targets for net-zero emissions by 2030, with additional measures to preserve green areas, and reduce emissions from deforestation and land and infrastructure planning. Sustainable Urban Mobility Plan for the City of Ljubljana and the Ljubljana City Region: Both plans require updates to be aligned with AP mainly in assessing GHG emissions within strategies and implementing actions set in AP.	stakeholders, thereby influencing policies, regulations and actions in these sectors.				
Digital Urban platform	The platform serves as a governance tool by improving the efficiency, transparency, and responsiveness of municipal administration. It integrates various urban	Barrier: - Siloed ICT systems that hinder interoperability	City transitional Team. Department for Digitalisation.	Citizens, non-governmental organisations, social enterprises, science and educational sector,	The Digital Urban Platform intervention enables climate neutrality by streamlining urban	Enhanced quality of life for residents. Increased awareness.

C.1.2: Relations between governance innovations, systems, and impact pathways						
Intervention name	Description	Systemic barriers / opportunities addressed	Responsible entity/ dept./*	Leadership and stakeholders involved	Enabling impact	Co-benefits
	policy management, planning, and implementation tools, facilitating better communication and coordination between the municipal administration, citizens, and the economy. This represents a governance innovation by enhancing the way city governance operates and engages with its constituents through digital means.	and data sharing. Opportunity: - Adoption of open standards and platforms to enable system integration and interoperability.		governmental institutions, city public administration, city council, city public companies, state-owned enterprises (SOEs), business sector, civil society, socially vulnerable groups – youth, elderly, children, socially vulnerable groups , low-income households, population facing health disparities, refugees, people with disabilities and special needs, stakeholders with higher purchasing power, public media.	governance processes, enhancing decision-making efficiency, and fostering greater stakeholder engagement. Through improved coordination and data-driven planning, the platform supports the implementation of sustainable and climate-friendly policies, directly contributing to the reduction of the city's carbon footprint.	Cleaner urban environment. Facilitation of stakeholder collaboration. Promotion of circular economy. More responsible consumption. Conservation of natural resources. Increased food self-sufficiency. Strengthening local businesses. Strengthening knowledge and skills. Increased public awareness and capacity building. Fostering technological innovation.
Strategic Alliances - Alignment and Support for National Climate Initiatives	This approach involves developing and implementing mechanisms to enhance alignment and support between city and national level to fully support city path to climate neutrality. The goal is to ensure that local	*Barriers:* - Challenges in achieving synergy between local actions and national climate strategies. *Opportunities:*	City Transitional Team Heads of relevant administrative departments.	Governmental institutions, city public administration, city public companies, state-owned enterprises	Fosters a unified approach to climate action by aligning local initiatives with national strategies, ensuring comprehensive and effective climate measures.	Increased energy security Enhanced capacity building Facilitation of stakeholder collaboration Promotion of circular economy Technological innovation

C.1.2: Relations between governance innovations, systems, and impact pathways						
Intervention name	Description	Systemic barriers / opportunities addressed	Responsible entity/ dept./*	Leadership and stakeholders involved	Enabling impact	Co-benefits
	initiatives for climate neutrality operate in synergy with national goals and strategies, thereby increasing the effectiveness and speed of achieving climate objectives across all levels of governance.	- Leveraging national policies and resources to support local climate initiatives, fostering a unified approach to climate action. - Enhancing policy coherence and coordination between different levels of government, leading to more efficient and impactful climate actions. - Access to national funding and technical resources for local climate projects.		(SOEs), business sector, civil society,	Streamlines access to national resources, expertise, and support, accelerating the city's progress towards climate neutrality.	Increased awareness Improved public health Conservation of natural resources

4.2 Module C-2 Social Innovation Interventions

This module lists the **actions taken by the city to support and foster social innovation initiatives or non-technological innovation more broadly** (e.g., in entrepreneurship, social economy, social awareness & mobilization, social cohesion and solidarity, etc) aimed to address the systemic barriers and leverage the opportunities identified in Module A-3[1]. It also includes:

[1] For more guidance on social innovation, please refer to the NetZeroCities Quick Read on Social Innovation,to the NetZeroCities Report on indicators & assessment methods for social innovation action plans and the Social Innovation Toolkit. Social innovation case studies are also available on the NetZeroCities website.

C.2.1: Relations between social innovations, systems, and impact pathways						
Intervention name	Description	Systemic barriers / opportunities addressed	Responsible entity/ dept./ person*	Leadership and stakeholders involved	Enabling impact	Co-benefits
(Indicate name of intervention)	(Describe the substance of the intervention)	(Refer to barriers and opportunities identified in Module A-3)	(Indicate responsible)	(List leaders and all stakeholder involved and affected, referring to the stakeholders mapped in Module A3)	(Describe how intervention enables climate neutrality)	(Indicate how intervention helps achieve impact listed in Module B-1)
Accessible **web tool for energy-efficient home renovation information.**	An innovative measure that will enable us to reach a larger number of residents involves creating a web tool that will allow individuals to obtain information about the expected energy and cost savings if they decide to renovate their homes for energy efficiency.	Barrier: Digital divide and lack of digital literacy among certain population groups. Opportunities: Ability to address more people through digital channel. Feedback from users to gather insights into their experiences, perceptions, satisfaction levels, and suggestions for improving the design, functionality, and effectiveness of climate-focused ICT solutions.	The Core City Team City Transitional team Department for Digitalisation	Citizens (all groups including vulnerable groups, non-governmental organisations, science and educational sector, governmental institutions, city public administration, city public and other companies, public media.	Greater awareness of sustainable energy use at the local level. New forms of public-private & community collaborations. Acceleration of energy refurbishment of households.	Reduced Energy Costs. Decrease in Dependence on Fossil Fuels. Improved Air Quality and Public Health. Increased Energy Security. Community Engagement. Investment Incentives. Technological Innovation. Enhanced Capacity Building. Increased Awareness. Cleaner Urban Environment. Enhanced Building.

C.2.1: Relations between social innovations, systems, and impact pathways						
Intervention name	Description	Systemic barriers / opportunities addressed	Responsible entity/ dept./ person*	Leadership and stakeholders involved	Enabling impact	Co-benefits
						Resilience to Climate Change. Creation of Jobs.
The **Info Point on climate change (one stop shop)** serves as a central hub providing comprehensive information to various stakeholders.	The Info point serves as a central source providing comprehensive information to residents, non-governmental organizations, company representatives, educational and research institutions, government authorities and other visitors about various steps and approaches that can contribute to achieving the city's goal of climate neutrality.	Barrier: Personal habits and consumption patterns. A lack of awareness or motivation among consumers to adopt energy-efficient solutions and technologies can slow the transition to sustainable energy. Public acceptance of new technologies and infrastructure. Opportunity: Enhanced community engagement.	The Core City Team City Transitional team	Citizens, non-governmental organisations, social enterprises, science and educational sector, governmental institutions, city public administration, city council, city public companies, state-owned enterprises (SOEs), business sector, civil society, socially vulnerable groups – youth, elderly, children, socially vulnerable groups , low-income households, population facing health disparities, refugees, people with disabilities and special needs, stakeholders with higher purchasing power, public media.	Promotion of research and innovation for new technologies. Greater awareness of sustainable energy use at the local level.	Community engagement. Increased awareness. Technological innovation. Enhanced capacity building. Promotion of circular economy. More responsible consumption. Increased awareness on waste reduction. Cleaner urban environment. Improved public health. Conservation of natural resources. Strengthening local businesses. Strengthening knowledge and skills.

C.2.1: Relations between social innovations, systems, and impact pathways						
Intervention name	Description	Systemic barriers / opportunities addressed	Responsible entity/ dept./ person*	Leadership and stakeholders involved	Enabling impact	Co-benefits
						Creation of jobs. Increased public awareness and capacity building. Facilitation of stakeholder collaboration.
Continued development of **ON-DEMAND TRANSPORTATION SERVICES.**	To improve accessibility for all, including persons with disabilities, we will continue to strive to develop services that will facilitate easier and more comfortable sustainable travel over longer distances. This includes the development of on-demand transportation services in various forms and the expansion or enhancement of the transport service for mobility-impaired individuals, known as "Kavalir".	Barrier: In general, high costs associated with transitioning to sustainable transportation systems. Opportunity: Organizational transformation to support sustainable transportation and transportation services.	The City of Ljubljana, Ljubljana public transport company.	The City of Ljubljana, Ljubljana public transport company, private companies, providers of electric vehicle, users of mobility services.	Implementation of accessible and sustainable transportation for mobility-impaired individuals.	Improved public transportation coverage. Improved user experience of public transport. Increased safety for traffic participants. Enhanced quality of life for residents. Community engagement. Technological innovation. Enhanced capacity building. Increased awareness. Decreased traffic congestion in the city.

