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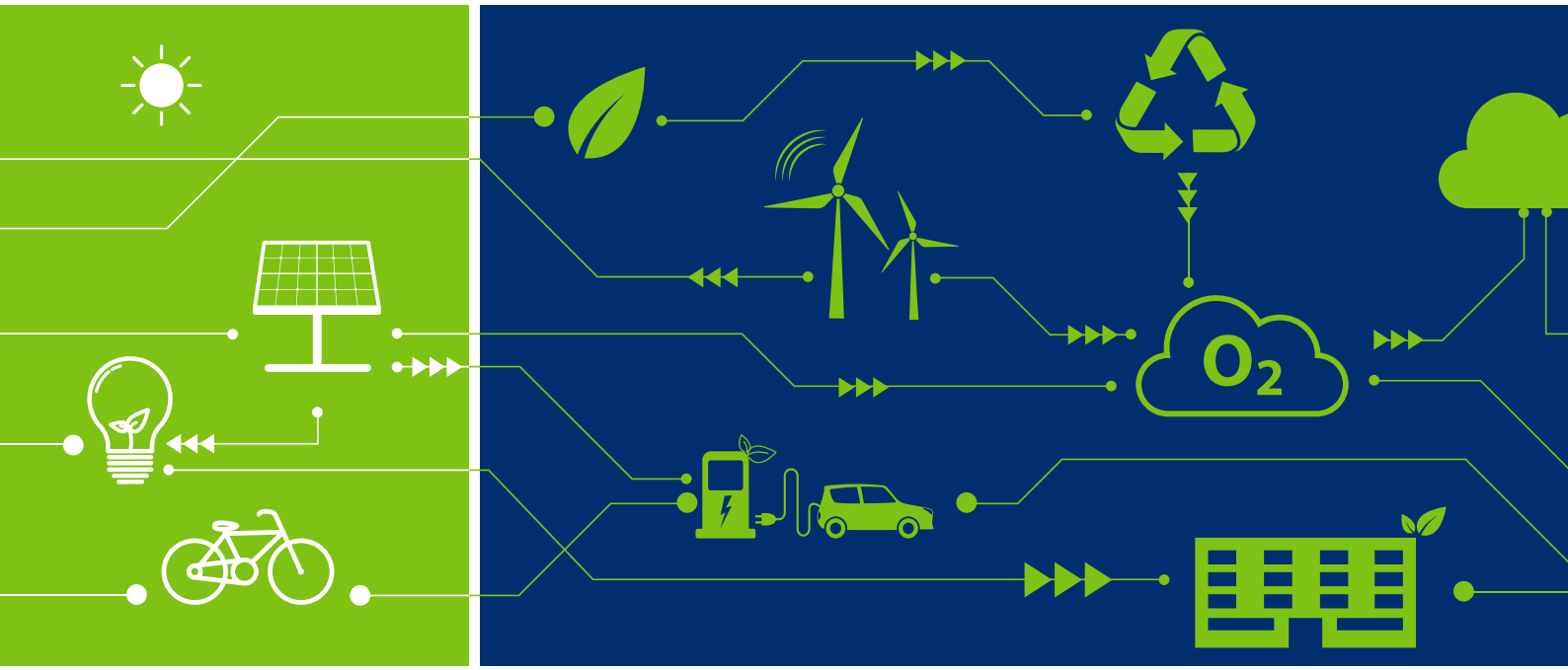
DEUTSCHE ZUSAMMENARBEIT

SECAP

Action Plan for Sustainable Energy and Climate

KUMANOVO



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Covenant of Mayors for Climate & Energy

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ABBREVIATIONS AND ACRONYMS

EU	European Union
GIZ	German Agency for International Cooperation
GWh	Gigawatt Hours
kt CO_2-eq	Kilotons of greenhouse gases emissions
MA	Mitigation Action
AA	Adaptation Action
EP	Energy Poverty
SDG	Sustainable Development Goals
SECAP	Sustainable Energy and Climate Action Plan
SEAP	Sustainable Energy Action Plan
BMZ	Federal Ministry for Economic Cooperation and Development
IBF	IBF International Consulting (the consultancy company chosen to develop the plan)
JRC	Joint Research Centre
BEI	Baseline Emission Inventory
RVA	Risk and Vulnerability Assessment
GPC	Global Protocol for Community-Scale Greenhouse Gas Emission Inventories
UNFCCC	United Nations Framework Convention on Climate Change
CAPEX	Capital Expenditure
TFFU	Kumanovo Territorial Firefighting Unit
ARNM	Army of the Republic of North Macedonia
IPCC	Intergovernmental Panel on Climate Change
RCP	Representative Concentration Pathway
CORDEX	Coordinated Regional Downscaling Experiment
WCRP	World Climate Research Programme
AFOLU	Agriculture, Forestry and Other Land Use
PPP	Public Private Partnership

Acknowledgement

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We would also like to express our gratitude for the financial support by the European Commission and the German Federal Ministry for Economic Cooperation and Development. We hope that the development assistance we have received so far will continue and be upgraded in support of the process of implementing the Sustainable Energy and Climate Action Plan.

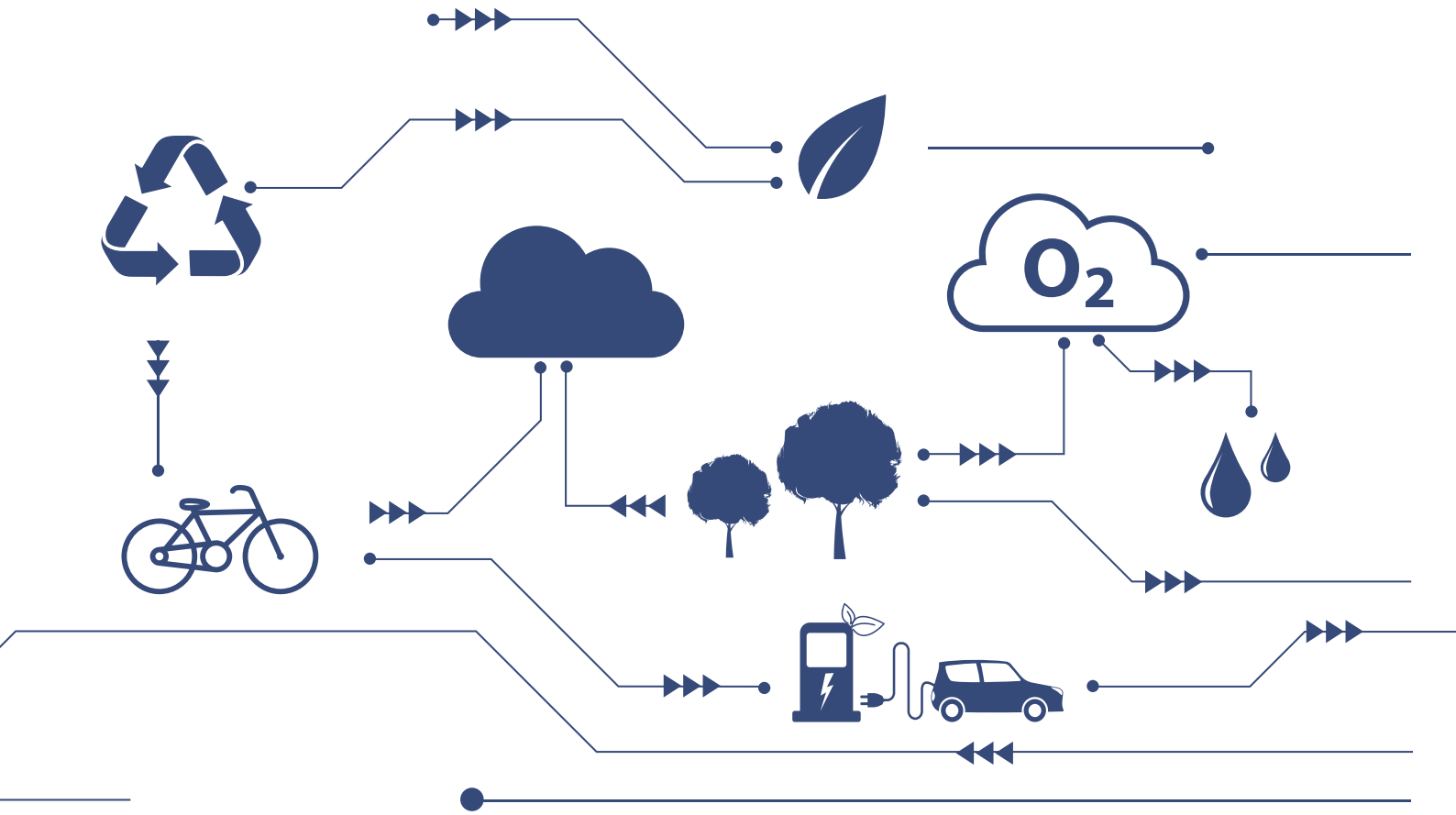
We extend our special gratitude to the representatives of the CSOs, business community and public enterprises that participated in the drafting of this document. We believe that the enhanced cooperation in terms of defining energy and climate policies and actions will be the basis for joint cooperation in the process of implementing the planned actions and even exceeding the projected goals.

We would like to thank the team of experts who worked on the development of the Baseline Greenhouse Gas Emissions Inventory and the Risk and Vulnerability Assessment of the Municipality Kumanovo.

The Municipality of Kumanovo is grateful for the dedication of the authors of the Sustainable Energy and Climate Action Plan and their close cooperation with the technical team of the Municipality of Kumanovo.