C.2.1: Relations between social innovations, systems, and impact pathways						
Intervention name	Description	Systemic barriers / opportunities addressed	Responsible entity/ dept./ person*	Leadership and stakeholders involved	Enabling impact	Co-benefits
						Reduction in dependence on fossil fuels. Improved air quality and public health. Facilitation of stakeholder collaboration. Creation of jobs. Enhanced building resilience to climate change. Reducing dependence on individual transportation.
URBAN DIGITAL PLATFORM is a tool for managing, planning, and implementing urban policies, as well as a unified information and communication point between municipal administration, citizens, and the economy.	In the first phase integration of functionalities of "Urbana" card (public transport journeys, SMS parking payment, cable car rides, "BicikeLJ" bike rental system usage, parking facilities, journey planning, etc.). The platform will enable the display of information such as weather conditions, air pollution levels, notifications about airborne allergen	Barrier: Siloed ICT systems that hinder interoperability and data sharing. Opportunity: Adoption of open standards and platforms to enable system integration and interoperability.	The City of Ljubljana, Ljubljana public transport company, service providers.	City of Ljubljana, Ljubljana public transport company, service providers, residents, city visitors and working migrants.	Pilot testing of digital solutions for neighbourhood improvement and carbon footprint reduction. Testing and evaluation of new digital solutions in collaboration with residents.	Enhanced quality of life for residents. Increased awareness. Cleaner urban environment. Facilitation of stakeholder collaboration. Promotion of circular economy.

C.2.1: Relations between social innovations, systems, and impact pathways						
Intervention name	Description	Systemic barriers / opportunities addressed	Responsible entity/ dept./ person*	Leadership and stakeholders involved	Enabling impact	Co-benefits
	levels, flood hazards, hail hazards, road conditions, etc. Through the platform, it will be possible to obtain a parking permit, arrange garden plot rental, and other functionalities. In the next phase, many new functionalities will be added (energy systems monitoring, inclusion of vulnerable groups, etc.).					More responsible consumption. Conservation of natural resources. Increased food self-sufficiency. Strengthening local businesses. Strengthening knowledge and skills. Increased public awareness and capacity building. Fostering technological innovation.
Introduction of a **SUSTAINABLE CITY CARD** for vulnerable groups.	Implementing a Sustainable City Card for the socially vulnerable and young, allowing repairs of clothing, bicycles, electronic equipment (e.g., 40 EUR/3 months).	Barrier: Lack of awareness or motivation among the public to participate in re-use of repaired clothing and equipment. Opportunities: Guide activities to reach a larger portion of the public. Improve the local economy and	The City of Ljubljana, Utility company VOKA SNAGA, waste management companies.	The City of Ljubljana, Utility company VOKA SNAGA, media, waste management companies, non-governmental organisations, households.	Establishment of a network of bicycle repair services. Establishment of repair services for electrical products. Introduction of repair cafes and "clothing repair shops".	More responsible consumption. Enhanced quality of life for residents. Community engagement. Strengthening local businesses. Increased public awareness and capacity building.

C.2.1: Relations between social innovations, systems, and impact pathways						
Intervention name	Description	Systemic barriers / opportunities addressed	Responsible entity/ dept./ person*	Leadership and stakeholders involved	Enabling impact	Co-benefits
		strengthen self-sufficiency by closing material loops of individual waste/materials.				Promotion of circular economy.
Promotion of **REFILL SYSTEMS** and **SECOND-HAND STORES**.	Promotion of refill systems and second-hand stores. The plan includes building 3 collection centres, expanding collection points, establishing 9 mini-collection centres The emphasis is on raising awareness, stricter environmental regulations, and tax incentives for eco-friendly practices, requiring promotion at the national level.	Barrier: Organizational support of reduction in one-way-packaging. Opportunity: Through incentives and education, promote sustainable consumption and the use of tools in the area of reducing the amount of waste generation (returnable packaging, shopping without packaging, etc.).	The City of Ljubljana, Utility company VOKA SNAGA, non-governmental organizations.	The City of Ljubljana, Utility company VOKA SNAGA, Government and regulatory bodies, environmental agencies, businesses and industries, media, waste management companies, educational institutions, non-governmental organisations, households.	Establishment of packaging-free sales points. Establishment of clothing exchange points.	Promotion of circular economy. More responsible consumption. Increased awareness. Higher proportion of recycled waste. Less landfilled waste. Reduction in plastic usage. Preservation of natural resources. Increased awareness on waste reduction. Community engagement. Strengthening local businesses. Strengthening knowledge and skills.

C.2.1: Relations between social innovations, systems, and impact pathways						
Intervention name	Description	Systemic barriers / opportunities addressed	Responsible entity/ dept./ person*	Leadership and stakeholders involved	Enabling impact	Co-benefits
						Enhanced capacity building. Facilitation of stakeholder collaboration.
FINANCIAL PARTICIPATORY APPROACH for residents and stakeholders.	A strategic intervention designed to directly involve residents and stakeholders in the financing of local climate projects through mechanisms such as municipal bonds, crowdfunding, and participatory budgeting. This approach aims to leverage community investment in renewable energy projects, green infrastructure, and other climate resilience initiatives.	Barriers: Limited financial resources. High costs associated with transitioning. Insufficient financial resources. Not sufficient financial incentives. Opportunities: Exploring innovative financing models and incentives Increased public engagement. Increased sense of ownership and accountability among citizens.	The City of Ljubljana.	The City of Ljubljana, residents, non-governmental organisations, social companies, scientific and educational institutions, Government and regulatory bodies, city public companies, business sector, civil society.	Mobilizes additional financial resources for climate action projects, enhances public engagement and awareness of climate change issues, and fosters a culture of participatory governance.	Community engagement. Investment Incentives. Enhanced capacity building. Creation of new jobs. Improved social cohesion and community well-being.

C-2.2: Description of social innovation interventions

SOCIAL INNOVATIONS ADDRESSING THE SYSTEMIC BARRIERS AND OPPORTUNITIES TO CLIMATE NEUTRALITY

ORGANISATIONAL MEASURES, INCENTIVES AND AWARENESS-RAISING MEASURES

The city has taken a wide range of organisational measures and is planning further measures to involve stakeholders and citizens in the climate neutrality process and to overcome existing barriers to participation and enablement:

Energy Systems:

- Promotion of energy efficiency and transition to renewable sources.
- Creating new jobs in the field of renewable energy and energy efficiency.
- Energy poverty.
- Energy communities.
- Energy consulting office.
- Research/educational content.

To promote energy efficiency, we will organise awareness-raising events and workshops and create a website tool that provides information on energy and cost savings when renovating homes. Collaboration with educational institutions will enable the training of workers and the promotion of innovation in the energy sector. The implementation of the measures is based on the national action plan to combat energy poverty, which provides for investment incentives and the establishment of advice centres.

The promotion of energy communities increases energy self-sufficiency and raises awareness of the sustainable use of energy. The energy advice centre offers information and advice for a more sustainable energy future. The research topics in the field of energy cover various aspects that influence energy efficiency and analyse social and psychological factors of energy consumption. The aim is to promote sustainable habits and combat energy poverty, focussing on a holistic approach to tackling the challenges of sustainable energy supply in the urban environment.

Mobility & Transport:

- Promoting sustainable mobility.
- Development of a new Sustainable urban mobility plan (SUMP).
- Research/educational content.
- Transport poverty.
- Establishment of the sustainable mobility department.
- Coordinating the needs of users who gravitate towards the City of Ljubljana.

Enhancing public transportation

Various measures will be implemented to significantly improve the overall public transportation system. This includes the introduction of additional urban public transport lines, increasing departure frequencies, adding bus lanes, smart traffic light management and using longer vehicles. Efforts will also focus on optimizing travel times, ensuring more efficient and punctual passenger transport.

Improvements in railway public transport will be pursued to provide seamless and integrated travel experiences. Additionally, the renovation of the main bus and train station is planned to modernize

and enhance the central public transportation hub. The area will be redesigned with new green spaces and safer traffic zones, aligned with the principles of sustainable mobility.

Improvements in railway public transport will be pursued to provide seamless and integrated travel experiences. Additionally, the renovation of the main bus and train station is planned to modernize and enhance the central public transportation hub. The area will be redesigned with new green spaces and safer traffic zones, aligned with the principles of sustainable mobility.

To expand public transportation options in the city centre, a circular route along the Ljubljanica river is planned, offering an alternative and eco-friendly mode of transport.

Furthermore, the introduction of a unified ticketing system for all passengers is envisaged to allow the use of a single ticket for various modes of transportation, promoting easy access and enhancing the attractiveness of public transport. These combined initiatives aim to create a more robust, accessible, and sustainable public transportation system for the community.

Improving green mobility and managing accessibility
The main goal of the measure is to reduce personal vehicle traffic in the city centre and areas outside the bypass, thereby alleviating congestion and encouraging the use of public transportation. These measures will be implemented after improving public transportation services to ensure a fair transition. The establishment of community mobility infrastructure is also planned, involving the development and implementation of transportation solutions tailored to community needs. This approach not only enhances transportation links and accessibility but also strengthens community spirit, cooperation, and contributes to a more sustainable and connected urban environment.

Building two new Park and Ride (P+R) facilities will encourage daily commuters to use public transportation, further reducing traffic in the city centre. These parking areas will be connected to new river public transportation stops, enabling travel to the city centre via river e-vessels.

Efforts to improve accessibility for all will continue with the development of services facilitating easier and more comfortable sustainable travel, including the expansion and enhancement of transportation services for people with disabilities through the "Kavalir" program.

The anticipated effects of the measures are a 28% reduction in kilometres travelled by private cars.

Measures to promote sustainable mobility include the promotion of cycling, walking, the use of renewable energy sources and public transport.

The development of a new comprehensive transport strategy for the city of Ljubljana is being carried out in co-operation with various stakeholders and includes the definition of targets, measures and mechanisms for monitoring and reporting.

Research and educational activities focus on technological, infrastructural, social, and psychological aspects of sustainable mobility and aim to develop strategies to promote sustainable habits in the urban environment.

Urban policy is already combating transport poverty by subsidising public transport, expanding cycling infrastructure and other measures. The action plan will complement these measures to reduce transport poverty, while the national plan will continue a comprehensive approach at national and local level.

The establishment of the Sustainable Mobility Department in the City of Ljubljana follows the global trend of many cities recognising the importance of sustainable mobility for the quality of life and the environment. This department enables a comprehensive approach to transport policy and coordinated action across all sectors, reducing greenhouse gas emissions and creating a healthier urban environment.

The adaptation of parking facilities and sustainable mobility in the city of Ljubljana is done by analysing and considering the needs of users from other municipalities before they arrive in Ljubljana.

Improving infrastructure for cyclists and pedestrians
The comprehensive measures aim to enhance the urban environment by improving conditions for pedestrians and cyclists. This includes the development of pedestrian-friendly infrastructure and dedicated cycling lanes. In addition, the initiative involves transforming conventional traffic zones into green and recreational spaces, fostering a more sustainable and liveable urban landscape. The promotion of walking and cycling is actively encouraged through awareness campaigns, educational initiatives, and community engagement programs, fostering a culture of environmentally friendly and healthy modes of transportation.

Green and blue-green infrastructure:

- Greening the city.
- Sustainable water management.
- Raising public awareness of the importance of green spaces.
- Promoting sustainable forest management.
- Enhanced control over logging and timber extraction from forests.
- Increased control over the implementation of greening measures.
- Promotion of climate and environment-oriented CAP interventions.
- Incentives for the implementation of advanced agricultural practices that contribute to the reduction of nitrous oxide emissions.
- Incentives for the implementation of advanced agricultural practices that contribute to reducing methane emissions.
- Establishment of the Green Infrastructure and Nature-based Solutions department.

Awareness about the importance of greenery in cities will be raised through campaigns, workshops, distribution of materials and online resources, focusing on the benefits for people and the environment and promoting care for green spaces.

Forest management

- Maintaining stable forest area.

A campaign to improve the management of private forests will encourage restoration work, adaptation of tree species and awareness about funding and legislation. The City of Ljubljana will strengthen supervision of the construction of forest roads, logging, timber harvesting and develop a plan to protect sensitive areas. Measures to monitor greening will include regular inspections, technological solutions, stakeholder collaboration for effective project implementation and monitoring of urban environmental impact.

Sustainable agriculture and agricultural policy

- Protection of agricultural land and increasing local self-sufficiency.
- Conservation and restoration of hedges and riparian buffer strips.
- Increasing the area of permanent crops.

- Rational fertilization of crops with nitrogen.
- More efficient nitrogen circulation in agriculture – gross nitrogen balance surplus.
- Increasing the efficiency of domestic animal breeding.
- Upgrading agricultural policy - integrating climate policy and climate change adaptation.

Built environment

- Evaluation of land based on its current use, classification, and future societal needs.
- Development of guidelines for the implementation of spatial integration measures.
- Development of guidelines for project tasks for competitions.
- Proactive land policy for climate change mitigation and adaptation.

Preparation of spatial analysis and land evaluation based on existing data is crucial for determining priorities and goals in future municipal spatial plans. The main goal of this measure is to preserve green areas outside the urban area of the City of Ljubljana, thereby reducing emissions from deforestation by 50% and emissions from construction by 25% by 2030 compared to 2018.

The development of Guidelines for the implementation of spatial integration measures is a strategic step towards promoting sustainable development and reducing the impact of climate change. Project tasks for competitions and proactive land policy represent additional approaches to integrating sustainable practices and mitigating climate change into urban design and land management.

ENGAGING AND COLLABORATING WITH STAKEHOLDERS

Integrative approaches to social innovation, collaboration, and inclusion:

- Integrated participatory and communication strategy for Climate Neutral Ljubljana by 2030.
- Workshops on participatory urban planning.
- Programs for green communities.
- Active use of stakeholder engagement platforms.
- Educational and awareness campaigns about climate change.
- Local challenges in the field of sustainable development (Financial Participatory Approach, regulatory sandpits).
- Capacity building on climate neutrality (Training and workshops on adaptation and mitigation, establishment of an educational partnership).
- Establishment of healthcare services related to climate change.
- Cultural and artistic projects for sustainable development.
- Sports projects for sustainable development.
- Comprehensive initiative for promoting sustainable certifications.
- Community-level biodiversity conservation projects.
- Climate advisory office.

Integrated participation and communication strategy for climate-neutral Ljubljana by 2030:
The comprehensive participation and communication strategy for "Climate Neutral Ljubljana by 2030" represents a key measure that combines the development and implementation of a comprehensive, open, and inclusive approach to involving residents in decision-making processes, policy formulation and project implementation with the goal of climate neutrality. This strategy emphasises the importance of transparency and accessibility of information, strengthening dialogue and collaboration between local authorities, local communities, businesses, academia, and civil society.

In order to develop the action and financial plan to achieve climate neutrality in the city of Ljubljana by 2030, a participatory communication strategy was developed, including a detailed stakeholder analysis. The measure represents a continuation of efforts to develop a comprehensive and transparent approach to public involvement and access to information.

Participatory urban planning workshops:
Participatory planning workshops enable the local population to take an active part in shaping the urban environment. An example of this is the renovation of a city park, where the ideas of the local population are incorporated into the final design that meets the needs of the community. Workshops are held on site in the city and offer the opportunity to gradually introduce measures and test their suitability.

Green communities programmes:
Green community programmes include initiatives such as urban gardening, tree planting and community clean-ups. Such programmes promote a sense of ownership among residents and contribute to the greening and biodiversity of the city. These activities not only provide space for urban agriculture, but also serve as inclusive social centres where people from different backgrounds can come together, share ideas, and learn from each other.

The measure includes the establishment of a mechanism for the management of green spaces and co-operation between the city and individual landowners.

Active use of stakeholder engagement platforms:
The measure includes the establishment of mobile applications and social channels, etc. that allow for ongoing dialogue, collection of input, dissemination of information on sustainable initiatives and reporting on progress towards common action goals.

Climate change education and awareness campaigns:
Campaigns will include various interactive and educational formats, including workshops, seminars, school programmes and media campaigns. Innovative formats such as hackathons, boot camps, maker fairs, technology meetings, think tanks and innovation labs will actively engage participants, especially young people, in developing and understanding models that are in line with the city's goals. In addition, the City of Ljubljana's Climate Point, which acts as a one-stop shop, will play an important role in climate change awareness raising and educational activities, ensuring accessibility and inclusion of different community needs, with a focus on the involvement and cooperation of all stakeholders.