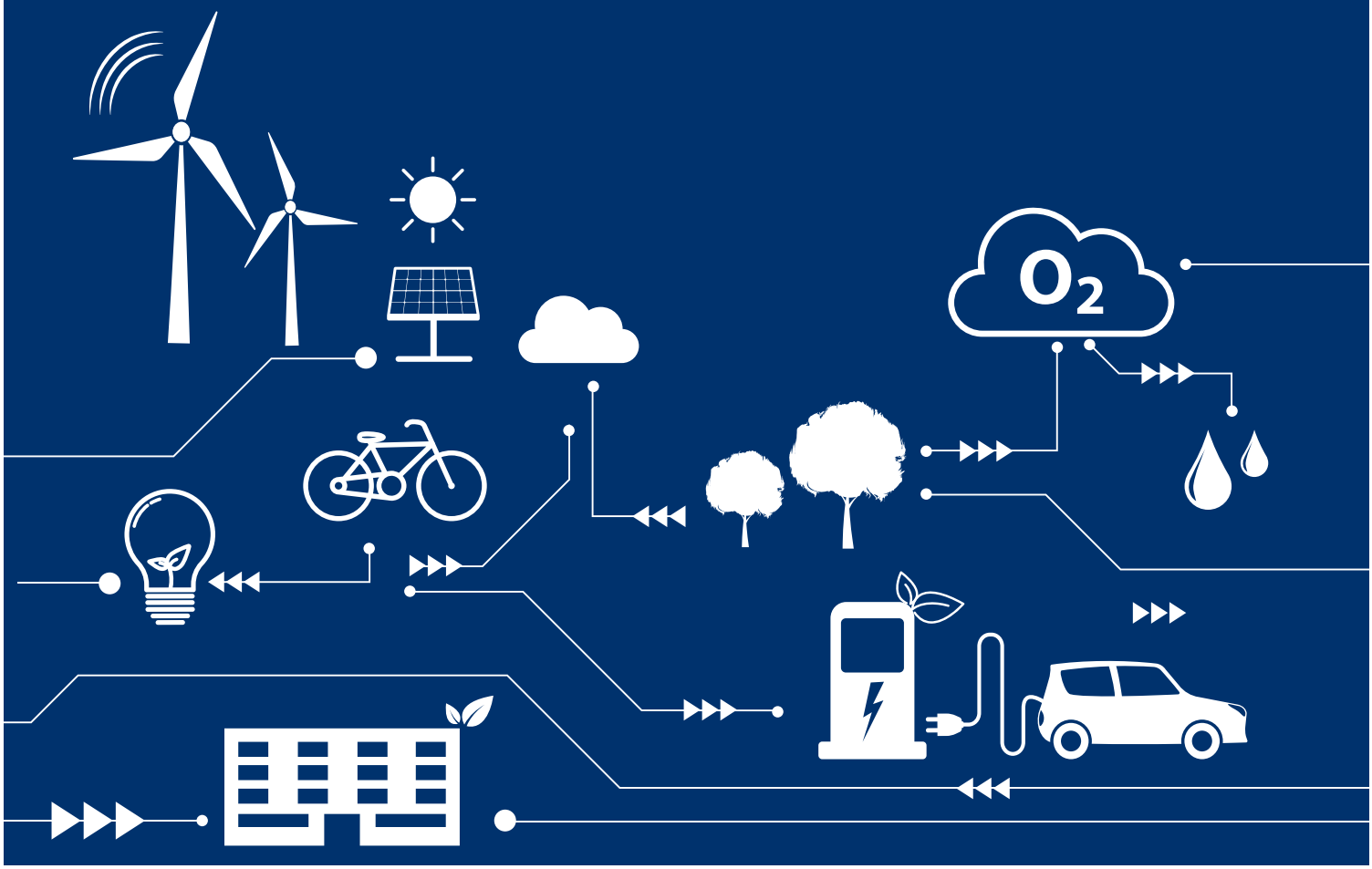
Finally, Kumanovo expresses its satisfaction with the quality of inter-sectoral coordination within the administrative body of the municipality, above all the technical readiness of the Department for Strategic Planning, Policy Making, Monitoring and Local Economic Development and the Sector for Communal Affairs, Infrastructure and Traffic and Environmental and Nature Protection.

We sincerely hope that we shall continue and strengthen the cooperation with all stakeholders in the process of implementing the Plan, and monitoring and reporting on the result.



The Sustainable Energy and Climate Action Plan (SECAP) of the Municipality of Kumanovo until 2030 has been prepared within the framework of the project "EU4Energy Transition – Covenant of Mayors in the Western Balkans and Türkiye," co-financed by the European Union and the Federal Ministry for Economic Cooperation and Development of the Federal Republic of Germany (BMZ), and implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH in the Western Balkans.

The SECAP was developed with the technical assistance of CETEOR, CEDES, and IBF International Consulting. The content of this document is the sole responsibility of the Municipality of Kumanovo and does not necessarily reflect the views of the European Union or the Federal Ministry for Economic Cooperation and Development.



Dear Fellow Citizens,

It is my great honor to present our municipality's Sustainable Energy and Climate Action Plan (SECAP). As a signatory of the Covenant of Mayors, we are committed to taking ambitious steps to lead the transition to low-carbon development, tackle climate change challenges, and secure a sustainable and resilient future.

The SECAP is our strategic roadmap for a greener, more energy-efficient future. It outlines key actions to reduce greenhouse gas emissions, boost energy efficiency, and protect the environment. This plan was developed with support from the EU4 Energy Transition: Covenant of Mayors in the Western Balkans and Türkiye project, implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH in the Western Balkans. Through this project, we collaborated with other cities and municipalities across the region, sharing ideas and best practices while defining crucial energy and climate actions. We also engaged citizens and local stakeholders through public consultations to shape the final plan.

The Action Plan provides clear goals and practical steps to guide our municipality's energy transition, improve climate adaptation, and support sustainable development. It will help us access funding, shape investments, and align with EU energy and climate goals, while addressing our local needs and priorities.
As your Mayor, I am committed to accountability and working together with citizens, businesses, and partners to make this transformation a reality. Your participation is key to our success. Together, we can create lasting change that benefits our community and environment.

Yours sincerely,

Maksim Dimitrievski
Mayor
Municipality of Kumanovo

EXECUTIVE SUMMARY

The long-term commitment of the Municipality of Kumanovo to support the vision and goals of the Covenant of Mayors enabled the development of the Sustainable Energy and Climate Action Plan. The main objective of the Plan is to create an advanced programme that will enable low-carbon development and achieving the long-term vision of climate neutrality.

The plan seeks to synchronise the energy and climate development programmes, while focusing on the areas of climate change mitigation, climate change adaptation and energy poverty reduction. This plan provides a realistic goals and actions projection.

In the process of preparing the development framework for mitigation, 2019 was chosen as the reference year for its reliable greenhouse gas emission inventory. The mitigation projections (including the contribution of the adaptation and energy poverty reduction actions) lead to a 47% reduction in greenhouse gas emissions by 2030. In order to set the development milestones in the process, the plan also provides information on the expected results in reducing emissions for 2027 (23.6% - first periodic report of the plan), 2040 (49.2% - medium-term goal) and 2050 (54.8% - long-term goal). The plan foresees for the Municipality of Kumanovo in 2030 to have energy savings of 110 GWh compared to 2019, 3 GWh energy obtained from renewable energy sources and for the greenhouse gas emissions to be reduced by 1,742 kt CO_2-eq.

The greatest potential for reducing greenhouse gas emissions exists in the "Agriculture, Forestry and Other Land Use" sector, in which the planned actions are aimed at substantially minimising its unexpectedly high share of 85% in the total baseline inventory in 2019. The plan also foresees substantial effect on the "Stationary Energy" sector, in which we expect a 51.2% reduction in greenhouse gas emissions by targeting the residential sector by investing in energy efficiency in the buildings sector, gasification and greater use of renewable energy.

In terms of adaptation, the Municipality of Kumanovo envisages actions that lead to increased resilience of citizens, primarily by preventing wildfires and floods. Special attention is expected to be paid to expanding the forest belt and increasing the urban forests.

Energy poverty is recognised as a significant challenge. In order to reduce the financial burden on vulnerable households, the Municipality provides subsidies for chimney cleaning and improvements to heating systems. In addition, free public transport is provided, which alleviates transport costs, provides easier access to social services, reduces greenhouse gas emissions, strengthens the inclusiveness of vulnerable categories and leads to overall socio-economic development and well-being.

The action plan refers to the 2025-2030 period and basically incorporates a group of continuous actions that should be implemented throughout the entire period covered by this plan. In order to maintain the commitment and implement the planned actions continuously, the Municipality of Kumanovo will strengthen its cooperation with all stakeholders and ensure the sustainability of the implemented actions.

Introduction

In 2008, the EU introduced the “Covenant of Mayors” initiative aimed at local governments to promote advanced development policies and sustainable energy actions. In October 2015, the “Covenant of Mayors” and “Mayors Adapt” initiatives were merged into a complex framework called the “Covenant of Mayors for Climate and Energy” with defined targets for 2030. This new framework creates conditions for a common vision of the parties aimed at decarbonised cities, resilient to climate change in which citizens have unhindered access to reliable, sustainable and affordable energy.

At the national level the EU Regulation 2018/1999 of December 2018 provides the necessary legal basis for credible, inclusive, financially justified, transparent and projected governance of the Energy Community and Climate Action. This regulation imposes an obligation for the EU member states to prepare and implement an integrated National Energy and Climate Plan. In this way, the European Commission synchronises initiatives at national and local level by securing a commitment at both national and local level for integrated planning and implementation of energy and climate programmes.

The Municipality of Kumanovo recognised the importance of synchronising energy and climate development policies and by joining the "Covenant of Mayors" expressed its commitment to achieving low-carbon development. Thus, Kumanovo voluntarily joined the European initiative and committed to develop an Energy and Climate Action Plan.

The Sustainable Energy and Climate Action Plan of the Municipality of Kumanovo elaborates on the actions that the municipality has recognised to be extremely important to be implemented by 2030, aimed at reaching the 2050 vision, which strives to achieve low-carbon development and further upgrade to climate neutrality and zero CO_2 emissions.

This document is guided by the guidelines of the Covenant of Mayors which calls for defining a greenhouse gas emissions baseline inventory and assessing the risk and vulnerability of Kumanovo. This further leads to the creation of policies and actions for climate change mitigation, climate change adaptation and energy poverty reduction.

The implementation of the actions and the making of a climate-resilient municipality will depend on the awareness and commitment of all citizens of the municipality of Kumanovo. The Action Plan calls for unity of citizens, civil society, the business sector and public institutions. Together we will create a better environment for all of us and a better future for the generations to come.