Local competitions and contests:
Competitions and contests are organised to encourage people, especially young people, to find innovative solutions to local sustainability challenges. These challenges can range from sustainable local food production and waste reduction to innovation competitions for sustainable technologies such as new bike-sharing technologies or environmentally friendly applications to reduce energy bills.

Training and workshops on adaptation and mitigation:
This group of activities focuses on engaging communities most affected by climate change (vulnerable groups), particularly in areas such as a just transition to energy and mobility. Activities to strengthen community resilience and adaptation include:
- Creating a catalogue of relevant content for stakeholders (addressing concerns, sharing experiences) and actively participating in the design of solutions to their specific challenges.

- Working together to organise resilience-building workshops and training in collaboration with universities and research institutes that focus on building resilience to the impacts of climate change, e.g. how to build, renovate and prepare for floods or heatwaves.

Establishment of health services related to climate change:
Increased collaboration with the health sector providing services such as health screening, counselling and support groups that focus specifically on addressing physical and mental health problems caused by climate change. Establishment of new mechanisms.

Cultural and artistic projects for sustainable development:
Incorporating arts and culture to educate, disseminate information and promote the importance of climate neutrality, e.g. by increasing the promotion and organisation of art exhibitions, performances and festivals or creating public art installations that raise awareness of climate change and its impacts.

Sports projects for sustainable development:
Sports projects are an important component in education, information dissemination and promoting the importance of climate neutrality. When organising these events, particular attention is paid to the creation of circular material flows and the sustainable use of materials.

Comprehensive initiative to promote sustainable certifications:
The measure aims to raise awareness and promote the use of internationally recognised sustainable certificates and standards in various sectors, including construction, energy, agriculture, tourism, circular economy, etc. The initiative aims to raise awareness of the importance of sustainable practices in achieving climate neutrality and sustainable development through education, partnerships and supporting stakeholders in obtaining certifications (e.g. ISO 50001, LEED, BREEAM, DGNB, Cradle to Cradle Certified™, Zero Waste Certification, Green Globe Certification, Travelife, Envision™ and Greenroads®, Green Infrastructure Certification Programme, Digital Accessibility Certifications and B Corporation, etc.).

Biodiversity conservation projects at the community level:
These initiatives include wildlife migration monitoring programmes, native plant species planting campaigns or community-managed green spaces. Local wildlife monitoring programmes, for example, allow residents to track and document the presence of wildlife in their area, promoting a better understanding of ecosystems and contributing to biodiversity conservation. Native plant species planting campaigns encourage the use of local plants adapted to climatic conditions and contribute to the preservation of natural habitats. Green spaces managed by the city enable the local population to actively participate in the planning, maintenance and use of green spaces in their neighbourhood, thus creating pleasant and sustainable public spaces.

The information point about Ljubljana's path to climate neutrality:
The Info Point on climate change (one stop shop) serves as a central resource that provides residents, non-governmental organisations, business representatives, educational and research institutions, government agencies and other visitors with comprehensive information on various steps and approaches that can help achieve the city's goal of climate neutrality.

The outcomes and enabling impacts of these approaches are:

- an improved public engagement leading to better decision-making for climate neutrality.
- Active involvement of residents in shaping urban environments and incorporation of community ideas into final designs.
- Community programs foster ownership, enhance greenery, and biodiversity.

- Active stakeholder engagement platforms facilitate continuous dialogue, contribution collection, and dissemination of information on sustainable initiatives.
- Educational and awareness campaigns about climate change engage youth through innovative formats and promote accessibility via the Climate point.
- Local competitions encourage innovative sustainability solutions, particularly engaging youth.
- Adaptation and mitigation workshops to enhance community resilience, especially among vulnerable groups, through collaboration with universities and research institutes.
- Strengthened collaboration with healthcare for addressing physical and mental health issues due to climate change.
- Cultural and artistic projects for education, information dissemination, advocating climate neutrality, and raising awareness of climate change impacts.
- Sports projects for sustainable development emphasise circular material flows, and sustainable practices in sports events.
- The comprehensive initiative promotes sustainable certifications and encourages sustainable practices within the relevant sector.
- Community-level biodiversity projects include wildlife monitoring for ecosystem understanding and campaigns for planting indigenous plants.
- The information point serves as a central hub providing comprehensive information to various stakeholders.

ADDRESSING SOCIETAL CHALLENGES WITH A BOTTOM-UP, COLLABORATIVE, HOLISTIC AND PEOPLE-CENTRED APPROACH TO INNOVATION

The city of Ljubljana addresses societal challenges with a bottom-up, collaborative, holistic and people-centred approach to innovation. The city has already conducted extensive and numerous experiments in research projects to develop new products, services or business models that improve the well-being and prosperity of the community and promote behavioural change and social transformation. It ensures that economic development and the overall well-being of people and the planet are taken into account. It strengthens the co-benefits of climate action, such as improved public health, job creation, public budget savings and more, and builds local capacity to tackle the challenges of decarbonisation. The examples listed here show how the city is creating opportunities for a wide range of stakeholders to co-create solutions through social innovation. The city's projects are **categorised and listed according to their contribution** to **entrepreneurship, social economy, social awareness and mobilisation, social cohesion and solidarity.**

SOCIAL COHESION AND SOLIDARITY

PROJEKT ZUNAJ 2021
(PROJECT OUTSIDE 2021)

http://www.pazipark.si/en/portfolio/project-outside/

Location: numerous locations in the City of Ljubljana
Time: March – October 2021
OUTSIDE is a project of the City of Ljubljana coordinated by the Pazi!park in 2021

Project OUTSIDE (Projekt ZUNAJ) was conceived in 2019 as a result of cooperation between Prostorož, the Institute for Spatial Policy – IPoP and the City of Ljubljana. In 2021 Pazipark took over the management of the project.

Project OUTSIDE **encourages residents to actively manage the public space and supports small local initiatives that can help citizens to improve their surroundings and benefit the wider community**. The project has been carried out for the third year and it is very well received by the citizens and more recognizable every year. 37 local initiatives have been implemented so far

providing **new spaces for socializing, wooden benches, herb and flower beds, sports trails, books exchange, renovation of playground equipment, landscaping between buildings and much more**. All the interventions are proposed and carried out by individuals through work campaigns, the coordinator covers material costs of implementation and offers professional assistance and mentoring. In 2021, twelve initiatives were supported and implemented.

SOCIAL AWARENESS & MOBILISATION
CHILDREN PLANNING CITIES

http://www.pazipark.si/en/portfolio/children-planning-cities/

Location: Centre of urban culture Kino Šiška
Date of performance: October 15th 2019 at 10:00

Organizer: Pazi!park Associationin collaboration with the Kino Šiška Urban Culture Centre and with funding of City community Ljubljana and Ministry of environment and area Republic of Slovenia.

On Tuesday, October 15th 2019, in the co-organization of the Pazi!Park Association and the Kino Šiška Urban Culture Center, an event dedicated to the **development of child- and youth-friendly cities** took place for the second year in a row, this time entitled “Children plan a city”.

The child-friendly place is friendly to all users. Although the current practice in our country does not yet emphasize the importance of **children as co-creators of public open space**, children in cities are becoming an increasingly topical topic that touches on many areas. When we talk about planning a space tailored to children, it is therefore necessary to include children as competent interlocutors for adults, as children are able to articulate their needs and desires, cooperate with others and co-create a common space. “I would close the roads and arrange forest paths instead,” said the second-grader, explaining that cars are noisy, sometimes dangerous, as they often do not stop at pedestrian crossings and their exhaust fumes have a bad smell.

“Why participation?” Asked the main guest of the conference, Roel Camps, who is responsible for the involvement and participation of the population in the Antwerp city administration. Camps has developed and tested more than 120 participatory projects involving more than 20,000 young people. He is convinced that a **combination of digital participation and field work is key to better involving young people in urban planning**. “Residents, including children, need to be involved in planning stages because only in this way can we know their wishes and their experiences add value to future development,” Roel Camps emphasized.

The conference was opened by prof. Janez Koželj, Deputy Mayor of the City of Ljubljana, who said that the opportunity for participation lies in the fact that it establishes informal, voluntary and multifaceted communication between residents and city planners, between users of public space and its managers. The goal of the city of Ljubljana is that one day the whole city will become a playful landscape where children can be more relaxed, more active and more creative. As part of the event, there was also a discussion with many Slovenian experts and agents from practice: urban sociologist, dr. Aidan Cerar from the Institute for Spatial Policy, prof. dr. Gregor Jurak from the Faculty of Sports, Nataša Jazbinšek Sršen, Head of the Department of Environmental Protection of the City of Ljubljana, Majda Koren, a youth writer, and Urška Kranjc, a landscape architect, a member of the Pazi! Park Association. In the conversation, with the presentation of good practices of inclusion of children and young people, Mag. Darja Silan from the Jože Plečnik High School, who presented the school roof garden, mag. Maja Brusnjak Hrastar, the initiator of the arrangement of the community meeting place in Novo Polje, and Lovro Planko and Jan Škrjanc, students from Šiška High school, who together with their classmates helped arrange the “school beach”, as the students call the new vacation space. The guests emphasized the importance of participation, which can have many positive consequences for all, although cannot be left to individual random cases, but rather be systematically supported.

On an urban walk before the conference, the organizers took visitors through various rooms along Vodnikova cesta from Vodnik’s homestead to the Valentin Vodnik Primary School. During the walk, the children talked about the obstacles on their daily way to school, they were mainly bothered by the noise and the difficult crossing of the road despite the pedestrian crossings. At the school playground,

they remembered how years ago, together with members of the Pazi!Park Association, they greened the playground. “We dug holes and planted trees and shrubs,” the students recall: “It was quite difficult because there were a lot of stones. We are now very careful about the planted trees, but we would like to see even more of them on the playground. “

SOCIAL AWARENESS & MOBILISATION
Project APPLAUSE – from harmful to useful with citizens' led activities

https://www.ljubljana.si/en/applause/

The project addresses unsolved questions with regard to invasive alien plant species in terms of the zero-waste approach and circular economy.

At present we are composting or incinerating these plants, and with the pilot project for processing plants into paper at a semi-industrial level we have proven that they can be utilised for other useful purposes.

The proposed system of managing invasive foreign plants is based on education and cooperation with the citizens of Ljubljana and three principles of operation:

»Do it yourself«,
»Process with us« and
»Bring to the collection centre.
We want to make it easier for the citizens of Ljubljana to recognise invasive non-native plant species on their own and then remove and process them into useful products (1). If they do not want to do that by themselves, they will be able to go to the newly planned re-use centre where we can process them together in workshops (2) or they can simply bring them to the new collection centre where project partners can process them into useful products and then sell them (3). The project addresses the widest possible circle of stakeholders: kindergartens, schools, pupils, students, households, property owners, companies, tourists, professional organisations on centre«.

SOCIAL AWARENESS & MOBILISATION
Participativni proračun v Četrtni skupnosti Polje
(Participatory budgeting in the Polje District Community)

At the City Municipality, we actively collaborate with representatives of district communities, with whom, in line with expressed needs, initiatives, and capabilities, we agree on the implementation of both small and large-scale projects in district communities (e.g., new green areas, school, kindergarten, and other playgrounds, comprehensive street and road renovations - including the renovation of entire infrastructures, renovations and expansions of cemeteries, renovations of health centers, construction of district centers, etc.).

Every year, we also jointly prepare plans for so-called minor works, through which we implement participatory budgeting. The proof of successful collaboration is evident in many concrete projects that gradually bring life back to all district communities.

ENTREPRENEURSHIP, SOCIAL ECONOMY
Projekt Center Rog
(Project Center Rog)

https://www.ljubljana.si/en/news/rog-centre-opened-its-doors/

On Thursday, 26 October 2023, we opened Rog Centre, a new, open creative centre, where we open the doors wide to cultural and creative people and place manufacturing, design and applied arts at the centre.

Creative Center Rog
The Rog Factory, symbol of the legendary Rog bicycles, is the most important industrial cultural heritage of the 20th century in Ljubljana. With **the renovation project** and the program of the Rog

Center, we will preserve the factory building in its original function. In the future, it will operate as a **public production space** of the 21st century, dedicated to the **cultural and creative sector**, with an emphasis on manufacturing, design, and applied arts.

Vision
By revitalizing the former Rog factory into the Rog Center, a new international **creative and social center closely integrated into the local environment will be established in the center of Ljubljana**. With circular space use, strong cross-sectoral and international orientation, and a commitment to sustainable development, the impact of the Rog Center will extend beyond direct users and positively affect the lives of the broader community.

Mission
With modern infrastructure, knowledge, and international connections, the Rog Center will provide a creative supportive environment for the development of socially beneficial innovative projects in the fields of manufacturing, urban craftsmanship, applied arts, design, and architecture.

Rog Center Program
The Rog Center will offer support programs and shared use of modern infrastructure for the needs of actors and creators in the target area (production, educational, event, and exhibition space) on four floors totaling 8,500 m^2.

Shared production laboratories
The ground floor and part of the second floor will house production spaces and shared laboratories - both those with modern computer-controlled technologies and those using more traditional techniques: 1) a 3D manufacturing laboratory or fablab with a recycling and electronics laboratory, 2) textile laboratory, 3) woodworking laboratory, 4) metalworking laboratory, 5) green laboratory, 6) glass and ceramic laboratory, 7) multimedia laboratory, and 8) culinary laboratory. This program will be open to the widest audiences: makers, urban craftsmen and artisans, designers, architects, engineers, artists, students, pupils, and enthusiasts of all generations.

Individual project spaces
These spaces at the Rog Center will be dedicated to makers, urban craftsmen and artisans, designers, architects, engineers, and those active in the field of applied arts. Rog Center will allocate around 25 individual project spaces on 1,250 m2 on a non-profit basis (without rent, covering only operational costs) based on public calls from the Rog Center. They will be intended for individuals and collectives developing socially beneficial products in line with the core values of the Rog Center.

Residential working spaces
Five residential spaces at the Rog Center will be dedicated to accommodation and work for foreign creators, researchers, and lecturers from the target areas of the public institution. The residential working spaces will serve as a tool for international exchange, enabling Slovenian creators to live and work in similar creative centers around the world.

Exhibition, event, and social spaces
The first floor will host a new unit of the City Library with a professional department in the target areas of the institution. In the field of exhibition and event activities, the Rog Center will offer a 600 m2 space for larger events and a multi-purpose lecture hall. Between the library and the hall, there will be a café with an exit to the terrace overlooking the Ljubljanica River. On the ground floor, there will be a bistro with a delicatessen, a restaurant, and 6 retail units with goods and services complementary to the Rog Center program.

Park (former factory courtyard)
The public park managed by the Rog Center will be a new 8000 m2 green area in Ljubljana, intended for daily use by citizens, as well as various public events in the target areas of the Rog Center.

Accessibility
All individual users of production laboratories, individual workspaces, and residential workspaces will be members of the Rog Center. Upon joining, they will receive a membership card, which will grant them access to the spaces as well as to the machinery and equipment. The membership fee system

will allow functional space sharing, independent use of space outside official opening hours, and consequently, greater utilization of public infrastructure.

Development and implementation
The development story of the Rog Center, which began in 2007, is long and complex, and despite the dialogue process involving numerous interest groups, often conflicted. Yet it is unique in Slovenia's history of developing cultural institutions, representing the most extensive example of distinctly community participatory planning of a major public investment. The professional foundations for the vision, mission, and program design of the Rog Center were developed through the pilot project RogLab in close collaboration with users and stakeholders. Between 2010 and 2022, 460 stakeholders, over 80 partner organizations, and over 6000 users from Slovenia and abroad participated in conceptualizing and testing the program.

Public Institution Creative Center Rog
In June 2021, the City Municipality of Ljubljana established the Public Institution Creative Center Rog. In the initial phase of the new public institution's existence, its focus on infrastructure involves coordinating the program design with the challenging process of renovating a protected cultural heritage building.

Programmatically, the Rog Center will, by 2023, focus on the development and implementation of the following areas of the institution's operation through participatory methods of public involvement: participatory decision-making and budgeting; inclusion of migrant and refugee creators, development of recommendations for gender equality; development of tools to support cross-sectoral creation of socially beneficial products, conceptualization of the park arrangement at the Rog Center, and development of sustainability criteria for the institution. This part of the development process has been financially supported by the European Cultural Foundation.