1 STRATEGY

The Energy and Climate Action Plan follows the Guidebook "How to Develop a Sustainable Energy and Climate Action Plan" under the Covenant of Mayors with technical support from the Joint Research Centre (JRC). The Guidebook provides clear recommendations about the chapters that should be incorporated in the Action Plan. In accordance with this Guidebook and the good practices from other cities, the Sustainable Energy and Climate Action Plan of the Municipality of Kumanovo in Chapter 1 describes the Strategic Framework in which it first presents the municipality's vision in terms of energy and climate.

In addition, this chapter presents the objectives and commitments in terms of climate change mitigation and adaptation actions. In this section, the Municipality of Kumanovo acknowledges the need to recognise the challenges in the area of energy poverty and further design of a development framework with concrete actions for its reduction.

The administrative structure and the setting up of a team of the Municipality of Kumanovo for planning, monitoring, evaluation and reporting is extremely important from the perspective of integrated planning and joint maintaining of the commitment, which on the other hand would ensure the proper implementation of the envisaged actions, monitoring and reporting on the results.

Furthermore, the guidebook requires a brief overview of the methodology implemented for the development of the document, the legal basis and the manner in which stakeholders are involved.

At the end of this chapter, the financial perspective, the assessment of adaptation options and the strategic approach to managing extreme climate conditions and energy poverty are provided.

1.1. Municipality of Kumanovo's Vision

The vision of the Municipality of Kumanovo is guided by the recommendations of the Covenant of Mayors and the National Energy and Climate Plan with a framework perspective of the EU Vision for climate neutrality and net zero greenhouse gas emissions.

The process of developing the Sustainable Energy and Climate Action Plan incorporates in each step the discussion about the vision and goals in the medium and long term. One of the bigger challenges was the lack of a baseline inventory of the Municipality of Kumanovo from 1990, which, as a reference year set by the EU, makes it impossible to compare and provide a numerical overview of the targeted reduction of greenhouse gas emissions. Hence, the 2019 inventory was taken as the baseline inventory, which within the framework of this document also represents the baseline for comparison with the goals for 2030 and 2040.

In 2050, the Municipality of Kumanovo would be a low-carbon, climate-resilient municipality with a clearly defined climate neutrality framework as a result of the already acquired strong commitment by all citizens.

Guided by the Vision 2050, the Municipality of Kumanovo, in cooperation with all stakeholders, has also set its short-term vision in accordance with the results of the modelling for emissions and energy poverty reduction and climate change adaptation.

In 2030, greenhouse gas emissions in the Municipality of Kumanovo are to be reduced by 40% compared to 2019 and the citizens to be mobilised to achieve the joint commitment for a "climate-resilient municipality".

In order to ensure for the vision to come true, a short-term mission has also been defined, which includes the envisaged actions for mitigation, adaptation and reduction of energy poverty.

The mission of the Municipality of Kumanovo is to implement highly inclusive processes for the purpose of realising the low-carbon development agenda, which in the perspective of 2025-2030 is based on strong investment in energy efficiency, increased participation of renewable energy, strengthening urban mobility, improved urban planning and afforestation and improvement of water resources management.

The vision of the Municipality of Kumanovo is the basis for further development of energy and climate related policies and actions. In addition, the Municipality of Kumanovo has ensured that the actions elaborated in this document are in accordance with the other line programmes with a particular commitment to alignment with the strategic documents on energy, environment and climate.

1.2. Action Plan Objectives

Climate Change Mitigation Objectives

The main objective of the Sustainable Energy and Climate Action Plan of the Municipality of Kumanovo in the climate change mitigation section is to reduce GHG emissions registered in the baseline inventory by at least 47.5% by 2030, compared to 2019. The long-term objective of the Municipality of Kumanovo has a vision for Kumanovo to follow the trajectory of becoming a low-carbon municipality by 2050 by reducing greenhouse gas emissions for over 58.8% compared to 2019.

The actions to mitigate climate change also reflect 3 out of the 17 Global Sustainable Development Goals (SDGs), adopted by all members of the United Nations in 2015.

Climate Change Adaptation Objectives

The Sustainable Energy and Climate Action Plan (SECAP) of the Municipality of Kumanovo in regard to the climate change adaptation focuses on two primary objectives:

- Improving environment quality, and
- Building climate resilience and resilient energy infrastructure with secure access to energy for all citizens.

These objectives represent the commitment of the Municipality of Kumanovo to create a cleaner, safer and more sustainable urban environment for all its inhabitants. Additionally, these objectives are in line with international frameworks such as the Sustainable Development Goals and the Paris Agreement on Climate Change. By adhering to these common goals, the Municipality of Kumanovo demonstrates its commitment to fostering sustainable development, combating climate change and building a resilient urban environment that meets the needs of both current and future generations.

Objective 1: Building climate resilience and resilient energy infrastructure with secure access to energy for all citizens – With this objective, the Municipality of Kumanovo will strengthen climate resilience and establish a robust energy infrastructure, ensuring equitable access to sustainable energy for all citizens. This approach includes expanding the gas distribution network (40km by 2030) in order to strengthen the energy diversification and security, installing photovoltaic (PV) systems on municipal buildings in order to demonstrate and promote the acknowledgement of renewable energy and integrating climate change aspects into the general urban plan. By strengthening the energy resilience and promoting the transition to clean energy sources, this initiative aims to mitigate climate risks and foster sustainable urban development.

Objective 2: Improving environment quality – prioritises the improvement of the environment by reducing wildfires, increasing forest cover and improving urban green spaces, along with improving hydrotechnical systems such as drainage and flood management. This comprehensive approach aims at addressing multilayered environmental challenges, reducing the frequency and severity of wildfires with proactive management strategies for the purpose of enhancing biodiversity and carbon sequestration and fostering urban green spaces (30,000m2) and mitigating heat island effects. Furthermore, improvements in the hydrotechnical systems, including improved drainage systems and flood management measures, contribute to protecting communities from climate-related risks, while improving the sustainability of water resources and the quality of the environment as a whole.

The actions for climate change adaptation also reflect 7 of the 17 Global Sustainable Development Goals (SDGs), adopted by all members of the United Nations in 2015.

Table 1 **Contribution of mitigation actions to the Global Sustainable Development Goals**

	Ensure access to affordable, reliable, sustainable and modern energy for all
	Make cities and human settlements inclusive, safe, resilient and sustainable
	Take urgent action to combat climate change and its impacts

Table 2 Contribution of adaptation actions to the Global Sustainable Development Goals

	Ensure healthy lives and promote well-being for all at all ages
	Ensure availability and sustainable management of water and sanitation for all
	Ensure access to affordable, reliable, sustainable and modern energy for all
	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
	Make cities and human settlements inclusive, safe, resilient and sustainable
	Take urgent action to combat climate change and its impacts
	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Objectives for reducing energy poverty

The Sustainable Energy and Climate Strategy (SECAP) of the Municipality of Kumanovo focuses on two primary goals for reducing energy poverty:

- Improving the economic situation of socially vulnerable categories of citizens
- Improving mobility and service accessibility.

The Sustainable Energy and Climate Action Plan aims to increase the economic opportunities for the citizens and to improve their access to energy, as well as services and mobility in the Municipality. The Action Plan reflects the priorities of the Municipality of Kumanovo for sustainability and fair social inclusion of all its inhabitants.

Objective 1: Improving the economic situation of the citizens of the Municipality of Kumanovo, including socially vulnerable categories – the aim is to alleviate energy poverty and improve economic prosperity by implementing targeted subsidies aimed at improving household energy efficiency and access to clean energy solutions. By applying strategic measures such as subsidies for chimney cleaning and improvements to heating systems, the Sustainable Energy and Climate Action Plan aims to reduce the financial burden on vulnerable households, reduce energy costs and promote sustainable practices. In addition, the provision of free public bus transport aims to alleviate transport costs and reduce dependence on fossil fuel-based transport, thereby fostering economic empowerment and social inclusion of citizens. The main goal is to create a fairer and more resilient community, where all citizens have access to affordable and clean energy sources by increasing the use of renewable energy and enabling access to natural gas by using subsidies thus contributing to the overall socio-economic development and well-being.

Objective 2: Increased mobility and access to basic services – this objective focuses on improving mobility and access to basic services by implementing initiatives aimed at promoting sustainable transport options and improving infrastructure for pedestrians and cyclists. By providing free public transport services, along with the widening of sidewalks and bike lanes, the Municipality of Kumanovo aims to facilitate mobility for all residents, especially the socially vulnerable categories. By prioritising sustainable ways of transport, such as walking, cycling and public transport, the aim is to reduce traffic congestion, air pollution and greenhouse gas emissions, while promoting an active lifestyle and improving overall public health and well-being.

Additionally, by improving connectivity to basic services such as healthcare, education and employment centres, the Municipality of Kumanovo aims to foster social inclusion and increased economic opportunities for its citizens.

Actions aimed at energy poverty also reflect 5 of the 17 Global Sustainable Development Goals (SDGs), adopted by all members of the United Nations in 2015.

Table 3 Contribution of energy poverty reduction actions to the Global Sustainable Development Goals

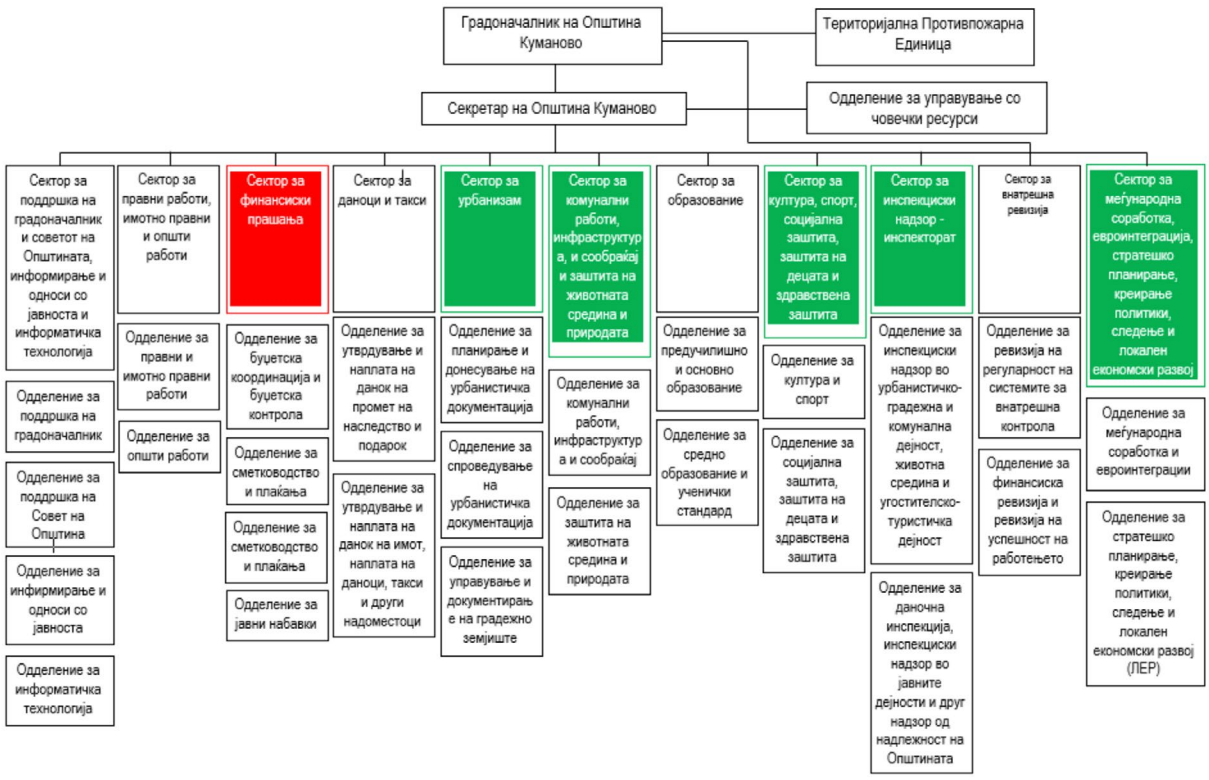
1 NO POVERTY	End poverty in all its forms everywhere
3 GOOD HEALTH AND WELL-BEING	Ensure healthy lives and promote well-being for all at all ages
7 AFFORDABLE AND CLEAN ENERGY	Ensure access to affordable, reliable, sustainable and modern energy for all
8 DECENT WORK AND ECONOMIC GROWTH	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
10 REDUCED INEQUALITIES	Reduce inequality within and among countries

1.3. Organisational structure of the Municipality of Kumanovo in view of the Action Plan

1.3.1. Organisational chart of the Municipality of Kumanovo

In order to have an active administrative body that will manage the processes of planning, decision-making, implementation, monitoring and reporting, the existing organisational chart of

Figure 1 Organisational chart of the Municipality of Kumanovo



It gives an insight into the sectoral or technical distribution of the staff at disposal to the Municipality of Kumanovo. According to the existing administrative distribution, intersectoral cooperation is extremely important for managing the processes covered by the Sustainable Energy and Climate Action Plan. For this purpose (in a green), the leading sectors that will ensure quality from a technical point of view have been highlighted. Additionally (in red), the sector that will ensure sustainable financial management of the envisaged plan has been highlighted. Naturally, the other sectors will also play a significant role in the processes of implementing the action plan.

These selected municipal bodies should lead to the establishment of an internal structure for managing the processes of the Sustainable Energy and Climate Action Plan.

1.3.2. Organisational chart of the Municipality of Kumanovo for the Action Plan implementation

The analysis of the organisational chart of the Municipality of Kumanovo first identified the sectors that are of vital importance for ensuring the technical quality of the processes related to the Sustainable Energy and Climate Action Plans. In that sense we should point out the following sectors:

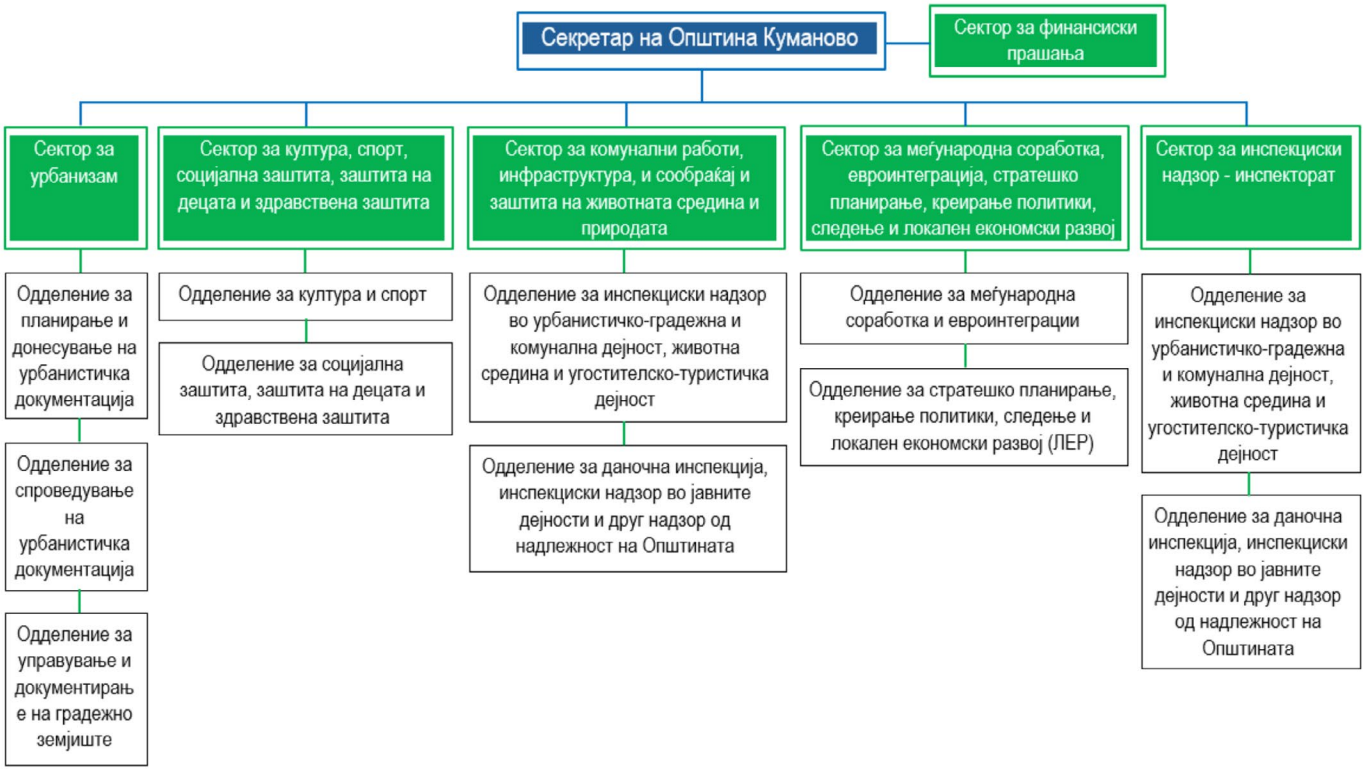
- Sector for International Cooperation, European Integration, Strategic Planning, Policy Making, Monitoring and Local Economic Development
- Sector for Communal Affairs, Infrastructure and Traffic and Environmental and Nature Protection
- Sector for Urban Planning
- Inspection Supervision Sector - Inspectorate
- Sector for Culture, Sports, Social Protection, Child Protection and Healthcare.

A special role in the overall planning, implementation and reporting process is expected to be taken by the Sector for International Cooperation, European Integration, Strategic Planning, Policy Making, Monitoring and Local Economic Development and the Sector for Communal Affairs, Infrastructure, and Traffic and Environmental and Nature Protection.

An additional significant role in the process of planning and implementing the Action Plan will be played by the Financial Affairs Sector, ensuring stronger financial management.

The remaining sectors are expected to join as needed, depending on the tasks that are of interest at a certain stage of the Action Plan, primarily in the process of its implementation.

Figure 2 **Organisational chart for the implementation of the Energy and Climate Action Plan**



Planning process

The sectors covering the field of strategic planning and environment are responsible for the technical part of the process of planning the objectives and actions.

The Sector for International Cooperation, European Integration, Strategic Planning, Policy Making, Monitoring and Local Economic Development, utilising the capacities of the two line departments and in close cooperation with the Sector for Communal Affairs, Infrastructure, Transport and Environmental and Nature Protection, will lead the technical team for planning actions within the framework of the Sustainable Energy and Climate Action Plan. In accordance with the level of technical details in the field of energy and climate, these two sectors should determine whether external resources (experts/consultants) would be needed in the planning process to provide additionally enhanced technical quality to the planned policies and measures (actions).

Appropriate financial management in the action planning processes is expected to be provided by the Financial Affairs Sector.

In order to ensure proper coordination of the processes, the political-operational coordination of the energy and climate action planning processes is taken by the Municipal Secretary. In their capacity as a coordinator, the Secretary will provide comprehensive technical and financial coordination by ensuring proactive cooperation of the five technical sectors and the financial sector as well as additional involvement of other sectors as needed.

The two leading sectors (the Sector for International Cooperation, European Integration, Strategic Planning, Policy Making, Monitoring and Local Economic Development and the Sector for Communal Affairs, Infrastructure, Traffic and Environmental and Nature Protection) provide the technical basis for developing the technical policies and measures, while the Municipal Secretary ensures political-operational correctness and harmonisation of the envisaged policies and measures, i.e. objectives and actions. Such close cooperation of the two sectors and their joint advocacy for the proposed policies and measures provide strong support and facilitate the decision-making process.

Decision-making process

The decision-making processes are led on an operational level by the Secretary of the Municipality of Kumanovo. In the process of advising the Mayor, the Secretary relies on the technical capacity of the Sector for International Cooperation, European Integration, Strategic Planning, Policy Making, Monitoring and Local Economic Development and the Sector for Communal Affairs, Infrastructure, Traffic and Environmental and Nature Protection.

In case of decisions that require adoption by the Council, the team additionally activates the essential participation of the Department Supporting the Council of the Municipality of Kumanovo i.e. the Sector for Support of the Mayor and the Municipal Council, Information Sharing and Public Relations and Information Technology.

At the end of the process, the mayor makes a decision that should either be implemented or submitted to the Council of the Municipality of Kumanovo for adoption before the proposed policies and measures are approved to be implemented.

Implementation process

The competences within the processes of implementation of the Sustainable Energy and Climate Action Plan comply with the structural distribution within the planning processes. The secretary of the municipality is responsible for the political coordination. The Sector for International Cooperation, European Integration, Strategic Planning, Policy Making, Monitoring and Local Economic Development and the Sector for Communal Affairs, Infrastructure, Transport and Environmental and Nature Protection are responsible for the technical implementation of the action plan.