SOCIAL AWARENESS AND MOBILISATION

LJUBLJANSKI LEDENIK
(Ljubljana Glacier)

An Innovative Initiative to Tackle **Heatwaves**

Ljubljanski ledenik (the Ljubljana Glacier) is an innovative, interactive urban orientation that seeks to raise **public awareness about the dangers of heat waves**. Specifically created for residents and visitors of Ljubljana, this project addresses the well-known issue of the heat island effect in the city during the summer months, which poses a significant threat to human health.

The objective of the project is to provide an innovative and easily accessible way of educating the public on the issue of heat waves. The theoretical aspects of protection, preventive measures, health risks, emergency procedures, and other relevant factors are presented in a practical manner through orientation in the urban environment. This approach offers an opportunity for active leisure while directing participants towards safe havens during heatwaves, including cool and shaded areas, and drinking fountains.

The project objectives are to:

- Providing a comprehensive and innovative way of educating the public about climate change adaptation with a particular emphasis on heat waves. The project intends to educate people about the importance of protection against extreme weather events and sustainable development practices within Ljubljana.
- In the springtime, an orientation will be established within the Municipality of Ljubljana, and a map will be created that leads to physical points in space where participants can access the content through a QR code.
- The project will organise a one-day event that includes a guided tour of the orientation and other activities.
- Additionally, schools and organisations in the Municipality of Ljubljana will be informed about the path's availability for sports days or other activities, ensuring that the content reaches the widest possible audience, including vulnerable groups.

- Project duration: januar 2023–oktober 2023

The project receives co-funding from the City of Ljubljana (COL) as part of the 2023 Public Call for co-financing environmental protection projects by non-governmental and non-profit organisations in COL.

ENTREPRENEURSHIP, SOCIAL ECONOMY

UMETNIŠKA ČETRT ŠIŠKA
(Art District Šiška)

In the building of the former Šiška municipality on Overseas Brigades Square, we have provided **spaces for use to 36 non-governmental organizations and individuals from the field of culture**. In doing so, we have established a new artistic district directly adjacent to Kino Šiška and in the vicinity of Vodnik Homestead, thus developing an important cultural center in this area.

SOCIAL AWARENESS AND MOBILISATION

PEŠBUS
(Walking Bus)

The "Pešbus" is a way of **organizing and monitoring walking to school for the youngest students**, including first graders. Children register for walking to school with the Pešbus in advance and, together with their parents, choose a Pešbus stop where they will join the group. In the morning, the children then gather at the selected stop at a specific time and walk together with supervisors along a carefully planned and marked route to school. Each Pešbus is accompanied by adults. At the beginning of the activity, children receive Pešbus tickets in which they collect stamps for each day of walking and stickers for each week of walking.

In this way, children enjoy a morning walk to school with other children and accompanied by an adult, while parents are relieved of the morning drive and escorting of children to school.

The Pešbus can be implemented in the form of shorter, occasional, and trial periods, or it can be permanent, daily, once a week, or otherwise, as agreed upon by the supervisors, school, and parents. It can be implemented in the first weeks at the beginning of the school year for children to get used to walking to school every day and to become more familiar with the route, or the school can actively encourage and organizationally support the path to school throughout the school year.

Since 2016, more than 150 different schools in Slovenia have implemented the Pešbus.

SOCIAL COHESION AND SOLIDARITY

Projekt URBforDAN – za boljše upravljanje urbanih gozdov
(The URBforDAN Project - for better management of urban forests)

In the Golovec area, we will arrange eight entrance points for visitors, pedestrian and cycling paths, as well as bridle paths. We will install urban equipment, including wooden benches and tables, as well as signs, signposts, and informational boards describing the area as a natural heritage, individual facilities, and other content on site. **We will mark an educational trail or several educational points and tools for outdoor education and establish so-called quiet zones with a special space for relaxation**.

Users will also have access to a smartphone application that will provide information about the area's content, thus allowing for even better utilization of the newly arranged areas. Specific measures will also depend on the suggestions of participants from various workshops and other events for different audiences.

As a special feature of the project, we are **developing participatory and integrated management of urban and suburban forests,** which are important areas of natural heritage. The biggest challenge in Ljubljana is the highly fragmented ownership of forests – for comparison: as much as 90% of the forest area in Golovec is privately owned – and the lack of connection and coordination among them, hindering the achievement of the stated goals.

Within the project, we expect to improve cooperation among key stakeholders (forest managers and owners, users or visitors, experts, non-governmental organizations, etc.), by actively involving them in project activities and measures. We will develop the most effective form of cooperation to connect these groups under the guidance of the City Municipality of Ljubljana and the Slovenian Forestry Institute. This will also serve as a basis for preparing international guidelines and transferring best practices and experiences to other European cities.

SOCIAL COHESION AND SOLIDARITY
Park varne mobilnosti
(Safe Mobility Park)

We will **establish a Safe Mobility Park**, dedicated to **education and practical demonstrations** of safe mobility. The Safe Mobility Park consists of a skills course and a facility.

The main objectives of the project are to:

- Provide appropriate infrastructure for implementing programs in the field of traffic education and safe mobility.
- Conduct practical training sessions.
- Contribute to safe mobility.
- Raise public awareness.
- Implement educational programs.
- Prevent personal and social distress due to the consequences of traffic accidents.

SOCIAL COHESION AND SOLIDARITY
Galerija Cukrarna
(Cukrarna Gallery)

The building of **the Sugar Factory**, formerly a sugar factory, has been **renovated and established as the Cukrarna Gallery, providing the city with the largest exhibition space suitable** for large and demanding exhibitions, as well as a venue for cultural and artistic events and education. The new multipurpose arts center **ensures greater accessibility to culture for all residents, easier promotion of cultural production, and the realization of other major projects**. This has also expanded the city center towards the east and provided additional public space for the residents and visitors of Ljubljana.

Works on the largest cultural project in Slovenia began on October 10, 2018. The project was co-financed by the European Regional Development Fund. The renovation was completed in approximately two years.

The project received a contribution from the Community amounting to EUR 10,774,396.00 from the European Regional Development Fund and a contribution from the Republic of Slovenia's own participation in the amount of EUR 2,693,599.00. Funds for the project are provided through the mechanism of Integrated Territorial Investments, aimed at addressing degradation and revitalizing urban areas.

As part of the Cukrarna Gallery Development Project, we carried out the reconstruction of the existing building, thereby improving the urban environment and further revitalizing the broader city center. Additionally, we removed a physical barrier in the space that hindered mobility in this part of the Poljane Embankment, thus preventing the optimal connection between the city center and urbanized areas to the east of the city. We also enhanced the social aspect of space utilization, as the area with new content and arrangements has become dynamic, programmatically rich, socially vibrant, and a safer and more pleasant place, appealing to both residents and visitors of Ljubljana for repeated visits.

The Cukrarna Gallery will be dedicated to presenting contemporary fine and visual arts, with the two most important biennial events in Ljubljana, BIO Ljubljana and the International Graphic Arts Biennial, undoubtedly playing a significant role. This has addressed the long-standing lack of large exhibition space in Ljubljana.

In planning the content of the gallery space, we pursued the following objectives:

- Improve the exhibition offering in the City of Ljubljana and increase the number of demanding exhibition projects that will attract a wide audience.
- Systematically present the collection of the City of Ljubljana and present and upgrade the collections of public institutions in the field of fine arts to create a new quality and representative offer in the exhibition field.
- Increase accessibility to culture for all residents and visitors of Ljubljana and promote cultural production more effectively.
- Collaborate with major international partners and implement larger joint projects, which have not been possible so far due to inadequate spaces.

SOCIAL COHESION AND SOLIDARITY
Project KAVALIR

Cities to Cities: Electric Minibus Kavalir

In recent years, Slovenian cities have been following the trend of expanding pedestrian areas, aiming to improve the quality of life in urban areas, revitalize city centers, and ultimately promote tourism. In doing so, they face the challenge of maintaining accessibility to pedestrian areas for all residents and city visitors. Ljubljana has addressed this issue by introducing on-demand transportation services, available within pedestrian zones.

Kavalir is one of the **measures aimed at introducing environmentally friendly forms of transportation in the city. Ljubljana has recognized the need for alternative mobility services** and has enriched the offer of urban public passenger transport. This small electric vehicle is designed to provide free transportation for the elderly, people with mobility impairments, and other residents and visitors within areas that are otherwise closed to traffic.

Kavalir **enables unrestricted movement within the pedestrian zone in the city center for seniors and is specifically adapted for people with mobility impairments**. Due to its low speed of up to 25 kilometers per hour, it can be stopped during the ride or transportation can be ordered by phone. It can accommodate up to five passengers at once and operates from six in the morning until ten in the evening. Free rides with Kavalir are provided by the public company Ljubljanski potniški promet, which is responsible for maintaining the vehicles and employs drivers.