In order to ensure a strongly coordinated implementation process, it is of utmost importance for these two sectors to have very close and proactive cooperation that will drive the entire system/team of the municipality in implementing the action plan. These two sectors have technical capacities that will ensure for the implementation of the actions to move in the direction envisaged by the Action Plan and the Vision of the Municipality of Kumanovo.

What is particularly important for this process is the integrated inclusion of the environment, economic development and social development's perspectives. In addition, the two competent sectors are responsible for the proactive involvement of public institutions, CSOs and the business sector.

Monitoring process

The monitoring process is assigned to two sectors. The Sector for International Cooperation, European Integration, Strategic Planning, Policy Making, Monitoring and Local Economic Development is responsible for the programme monitoring. The Financial Affairs Sector is responsible for financial monitoring.

In addition, the Internal Audit Sector plays the role of

internal corrector of the processes of implementation and re-planning while the Sector for Communal Affairs, Infrastructure, Transport and Environmental and Nature Protection is expected to provide technical support within the programme monitoring the Action Plam implementation. Programme monitoring is further supported by the Urban Planning Sector, Inspection Supervision Sector – Inspectorate, Sector for Culture, Sports, Social Protection, Child Protection and Health Protection and the Territorial Firefighting Unit of the Municipality of Kumanovo.

Financial monitoring refers to simple financial parameters that are further subject to technical analysis that ensures performance monitoring in regard to the vision and objectives set out in the Action Plan. The Sector for International Cooperation, European Integration, Strategic Planning, Policy Making, Monitoring and Local Economic Development is also responsible for that task.

Reporting process

The Secretary of the Municipality of Kumanovo is responsible for reporting. In order to ensure adequate reporting, this process is divided into two separate parts: a) technical reporting, responsibility of the Sector for International Cooperation, European Integration, Strategic Planning, Policy Making, Monitoring and Local Economic Development; and b) financial reporting, responsibility of the Financial Affairs Sector.

The financial reporting is again subject to review and approval by the sector responsible for technical reporting in order to synchronise the reports and appropriately lead to their consolidation into a single joint report, which is further subject to review by the Secretary of the Municipality before approval by the Mayor.

If there is a need for the public to be informed, the responsibility is assumed by the Sector for Support to the Mayor and the Municipal Council, Information and Public Relations and Information Technology. This sector channels all issues of a technical nature and consults the sectors responsible for strategic planning and environmental protection before responding. The Secretary and the Mayor are consulted for questions of a political nature. Additionally, this Sector is also responsible for informing the Council of the Municipality of Kumanovo if necessary.

Risks

Risk 1: Limited technical and financial capacities for drafting the first biennial report on the results from the implementation of the Action Plan.

Recommendation 1: To secure a commitment from GIZ for technical and financial support for the drafting of the first biennial report. If this support is not possible, the Municipality of Kumanovo should draft a list of potential partners for completing this task and to initiate a dialogue by starting a partnership for long-term cooperation in the area of planning, implementation and reporting related to the Action Plan. In the meantime, GIZ should help with the capacity building of the Municipality of Kumanovo for appropriate reporting.

Risk 2: Limited technical and financial capacities for the implementation of the planned actions with high financial implications.

Recommendation 2: Developing a concept for each of the envisaged actions with high financial implications and initiating a direct dialogue with donors with an appropriate portfolio in the country. Conducting studies that will provide a technical basis for dialogue with the donors that have been targeted. Securing support from the Ministry of Economy and the Ministry of Environment and Physical Planning to mobilise financial resources from the donor community.

Risk 3: Potential change in the priorities of the Municipality of Kumanovo in the field of energy and climate.

Recommendation 3: If the change occurs before 2027, it is recommended that the challenges be addressed within the framework of the biennial reporting process by revising the Sustainable Energy and Climate Action Plan. If the change in priority measures occurs after the completion of the two-year reporting process, it is recommended to proceed with a revision of the plan immediately after the new situation is identified.

The remaining identified risks are of a lesser importance and of a nature that should be defined and managed through the inter-sectoral working group technically led by the Environmental Protection Sector and politically and operationally supported by the International Cooperation Sector.

1.4. Methodology

1.4.1. Basic information for developing the Action Plan

The preparation of this Action Plan calls for two key commitments by the municipality and the state that stem from the European agenda for achieving climate neutrality and zero carbon emissions by 2050.

The first commitment is the decision of the Municipality of Kumanovo to accede to the Covenant of Mayors, which further led to the development of this Sustainable Energy and Climate Action Plan.

The second commitment is the one that the Republic of North Macedonia voluntarily undertook in regard to the newly promoted EU Regulation 2018/1999, which further resulted in the development of the National Energy and Climate Plan. Namely, in 2018, the new EU Regulation 2018/1999 on the Energy Community and Climate Action was announced, and it was adopted in 2019 as part of the Clean Energy for All Europeans package. This regulation required for all EU Member States to submit their draft National Energy and Climate Plans by the end of 2019. The Republic of North Macedonia recognised the importance of this process, clearly expressed its readiness and in record time managed to respond to the complexity of the process by developing its Energy and Climate Plan, thus being the first one among the Western Balkan countries.

Regulation 2018/1999 affects the national energy and climate plans which in turn further affect the municipal energy and climate plans recognised as active tools for the decentralisation of the European and national vision. It is this process that secured the interest of the Municipality of Kumanovo to engage in and support the processes guided by the Covenant of Mayors.

A special role in ensuring a smooth process of developing the Action Plan was played by the “Open Regional Fund of South-East Europe - Energy, Transport and Climate Protection” led by the German Agency for International Cooperation (GIZ) and financially supported by the German Federal Ministry for Economic Cooperation and Development (BMZ) and the European Union (EU).

Based on the interest of the Municipality of Kumanovo, GIZ helped Kumanovo to be part of the regional project aimed at developing Sustainable Energy and Climate Action Plans (SECAPs) in five countries.

The development of the Sustainable Energy and Climate Action Plan of the Municipality of Kumanovo was carried out in two phases. In the first phase, the project secured a team of experts who technically supported the compiling of the Baseline Inventory of the Municipality of Kumanovo and the completion of Risk and Vulnerability Assessment of the Municipality of Kumanovo. In this phase, apart from the public enterprises, the Municipality of Kumanovo also ensured the participation of local stakeholders, primarily representatives of the local CSOs and civic initiatives.

The second phase involved the development of the Action Plan. For this purpose, the consultancy company "IBF International Consulting" was selected, which, with a team of five experts, led the process of developing the Action Plan. In this phase, the proposed actions, the baseline inventory and the risk and vulnerability assessment were taken as already adopted positions based on which the medium-term energy and climate development framework of the Municipality of Kumanovo was to be developed. The IBF team provided an elaboration of the proposed actions and, in cooperation with the Municipality of Kumanovo, came up with an extended list of recommended key measures, from which the Municipality of Kumanovo selected the final ones that are clearly defined in the plan and which are to be entered into the software tool of the Covenant of Mayors, thus committing as a city to monitor and report on the selected key measures.

In this way, full ownership of the Municipality of Kumanovo is secured, which also confirms the clear long-term commitment to implementing the plan and achieving the goals that lead to creating conditions for achieving the envisaged low-carbon development in the long run.

1.4.2. Municipality of Kumanovo’s Methodology

The Covenant of Mayors for Climate and Energy is an extremely ambitious initiative to encourage commitments that include planning and implementing advanced energy and climate actions. To this end, with the technical support by the Joint Research Centre (JRC), a guidebook has been prepared that provides the recommended set of methodological principles, procedures and good practices for the development of top-quality Sustainable Energy and Climate Action Plans. It is the document titled "How to Develop a Sustainable Energy and Climate Action Plan".

In this way, the methodology had been established in advance and as such was implemented by the Municipality of Kumanovo and the German Agency for International Cooperation (GIZ).

In order to ensure the quality of the Baseline Emission Inventory (BEI) and the Risk and Vulnerability Assessment (RVA) of the Municipality of Kumanovo, a team of experts in specific fields worked with the Municipality of Kumanovo and all stakeholders. The results of the baseline scenario and the risk and vulnerability assessment led to the drafting

of a list of recommended actions for implementation in the period 2024-2030. These measures were also prioritised. The prioritisation process included both the priorities of the Municipality of Kumanovo and of the public. At the end of this process, there was a proposal of measures and their recommended prioritisation. These measures were subject to review, modelling and elaboration in the process of developing the Sustainable Energy and Climate Action Plan of the Municipality of Kumanovo. The full report on BEI and RVA is included in this document (Annex 3).

The methodological approach enabled the transition from doing the BEI and RVA to the development of the Action Plan by organising a two-day workshop at which the team responsible for developing the Sustainable Energy and Climate Action Plan had the opportunity to work with the technical team of the Municipality of Kumanovo and to provide information that defined the technical framework of the plan. The planned actions were reviewed and discussed at the workshop. In accordance with the needs for revision, they were redefined, confirmed and then prioritised, resulting in an expanded list of priority measures at the end of the workshop, which the Municipality of Berovo committed to further review in a broader composition and from the expanded list of 5-7 separate mitigation and adaptation actions to make the final short list of key actions.

In order for decision-makers to have a clearer idea when choosing key objectives, the team of experts responsible for developing the plan elaborated on the expected benefits of each individual action, as well as the financial implications both in terms of investment and future savings. In this way, the Municipality of Kumanovo had a clear picture of the possibilities thus having the internal discussions resulting in a list of key measures that are elaborated in Chapter 4.

In order to ensure alignment and further improvement of the current energy and climate development framework, the findings from the documents listed in the References were reviewed and addressed in detail.

The quality of the document has been ensured by the team of international experts, the technical team of the Municipality of Kumanovo and the internal resources of the "Open Regional Fund of South-East Europe for Energy, Transport and Climate Protection".

Methodology used for each chapter

The Energy and Climate Action Plan follows the Guidebook “How to Develop a Sustainable Energy and Climate Action Plan” under the Covenant of Mayors with technical support from the Joint Research Centre (JRC). The Guidebook provides clear recommendations regarding the chapters that should be covered in the Action Plan.

- Strategy
- Baseline Greenhouse Gas Emissions Inventory
- Risk and Vulnerability Assessment
- Mitigation Actions
- Adaptation Actions
- Energy Poverty Actions
- Actions Impact

Each of the chapters was subject to a in detailed defined approach in order to get key information from each process that would lead to increasing the quality of the plan.

The Strategy provides within its framework the Vision 2030 of the Municipality of Kumanovo in terms of energy and climate. In order to make the vision sustainable, the Municipality of Kumanovo decided to have it also as a long-term vision for 2050, from which a cross-section was done for the year 2030 in accordance with the time scope of this document that provides the Energy and Climate Vision for the year 2030.

The Strategy also provides a brief overview of the goals and commitments of the Municipality of Kumanovo in terms of mitigation and adaptation. The goals and commitments are on the one hand derived from the 2030 Energy and Climate Vision, but on the other hand are a clearly defined reflection of the line programmes developed by the Municipality of Kumanovo, which in turn arise from the citizens’ needs. In this way, the Municipality of Kumanovo has ensured that the actions and the objectives follow a synchronised “bottom-up” approach with a clear contribution to achieving the city’s 2030 target.

Within the framework of the strategy, efforts are also being made to address the challenges of energy poverty, which is in line with the findings that this area will soon be part of the list of mandatory chapters. Energy poverty is an area of particular interest to the Municipality of Kumanovo because it largely focuses on addressing and overcoming the challenges faced by vulnerable categories of citizens, especially those facing a high level of socio-economic risk.

Furthermore, the strategy chapter provides a brief overview of the administrative structure that is part of the planning and is intended to be part of the monitoring, evaluation and reporting process. The methodology used to set up the framework for managing the processes envisaged by the Action Plan is based on identifying the necessary and available technical capacity and committing the necessary political-operational capacity that will support the plan’s development and implementation. In this way, two working

groups were formed, whose close cooperation is monitored and led by the Sector for Support of the Mayor and the Secretary of the Municipality of Kumanovo.

According to the Covenant of Mayors Guidebook, the financial perspective is also an integral part of the strategy chapter. In this section, the Covenant's guidelines and the list of recommendations were reviewed in detail. The software tool attached to the Covenant's e-platform served as the basis for discussions with the Municipality of Kumanovo in terms of identifying potential sources of funding and financial planning. The cooperation so far with the donor community has been the basis for mapping entities for financial support and to which the remaining potential sources of funding are added.

The Baseline Greenhouse Gas Emission Inventory and the Risk and Vulnerability Assessment of the Municipality of Kumanovo represent a mandatory chapter for building the technical framework of the Sustainable Energy and Climate Action Plan. Following the guidelines from the Guidebook "How to Develop a Sustainable Energy and Climate Action Plan" in making the inventory, a comprehensive approach was applied in order to incorporate all 3 main types of greenhouse gas emissions.

a) direct emissions from final energy consumption;

b) indirect emissions related to grid-supplied energy (electricity, heat) consumed on the local territory; and

c) direct non-energy-related emissions occurring on the local territory.

This inventory includes greenhouse gas emissions (CO2, CH4 and N2O) for the sectors: a) stationary energy; b) transport; c) industrial processes; d) waste; and e) agriculture, forestry and other land use.

The Greenhouse Gas Emission Inventory of the Municipality of Kumanovo is done in accordance with the guidelines and methodologies prescribed in the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) also defined as the Standard for Calculating and Reporting at local level, which is in line with the methodology for national inventories of the Intergovernmental Panel on Climate Change. Additionally, the emission categories are adjusted to match the sectors categorisation according to the Covenant of Mayors in order to be applicable for the Covenant's reporting method.

The reference for the preparation of this document is the 2019 inventory, which has reliable data that could be used as the baseline for energy and climate policies and actions. It should be noted that the recommendation of the Covenant of Mayors is to choose a reference year between 1990 and 2005. However, this approach does not correspond to the expectations of the Municipality of Kumanovo, because the municipality does not have an inventory from that period. Therefore, the Municipality of Kumanovo refers to the additional recommendation given in the Covenant of Mayors, which states that the parties to this Covenant that do not have an inventory for one of the years in the period 1990-2005, are free to choose a reference year in line with the complexity of the set of available data. Hence, the availability of reliable and comprehensive data that enable top quality modelling and definition of short-term and long-term objectives for the planned reduction of greenhouse gas emissions was reviewed. Thus, the year 2019 was chosen since there is an inventory of a high volume and quality of data available for that year. The Municipality of Kumanovo commits to using the selected reference year for all subsequent processes of developing Sustainable Energy and Climate Action Plans, which will ensure continuity in planning, modelling and defining goals, as well as quality in presenting the progress of the Municipality of Kumanovo in implementing the vision for reducing greenhouse gas emissions.

The Municipality of Kumanovo applied the "action-based approach" when making the inventory, which is used in national reporting within the UNFCCC framework and is also compatible with the binding EU legislation on climate and energy. This approach is also recommended by the Covenant of Mayors when developing the Sustainable Energy and Climate Action Plan.

The plan then goes into its technical part, in which it lists the mitigation, adaptation and energy poverty actions and tries to elaborate them in order to ensure an appropriate approach in their design and future implementation.

Firstly, an overview of the mitigation actions is given. For this purpose, a methodology is provided that incorporates elaboration of the following fields of interest: a) Action description, b) Implementation timeframe, c) Responsible authority, d) Cost estimate (Investment and current costs), e) Estimated impact and f) Monitoring indicators. In terms of the estimated impact, the estimated energy savings, the increased production of renewable energy per target year and the estimated reduction of greenhouse gases per target year are included. In addition, the actions are divided into 4 areas: a) Buildings, equipment/facilities and industries, b) Transport, c) Waste and d) Other areas.

The adaptation actions follow the approach of the mitigation actions, and the actions are focused on the following priority areas: a) wildfires, b) floods, and c) other areas - energy.

Energy poverty is incorporated in the mitigation and adaptation actions. However, the recognised importance of this area has led to the need for energy poverty to be given a separate chapter.

Finally, the Action Plan provides numerical conclusions on the impact of the planned actions presented as energy saving targets, renewable energy's share, CO_2 emission reduction and the total expected reduction of greenhouse gas emissions. This also enables a comparison of the

1.5. Legal framework relevant for the Sustainable Energy and Climate Action Plan

EU Acquis

The advanced European "Covenant of Mayors" initiative was presented in 2008 by the European Commission and the Committee of the Regions resulting from the efforts elaborated in the "EU Climate and Energy Package" in 2007. The aim of this initiative was to support local governments in promoting advanced development policies and actions for sustainable energy with a view to building a low-carbon society. The parties to this Covenant have an obligation to prepare a Sustainable Energy Action Plan, to monitor it and to report on the results.

In parallel to this initiative, the European Commission, through the Climate Change Adaptation Strategy, presented in 2014 a separate initiative "Mayors Adapt". Using the same approach, this initiative calls on mayors to demonstrate leadership in adapting to climate change at the local level by preparing and implementing a local climate change adaptation strategy.

In October 2015, the "Covenant of Mayors" and "Mayors Adapt" initiatives were merged into a complex framework called the "Covenant of Mayors for Climate and Energy" with defined targets for 2030. The development framework is presented in three main areas: a) mitigation, b) adaptation, and c) reliable, sustainable and affordable energy.

This new framework creates conditions for a common vision of the parties aimed at decarbonised cities, resilient to climate change in which citizens have unhindered access to reliable, sustainable and affordable energy.

EU Regulation 2018/1999 of December 2018 provides the necessary legal basis for credible, inclusive, financially justified, transparent and proactive governance of the Energy Union and Climate Action, which as a programme mechanism ensures setting and achieving the 2030 targets and the long-term goals set by the 2015 Paris Agreement.

This regulation imposes an obligation for the EU member states to prepare and implement an integrated National Energy and Climate Plan. In this way, the European Commission synchronises initiatives at national and local level by securing a commitment at both national and local level for integrated planning and implementation of energy and climate programmes.

Our country is not obliged to develop a National Energy and Climate Plan. The Municipality of Kumanovo is also not obliged to develop a Sustainable Energy and Climate Action Plan. However, the Republic of North Macedonia and the Municipality of Kumanovo voluntarily committed to developing these complex plans and thus not only confirmed the importance and need for drafting the documents but also confirmed the strategic commitment to contribute to the EU's efforts to transition to low-carbon development and move closer to the long-term vision of climate neutrality.

National legal framework

The EU energy and climate policies in the context of the Republic of North Macedonia are transposed in the Law on Climate Action, which in its draft version in its Article 14 provides for two "basic strategic and planning documents":

1. Long-term climate action strategy, and
2. National energy and climate plan.

The law does not provide for the national obligation to create an integrated strategic energy and climate framework that would be further transferred as an obligation to local self-government units.

The National Energy and Climate Plan does not give recommendations for the development of local energy and climate plans. The Long-term Climate Action Strategy also does not give guidelines for the development of local energy and climate plans.

Local legal framework

The local legal framework in the country does not provide for any obligation or guidelines concerning the development of the Sustainable Energy and Climate Action Plan.

The Municipality of Kumanovo recognising the importance of this document, voluntarily joined the European initiative for developing local energy and climate development policies, which in turn contribute substantially to the implementation of national and EU energy and climate policies.

1.6. Stakeholders' inclusion

The Municipality of Kumanovo strives to involve all the stakeholders in the processes of planning and implementing the municipal development policies and measures. Particular attention is paid to the inclusive approach in processes focused on environmental actions, including energy and climate.

The stakeholders were particularly involved in compiling

the Baseline Greenhouse Gas Inventory and doing the Risk and Vulnerability Assessment of the Municipality of Kumanovo. This process also listed the actions that should be the subject of this document. Additionally, the stakeholders also participated in the process of prioritising the planned actions.

In the context of the Sustainable Energy and Climate Action Plan development, the stakeholders' group consisted of representatives of public institutions, CSOs, civic initiatives and local businesses. There was a particularly significant participation by CSOs that have knowledge and information in the field of energy and climate, thus ensuring active participation with progressive ideas.