The first Kavalir hit the streets of Ljubljana in 2008 when it was introduced as an on-demand transportation service as part of the European project CIVITAS ELAN. Due to a positive response and increased demand, additional vehicles were purchased in the following years. Today, there are six Kavalirs operating within the pedestrian zone, with three closed vehicles available all year round and three open ones operating from April to October or depending on the weather. On Sundays and holidays, Kavalir is also available at the Žale Cemetery.

Since Kavalir has also become a unique tourist attraction, an electric tourist train called Urban has been additionally introduced for tourist visits, which follows a set route and connects the sights of Ljubljana (Ljubljana Castle, Špica by the Ljubljanica River, Trnovo, and the Modern and National Galleries).

The service has become an indispensable part of the public transportation services in Ljubljana. In this way, seniors and people with mobility impairments can cover distances and run errands within the pedestrian zone, improving their integration into everyday social life in the city. The success of the practice is also evident in its adoption by other cities, including Kranj (Kranvaj), Maribor (Maister), Koper (Kurjerca), Novo mesto (Leon), and even beyond the borders of Slovenia, such as in Corsica with the "wave and ride" service.

SOCIAL AWARENESS
Projekt PSLifestyle
(Project PSLifestyle)

https://pslifestyle.eu/about/project

PS**Lifestyle is closing the gap between climate awareness and individual action**! PSLifestyle will inspire you to adopt a positive, sustainable, and healthier lifestyle by helping you reduce your environmental impact. Come and join PSLifestyle and help us shape visions of positive and better lifestyles!

The Lifestyle Test will help you get informed about the environmental impact of your day-to-day activities and will inspire you to think about your current habits and how they could be changed through smart, everyday actions. On the web app you will get the chance to develop your personalised plans and keep track of your progress!

The Lifestyle Test was **co-created with residents in a series of Living Labs workshops** hosted in eight European countries: Estonia, Finland, Germany, Greece, Italy, Portugal, Slovenia, and Turkey. Through the Living Labs individuals engaged with other locals in their communities, and were able to help design the Lifestyle Test by assessing its features for further improvements, including its functions and design as well as the country-specific lifestyle suggestions.

The PSLifestyle project is set to continue its path towards **co-creating positive and sustainable lifestyles by initiating additional workshops i**n the eight countries during 2024. They will aim to collect local insights and innovative solutions on how to best deploy the Lifestyle Test throughout the EU as well as further identifying local and topical customisation needs, such as incorporating biodiversity aspects. Stay tuned!

Our PSLifestyle goals are to:

- Inspire and equip you to adopt lasting sustainable and healthy habits for a good life!
- Organise Living Labs so you can contribute to developing the Lifestyle Test.
- Co-develop an online tool that enables you to adopt a positive, sustainable, and healthier lifestyle.
- Enable further research and climate actions across Europe.

SOCIAL AWARENESS AND MOBILISATION

ČEBELJA POT
(BEE PATH)

The Bee Path was conceived and opened in 2016 as one of the activities within the framework of the European Green Capital project in 2016. Originally, it was envisioned merely as an actual path connecting various locations related to beekeeping and bees in Ljubljana. Through the participatory approach with individual members, it became evident that the path is much more than just a work program or project. It became synonymous with all activities related to bees and beekeeping in Ljubljana.

Today, the Bee Path in Ljubljana represents:

- A physical trail that **connects the city and the countryside into a whole**. Visitors can experience Ljubljana from a different perspective by walking along the path – they can learn about the **cultural and natural heritage associated with beekeeping in Ljubljana**, witness active beekeeping processes, as well as taste and purchase honey and other bee products.
- **A network of beekeepers, cultural, educational, and health organizations, companies, non-governmental organizations, as well as individuals interested in beekeeping and its development in urban areas**.
- An **educational program** aimed at raising awareness among key target groups about the importance of bees, from the youngest to adults, as well as promoting comprehensive and sustainable management of urban and rural areas.
- A **think-tank and incubator for the development of new entrepreneurial ideas in beekeeping and new bee products and services.**

- A movement that connects all interested parties who want to maintain high environmental awareness, preserve bees in urban areas, and further develop urban beekeeping in Ljubljana, as well as a strong advocate for the international initiative for World Bee Day.
- The Bee Path connects two important contents for our development and existence – biodiversity conservation on one hand and local self-sufficiency, as two-thirds of food depends on pollinators.

In the Bee Path, we have set the following goals:

- Increase and develop beekeeping in the wider area of the City Municipality of Ljubljana (education of beekeepers, financial assistance for the development of activities, co-financing the operations of five beekeeping associations).
- Development of beekeeping in the urban core, with an emphasis on safety, awareness, and education of citizens, rules of beekeeping in urban areas...
- Creation of new tourist products with the presentation of natural and cultural heritage related to beekeeping in the city.
- Education of the youngest and the creation of educational programs.
- Development of new urban apiaries and bee stations.

SOCIAL COHESION AND SOLIDARITY
Šmartinski Park, Playground

https://landezine.com/smartinski-park-playground-by-luz/

We are **transforming degraded, neglected, and underutilized parts of the city into new green areas, thereby contributing to mitigating climate change and enhancing the quality of leisure time for residents and visitors of Ljubljana (parks, gardens, playgrounds, urban orchards,** etc.). Since 2006, we have established over 90 hectares of new green spaces.

Amidst the hustle and bustle of traffic, the park offers an opportunity for relaxation in a pleasant green area.

Today's Šmartinski Park used to be a vast area of informal and individuals allotment gardens. In the municipal spatial planning documents the area was defined as green space and an infrastructural corridor, but in reality it was covered with garden beds and sheds, cut by a traffic road and crossed by a few main power lines. Still in 2007, the area mainly served as a buffer zone between busy roads and the city's central cemetery Žale and was constantly referred to as a problem zone. The main reason for the criticism was the contradiction of unregulated gardening and the iconic architecture of the Žale cemetery, designed by recognized Slovene architect Jože Plečnik. Ironically, allotment gardening was indeed planned on the site in late 1950s but went out of control when years went by. At its final stage, gardening here was declared illegal, nobody knew how many individual gardens there are or who they belonged to. The area consisted of vegetable beds with various wooden or tin shacks and small constructions, scattered around. The area was planted randomly with different fruit trees and numerous perennials. From the outside, the place seemed unfriendly, even confusing and difficult to cross, belonging to a closed community of gardeners.

Back in 2007, the area was first in a row to be cleared of illegal allotment in the Municipality of Ljubljana to **demonstrate new urban development and management policy**. The clearing of gardening beds and sheds was announced and executed in a close cooperation between mayor's office, municipal officials and public companies. This most delicate action was carried out with a lot of sensitivity to the gardeners and the future of gardening in the city as well as for the area's future development. The allotment gardeners were able to get explanations from the mayor on site, the vice major gathered a professional team to mark and protect the existing trees form construction damage, and a **new gardening policy** was announced publicly. Rehabilitation was discussed and planned along with fieldwork which led to an idea of minimal intervention. After clearing of the area only a flowering lawn mixture was sown in the first season and the area was open to public use while the process of planning and designing started. The nearby local communities were consulted about their wishes and they confirmed a need for a new park and playground. **The area was to become a public**

park in a new master plan and the road that was bisecting the area was to be omitted from it. The new park was to become Šmartinski Park, named after a road nearby.

Due to its vast dimension of nearly 13 ha, **the transformation of the area into a park was to be gradual**, starting the process in 2007, step by step reaching its climax in 2015 by constructing one of the **city's biggest and most exciting playgrounds**. In the first phase of park development only two basic walkthrough paths were erected, the terrain was reshaped and new large trees were planted while remnants of existing fruit trees were left on site. The playground was designed later due to many requests. The initial design idea was to provide a play area for all, no matter the age, physical or mental ability. The playground location was planned carefully, with a proper relation to the cemetery, behind a gas station and out of impacts of main road and power lines. The design team's previous experiences with school and nursery kids participating in various play projects were used as most valuable baseline for a new design concept. The design itself was to provide spaciousness, playful terrain, water feature in combination with sand, lots of vegetation and play equipment with a diverse set of functions – a high climbing net with a view being one of its essentials. Playful water feature and path design were moulded to the park layout, adding soft curved circular shapes with high play value to the existing straight functional park paths.