The stakeholders in the process of developing the Sustainable Energy and Climate Action Plan have been recognised as an extremely important capacity that should play a significant role in the process of implementing the plan. For this reason, the Municipality of Kumanovo will continue maintaining and developing the cooperation in order to ensure conditions for an inclusive approach to the implementation of the plan.

1.7. Monitoring and evaluation processes

Monitoring is a key element in the process of implementing the Sustainable Energy and Climate Action Plan. Regular monitoring followed by adequate adjustment of the Plan allows for the initiation of continuous improvement of the actions and objectives set therein.

According to the "Covenant of Mayors" initiative, the parties to the Covenant are obliged to submit a Monitoring Report every second year after the submission of the Plan, for the purpose of evaluation, monitoring and verification of the objectives. Such a report should contain an updated Greenhouse Gas Inventory in accordance with the monitoring (MEI – Monitoring Emission Inventory), prepared based on the same methodology and input data as the Baseline Greenhouse Gas Inventory in order to enable comparison and reconciliation.

In case of insufficient human and financial resources for the preparation of an updated inventory, local authorities may submit only an "Actions Report" every second year, while a "Complete Report" should be submitted every fourth year, which, in addition to reporting on the actions, would also contain the updated Greenhouse Gas Inventory.

The "Action Report" generally presents a qualitative description of the Plan's implementation, stating information related to the barriers arising from the implementation of the Plan, the status of each of the actions included in the Plan, etc. On the other hand, the "Complete Report", with the updated inventory, provides a complete quantitative picture of the evolution of energy consumption and production and has the greenhouse gas emissions compared to the baseline inventory. In this way, a deeper understanding of the results from the implemented actions is provided and allows definition of corrective and preventive measures if necessary.

The Municipality of Kumanovo has also included adaptation actions in its Plan, the implementation of which will also be subject to monitoring and evaluation. Namely, every second year, the "Action Report" will include information on the results from the adaptation measures implementation with an overview of current/future climate risks as well as possible corrective measures in relation to the set goals.

The monitoring reports need to be reviewed by all departments of the Municipality of Kumanovo in order to review the objectives and actions prescribed by the Plan, taking into account new technological and financial opportunities, as well as new available knowledge and expertise. The Action Plan is a document that evolves and changes in accordance with the circumstances and therefore needs to be periodically adjusted and effectively improved.

Additionally, the implementation monitoring reports will be translated into Macedonian and made public in order to ensure transparency and accountability. In this way, the municipality will strengthen its communication with the citizens and stakeholders, informing them about the progress achieved, barriers encountered, new opportunities, as well as the possible need for corrective measures.

1.8. Financial perspective

The following tables present the total budget for implementation of the Sustainable Energy and Climate Action Plan. The financial analysis takes into account the following elements:

It does not include operational and maintenance costs

The municipality seeks to obtain additional financial support through non-repayable sources (grants) from both donors (bilateral and multilateral) and the central government. For now, most of this value is included in the local government's own resources, but it can be transferred over time, and it could have a clearer specification of possible sources of financing.

Part of the required investment is listed under "Not allocated to any source" because the activities are not planned to be implemented from the municipality's own

funds, but no financing has been secured for them.

In the case of a loan from a commercial or development bank, the financial resources are presented as Local Government's Own Resources.

The total estimated capital expenditure (CAPEX) / investment (including analyses and studies) identified for the implementation of the SECAP over the next 6 years totals 121.44 million EUR – part of which would be financed by the municipality or public enterprises owned by the municipality.

1.9. Municipality of Kumanovo's Vision

1.9.1. Adaptation measures assessment

The assessment of climate change adaptation options in the Municipality of Kumanovo was conducted based on public consultations with a wide range of stakeholders.

The main objective of the consultation process was to discuss local issues and priorities related to climate change adaptation and mitigation, to check whether the pre-selected measures for climate change adaptation and mitigation can be useful and applicable for the selected municipalities, to define inclusively new measures and to prioritise and assess the defined measures for climate adaptation and mitigation. The pre-defined measures were submitted to the public in order to get their opinion on what should be prioritised, and which measures can be easily implemented.

Several consultations were organised within the framework of the consultation process, and the process was expanded to include the broader public.

The measures were pre-defined based on a comprehensive climate change risks and vulnerabilities assessment in the following sectors: water, agriculture, forestry, health and the economic sector. Based on the risks and vulnerability and exposure level, each of the sector experts defined measures to address the risk and the prevention potential in the future.

Table 4 **Total budget for implementation of the Sustainable Energy and Climate Action Plan**

Element	Investment
Total Budget (EUR)	177.3
Mitigation (%)	66%
Adaptation (%)	31%
Energy poverty (%)	3%
Sources of financing	Share in the total financing (%)
Local government's own resources	7%
External sources of funding	50%
Not determined	43%

The previously defined measures were submitted to relevant stakeholders in the Municipality of Kumanovo, such as the sectors for local economic development, energy efficiency, urban planning, as well as representatives from the Public Enterprise “Javna Higiena” (Public Hygiene), the firefighting unit, civil society organisations, etc.

The first consultative event was held in May 2023 in Dojran, together with experts and working groups from each municipality that were responsible for the development of the SECAP. The event was organised as a workshop where the working groups had the opportunity to discuss and decide on the priority measures for each sector and which measures can be implemented and are important for each department of the local government.

The prioritisation of measures was conducted within the framework of the prioritisation exercise based on the following parameters: costs for each measure/action, population exposure or how many people live in the area, local authority responsibilities (responsibility for implementation), implementation deadline, required budget, hazards’ impact and number of warnings for the specific measure.

After the workshop and prioritisation of adaptation and mitigation measures, another workshop was organised at the end of 2023 in Kumanovo, which engaged broader stakeholder groups (national authorities, agencies, public enterprises, civil society organisations) in terms of priority sectors and activities for climate change mitigation and adaptation.

Below is a list of stakeholders who were part of the workshop for prioritising measures.

Representatives from the Municipality of Kumanovo, part of the SECAP working group

Representatives from other sectors in the Municipality of Kumanovo

Civil Society Organisations

Private companies

Public Utility Company

Firefighting Unit - Kumanovo (TFFU)

During this workshop, a prioritisation of the measures that were of the highest priority for the representatives of the municipality was conducted, i.e. the measures that received more than 12 points at the first workshop. Participants representing the broader group of stakeholders had the opportunity to prioritise the measures together using a scale of 1-10, where 1 was the least priority and 10 the highest priority.

In parallel with the organisation of the workshops, questionnaires were distributed to potential respondents to engage the broader public in prioritising climate change mitigation and adaptation measures. The prioritisation was conducted based on the measures that got top scores, i.e. more than 12 points at the first workshop for prioritising measures. Using a Google form questionnaire, the public had the opportunity to prioritise the measures using the scaling method (1 being the lowest on the scale and 5 being the highest) on a multiple-choice grid.

Below is the prioritisation of adaptation measures made by representatives of the Municipality of Kumanovo and defined in the document "Baseline Greenhouse Gas Inventory and Risk and Vulnerability Assessment of the Municipality of Kumanovo".

At the First Workshop on the Development of a Sustainable Energy and Climate Action Plan, held in Mavrovo on 21-22 December 2023, the representatives of the municipality, based on their vision and defined adaptation objectives, and the implementation capacity, established priority actions that they consider should be part of the Sustainable Energy and Climate Action Plan.

The methodology for conducting the technical discussion on mitigation, adaptation and energy poverty was: a) to identify the options that are included in the list, but should not be part of the action plan; b) to identify possible activities that are important to be integrated into the final SECAP, but are not proposed in the draft list of options; c) to identify options that need to be re-phased or reformulated by merging multiple options into one or dividing more complex and/or irrationally merged options; and d) to determine priority actions for adaptation, mitigation and energy poverty.

The identified priority measures for climate change adaptation are presented in the following table.

Table 5 **Adaptation measures prioritisation results**

Adaptation measures
Risks communication – advice for the population (vulnerable groups)
Climate change adaptation action plan.
Training and education of the general population on risk recognition and prevention (especially of vulnerable groups)
Needs assessment and investment in healthcare institutions' capacities and human resources (hospitals) to deal with climate extremes.
Enhanced air, drinking water and food quality monitoring
Early warning system for climate change extremes risks (heat/cold waves, droughts, floods, fires, vector-borne diseases, etc.)
Intersectoral information system for collecting and processing health and non-health climate change related risk indicators
Developing tourism adaptation plans
Sustainable tourism promotion
Strengthening the capacity of the fire department
Improved water supply management
Cooperation and networking with the private sector
Investments in infrastructure for protection against damages from extreme weather events (dams, embankments, etc.).
Implementation of green infrastructure (green roofs, urban forests and rain gardens, etc.).
Improving the preparedness for dealing with risks and disasters
Promotion of green energy production opportunities
Incorporation of risk zones in existing planning documents (urban plans).
Risk mapping - Floods and flash floods (in accordance with the Law on Waters, Protection from harmful effects of waters)
Definition of fire hazard areas
Defining erosion prone areas and areas under threat of erosion
Procurement of proper vehicles and equipment for preventing and suppressing wildfires (early response / initial attack)
National strategy for preventing illegal logging and monitoring the loss of forest cover from illegal logging
Development of a comprehensive programme for forestry adaptation to climate change
Continued oversight of soil fertility and development of plant nutrition and fertilisation programmes
Establishment of a centre for training and support of knowledge transfer programmes in the field of agriculture
Setting up a network of agrometeorological stations
Measures for integrated plants protection
Long-term campaign to raise awareness of the impact of climate change on agriculture
Measures to protect the soil and preserve its fertility
Establishment of climate related services (forecasting frost, dry periods, summer waves, etc.)
Establishing a Technology Transfer Centre.
Digitalisation and application of smart agriculture in practice
Storm sewar with a capacity adjusted to the number of citizens
Greater involvement of the civil sector in the fight against climate change (establishing volunteer committees for responding to natural disasters and catastrophes)
Regular cleaning of the canal network
Regular monitoring of riverbeds to detect critical floods
Reducing losses from water supply systems
Development of river basin management plans
Measures to raise awareness among citizens (organising consultations, symposiums, workshops) and change habits for waste management and waste disposal in rivers and regular monitoring of hydro and meteorological alarms
Strengthening the hydrometeorological monitoring
Analysis of the dimensioning of bridge structures which pillars can be critical points
Expansion of green areas, actions for afforestation of erosion prone areas

Table 6 **Priority measures for climate change adaptation**

Measure	Commitment
Integration of climate change in urban planning	Focusing on adaptation, with an impact on mitigation
Procurement of vehicles and equipment for urban, rural and wildfires coping and management	Focusing on adaptation, with an impact on mitigation
Conducting a study for improving the hydrotechnical infrastructure	Focusing on adaptation
Development and maintenance of storm sewar	Focusing on adaptation
Expanding the gas network	Focusing on adaptation, with an impact on mitigation
Promotion of green energy use opportunities	Focusing on adaptation, with an impact on mitigation
Waste management programme	Focusing on adaptation

1.9.2. Strategy in case of extreme weather events

The Municipality of Kumanovo in its structure has a Territorial Firefighting Unit, TFFU Kumanovo, which primary purpose is protection and rescue, crisis management, defence and firefighting in accordance with the laws and it coordinates its work with other sectors within the municipal administration and other state institutions for that purpose.