The **transformation of allotment into a park** was very well accepted almost from the beginning, even the **gardeners recognized the quality of open public space and requests for a playground started to reach the city hall in the first season of park operation**. At first idea of a playground in front of a cemetery sounded a bit unusual but life proves it right: people wished to have a playground constructed in a park more than anything and the visitors today are coming from near and far, even from outside of Ljubljana. Some of the users initiated ideas, such as circular paths for running or scooter riding with graphic length marks, a wavy up and down path and a softly curved hill with assortment of slides are the busiest features alongside water play – pumps, dams, channels or mills in combination with sand, a rarity in Ljubljana's otherwise diverse play options. Playground safety (gravel in combination with sand) is fully provided by careful detailing without abundant constructional additions. After the playground was open, many people visited it, proposing additional bike racks and a dog park and both of proposals were realised. Recent popularity of the park also triggered an expected initiative to build a teahouse with necessary service features for the park and playground users.

ENTREPRENEURSHIP, SOCIAL ECONOMY, SOCIAL AWARENESS AND MOBILISATION,
Projects for the Digital Development Strategy of the Municipality of Ljubljana

With the first Strategy of Digital Development in Ljubljana, we aim to achieve the goal of simpler and more user-friendly collaboration with the city's residents. Processes in which residents engage with city management will be simplified, making city management more efficient and transparent.

The process of shaping this strategy has been going on for eighteen months, involving participation of residents, city administration, experts and political decision-makers. The collaboration included individual and group interviews, surveys, workshops and online discussions with the public.

The vision of digital development of the City of Ljubljana will further promote Ljubljana as a pleasant and green city for everyday life. Human-centered development, supported by modern **digital solutions, will address the real challenges faced by the city's residents, enhance the existing urban services, and assist city managers in faster responding to risks.**

The Digital Development Strategy is based on the values and principles reflected in the Vision of Ljubljana 2025. **Ljubljana needs to remain a city tailored to its residents, a green and a healthy city that promotes fair economic progress, provides (digital) security to its residents, and operates transparently.**

CLAiR-City
(*Improving the Air Quality and Reducing the Carbon Footprint of European Cities*)

Promoting sustainable mobility, quality of life and a healthy lifestyle, which contributes to a quality living environment and the achievement of EU 2050 goals (reducing air pollution...).

Save the homes (H2020)

The "Citizen ESCO" model is an **integrated home renovation service** based on the concept of "one-stop-shop" and offers an attractive business model for citizens and a proposal for homeowners for a comprehensive energy renovation of their homes in cooperation with the municipality and its networks.

GeoPLASMA-CE (INTERREG Central Europe)

Development of **tools and procedures for assessing the possibility of using low-temperature shallow geothermal energy** in urban areas; promoting the exploitation of shallow geothermal resources in the area of the City municipality of Ljubljana.

5 Outlook and next steps

This section should draw any necessary conclusions on the CCC Action Plan above and highlight next steps and plans for refining the CCC Action Plan as part of the Climate City Contract in future iterations.

Plans for next CCC and CCC Action Plan iteration

Building on the knowledge and experience gained during the drafting of the Climate City Agreement and based on successful practices in the past, a key focus will be on **maintaining the momentum** and **stability of the established stakeholder processes.**

Joint initiatives have been launched since November 2022. In addition, several **new projects** resulting from these efforts are already **underway**, such as the development of energy renovation models for the city's building stock, the revitalisation of inner courtyards and the modelling of urban heat islands, to name but a few.

Success **in creating a favourable environment for all stakeholders** to work together will play a crucial role. The focus is on understanding fields of action and recognising their **interconnectedness.**

Central to this approach is the **promotion of a positive attitude that emphasises the collective strength**, **belonging and responsibility** that comes from working together in the form of joint actions, projects and research and development.

The Climate City Contract is an **ongoing process** that will be implemented through the following measures:
1. **existing and newly formed partnerships** as well as stakeholder groups, including the local transition team (consisting of CCT city government departments, city public enterprises and interested stakeholder groups) and specialised focus team stakeholders. Activities will continue in line with the CCC Participatory-Communication Strategy (CCC-PCS).
2. the dynamic nature of the action plan emphasises continuous learning and focuses on collaboration, reflection, and improvement. Efforts to **create robust frameworks, gain the support of policy makers and increase stakeholder engagement will continue**. Obtaining **additional signatures/commitments** from various stakeholders as identified in the stakeholder map created as part of this dynamic approach will be perused.
3. **identify and develop new funding opportunities, grants and partnerships with the public and private sector.** Ensuring a steady flow of resources will enable the continuation and expansion of projects aligned with the CCC Participatory-Communication Strategy (CCC-PCS) and strengthen the City's commitment to achieving its climate neutrality goals.
4. the newly established **Climate Change Council of the City of Ljubljana will be appointed** by the mayor within two months of receiving the EU Mission Seal. The Council will hold its first joint meeting within one month of its appointment to draw up a work plan that includes advice on planning and implementation measures and closely monitors impacts.

5. one year after receiving the seal, the city's transition team will prepare an **annual report on the implementation of the CCC.** This reports, prepared in collaboration with various stakeholders, will include all activities related to CCC implementation, indicators, including stakeholder engagement efforts, during the year. The report will be presented to interested parties (public), whose considerations will be incorporated into the final report, which will also be reviewed by the Council for Climate Change City and City Council. The CCC will be supplemented by annual reports in the form of annexes. An updated of CCC (every two years) will be uploaded into Mission Platform. An update will also include a report on the status and progress of the measures implemented in the organisations that have committed to the CCC (signatories to the CCC) in the areas they have identified or implemented that address the climate neutrality targets. This approach enables the evaluation of signatories' effectiveness and commitment, informs investment, and encourages further progress and improvements in the CCC processes. The final decision on the measures to be taken based on yearly reports lies with the Mayor and the City Council. Indicator reporting will be conducted annually on the CDP/ICLEI platform, reflecting Ljubljana's consistent yearly submissions to the platform since 2017.
6. **a digital platform** will be set up within a year to support numerous activities in the field of climate protection.
7. a key perspective arising from the development of the Climate City Contract is also that future **revisions of strategies, policies and other programmes** will incorporate key elements identified as gaps in the development of the action plan, taking Mission 100 into account. The main focus will be on the coherence and interdependence of the areas and on the integration and monitoring of the indicators described in Mission 100. Particular emphasis will be placed on the **coherence and interdependence of the domains,** together with the integration and monitoring of the indicators outlined in Mission 100.
8. **exploring and adopting innovative technologies and solutions** will play a central role in accelerating progress towards climate neutrality. This includes keeping pace with advances in CCU technologies, smart city technologies, sustainable transport, behavioural change, regulatory frameworks, and new employment opportunities. Through established and new partnerships with universities, technology companies, research institutions and innovation centres, the city will begin to test innovative solutions that have the potential for scalability and significant impact on reducing carbon emissions.
9. **lobbying to ensure that the political and regulatory framework is conducive** to achieving carbon neutrality. This means lobbying policy makers, regulators, and other government agencies to adopt progressive environmental policies, incentivise green investments and regulations that promote sustainable practices. Concerted efforts will be made through lobbying, public campaigns and stakeholder alliances and regulatory sandboxes to influence policy formulation and regulatory adjustments in favour of climate action in the city.
10. **improving the expertise of the city administration and project teams** is key to achieving the objectives of the Climate City Contract. The focus will be on targeted training and education initiatives to improve skills relevant to the Climate City. Collaboration with educational institutions and professional organisations will be prioritised to ensure a well-informed and competent workforce ready to tackle the challenges of climate action in the coming period.
11. **establishing a CCC as the new normal**, with the aim of institutionalising it and strengthening mindset and content integration efforts. The new normal is characterised by the following:

- The CCC, as well as other city policies, functions as a unified policy.
- The City Transitional Team ensures co-operation at all levels.
- The City of Ljubljana Climate Change Council, which involves the interested public and city councillors, monitors the progress of the CCC annually.
- The city's CCC is regularly addressed at regional and national level and in line with international targets.
- Co-operation agreements and implemented projects imply the integration of the signed CCC commitments in the daily work of all stakeholders. Partnerships with universities, citizens' initiatives, non-governmental organisations, and others demonstrate inclusive governance.
- The dynamic nature of the action plan reflects continuous learning and emphasises collaboration, reflection, and continuous improvement.
- The goal of climate neutrality is an integral part of Ljubljana's operational culture.