TFFU Kumanovo, within its jurisdiction, performs the following tasks:

- Extinguishing fires and saving the lives of people and material goods threatened by fire or other types of disasters and accidents.
- Conducting technical interventions and training firefighters for that purpose, namely: rescue from heights, depths, draining water from flooded buildings, as well as rescuing people from crashed vehicles in traffic accidents.
- Professional training and advanced training of firefighters is carried out in accordance with the Rulebook on professional training and advanced training of firefighters.
- Testing of FF equipment in accordance with the Rulebook on TFFU and FFU uniforms, insignia and protective equipment requirements, Article 12 and the Guidelines for the periodic testing and checking whether the TFFU's FF equipment is functioning properly.
- Keeping the prescribed records in regard to the work of the unit such as: fire reports, registers, fire and technical intervention records, information about fires, analyses, inspection reports, etc.
- Preventive activities are carried out in cooperation with the fire protection inspector from the Protection and Rescue Directorate during harvest activities as well as appealing to citizens not to burn stubble before and during the summer season.
- TFFU's equipping is carried out in compliance with the Programme, i.e. the requirements for equipping TFFUs submitted to the Protection and Rescue Directorate and the Municipality of Kumanovo.
- The cooperation with Municipal Firefighting Union and Volunteer Fire Association consists of lectures and exercises with members of VFA and FF municipal primary and secondary schools' organisations.
- The cooperation with companies that manage forests, agricultural land, the water supply network, electricity, etc. consists of the following: with PE Macedonian Forests, Kumanovo Branch in terms of implementing the Operational Plan for Fire Protection and Extinguishing Fires in Forests and Other Open Spaces; with PE Vodovod in terms of maintaining and oversight of the proper functioning of underground street hydrants and appropriate incorporation in the municipality's blueprint; with EVN-ESM, Kumanovo Branch Office in terms of faster reaching of the locations on fire and timely disconnection of the building from electricity supply.

- Visit to the Skopje International Airport, only by the squads' commanders, during which access roads, entrances, hydrant network layout are registered, as well as detailed familiarisation with their protection and rescue plan, which is also covered by TFFU Kumanovo.
- Inspection of TFFU members is carried out in accordance with Article 6 of the Rulebook on the manner of operation, the minimum technical equipment and fire extinguishing means of TFFU and FFU.
- Drafting internal instructions: house rules, instructions for the liaison officer on duty and the person on duty at the facility, etc.
- Making a catalogue of buildings, streets and of the hydrant network.
- Servicing of fire extinguishers and other equipment by Preventiva 2018 Service Company because the unit does not have its own repair shop.
- TFFU inspection by the TFFU Commander at least four times a month outside the commander's working hours, two during the day and two at night after 23:00 hours and they have to be recorded.
- Updating the plan for mobilisation of off-duty unit members in case of a fire or training activities.
- Providing professional assistance to citizens, companies and other legal entities if such assistance is requested.
- Compiling inventory of available firefighting equipment from neighbouring municipalities that could be engaged in extinguishing large fires.
- Meetings with commanders from neighbouring municipalities are held at one of the TFFUs' offices before and after the end of the summer season to plan possible joint operations in extinguishing fires in open spaces, since such operations are possible and have been conducted before, as well as to discuss other issues.
- Preparing an annual report on the work of the unit after the end of the year, one copy of which will be submitted to the Municipality of Kumanovo and one to the TFFU's archive.
- Other planned activities are aimed at fire protection of areas for which the TFFU is responsible, if needed in the course of the year.

There is also a Regional Crisis Management Centre operating on the territory of the Municipality of Kumanovo. The Crisis Management Centre, as well as the Steering Committee and the Assessment Group, were established to propose decisions and ensure constant consultations, coordination, timely response, efficiency and appropriate use of resources available in the event of a crisis, and to ensure reliable, timely and realistic risk and threat assessment of the Republic of North Macedonia.

A total of 35 centres operate in the country: 34 regional crisis management centres with headquarters in certain municipalities and one Crisis Management Centre in Kumanovo. The responsibilities in the regions where they are located are to inform, monitor the situation and exchange data and information. Their job is also to provide proposals for crisis management and to prepare an assessment. Regional headquarters are established there, and the Crisis Management Centre establishes Main Headquarters, headed by the Director of the Centre, as an operational professional body, which manages the activities for crisis prevention and management. The dispersion of regional responsibilities, more precisely of the municipal ones, means creating conditions for everyone to plan and be trained to deal with a crisis. When the crisis exceeds the capabilities of the municipality, then the action is profiled at another level i.e. the way of dealing with the crisis, first at the inter-municipal level (neighbouring municipalities), and then at the state level, through coordinated action with the resources available to the state.

1.9.3. Assessing the energy poverty related options

At the First Workshop for the Sustainable Energy and Climate Action Plan Development, held in Mavrovo on 21-22 December 2023, the representatives of the municipality, based on their vision and defined energy poverty related objectives, defined priority actions that they had considered should be part of the Sustainable Energy and Climate Action Plan.

The methodology for conducting the technical discussion on mitigation, adaptation and energy poverty was: a) to identify the options that are included in the list, but should not be part of the action plan; b) to identify possible activities that are important to be integrated into the final SECAP, but are not proposed in the draft list of options; c) to identify options that need to be re-phased or reformulated by merging multiple options into one or dividing more complex and/or irrationally merged options; and d) to determine priority actions for adaptation,

Table 7 **Energy Poverty Reduction Measures**

Measure	Commitment
Introducing free transport	Focusing on energy poverty with an impact on mediation
Improving the urban mobility	Focusing on mediation, with an impact on energy poverty
Implementing the programme for annual cleaning of chimneys	Focusing on mediation, with an impact on energy poverty
Efficient heating and cooling with heat pumps in households	Focusing on mediation, with an impact on energy poverty

2

BASELINE EMISSIONS INVENTORY

The methodology for the Baseline Greenhouse Gas Inventory development follows the instructions given in the Covenant of Mayors guidebook titled “How to Develop a Sustainable Energy and Climate Action Plan” prepared by the Joint Climate Research Centre (JRC).

Scope and incorporated greenhouse gases

In the development of the inventory a comprehensive approach was used to include all 3 main types of greenhouse gas emissions:

a) direct emissions from final energy consumption;

b) indirect emissions related to grid-supplied energy (electricity, heat) consumed on the local territory;

c) direct non-energy-related emissions occurring on the local territory.

This inventory includes the greenhouse gas emissions (CO_2, CH_4 and N_2O) in the following sectors:

a) stationary energy;

b) transport;

c) industrial processes;

d) waste; and

e) agriculture, forestry and other land use.

Applied methodology

The Greenhouse Gas Emission Inventory of the Municipality of Kumanovo is done in accordance with the guidelines and methodologies prescribed in the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC), also defined as the Standard for Calculating and Reporting at a local level, which is in line with the methodology for national inventories of the Intergovernmental Panel on Climate Change. Additionally, the emission categories are adjusted to match the sectors categorisation of the Covenant of Mayors in order to be applicable for the Covenant’s reporting method.

Reference year

The reference year is the year taken as the baseline year against which emission reduction targets are compared. The recommendation of the Covenant of Mayors is to choose a reference year between 1990 and 2005. However, this approach does not correspond to the expectations of the Municipality of Kumanovo, because the municipality does not have an inventory from that period.

Therefore, the Municipality of Kumanovo refers to the additional recommendation given in the Covenant of Mayors, which states that the parties to this Covenant that do not have an inventory for one of the years in the period 1990-2005, are free to choose a reference year in line with the complexity of the set of available data. Hence, the availability of reliable and comprehensive data that enable top quality modelling and definition of short-term and long-term objectives for the planned reduction of greenhouse gas emissions was reviewed.

Within the framework of technical discussions led by the municipality, it was decided to choose 2019 as the reference year. One of the most important reasons for choosing 2019 as the reference year is the quality and quantity of data contained in the 2019 Inventory of the Municipality of Kumanovo. It is important to note that the compiling of this inventory was followed by a process of additional updating of the 2019 inventory, which further strengthened the quality of the data.

The Municipality of Kumanovo commits to using the selected reference year for all subsequent processes of developing Sustainable Energy and Climate Action Plans, which will ensure continuity in planning, modelling and defining goals, as well as quality in presenting the progress of the Municipality in achieving the vision for reducing greenhouse gas emissions.

Approach in compiling the emissions inventory

The Municipality of Kumanovo applied the "action-based approach" when compiling the inventory, which is used in the national reporting within the UNFCCC framework and is also compatible with the binding EU legislation on climate and energy. This methodology is used, and it is recommended by the Covenant of Mayors for the development of the Sustainable Energy and Climate Action Plan.

Emission factors

For direct emissions, the standard emission factors from the 2006 IPCC Guidelines were used.

For the indirect emissions, grid-supplied energy greenhouse gas emissions, the emission factor was calculated based on the fuel mix used for generating electricity in the given year. Emissions from transmission and distribution losses of grid-supplied electricity were also calculated. The primary data source for these calculations was the 2019 Annual Energy Balance published by the State Statistical Office (SSO) and the Energy, Water Services and Municipal Waste Management Services Regulatory Commission (ERC).

Table 8 Grid emission factors in 2019

	tCO_2 /MWh	tCH_4 /MWh	tN_2O/MWh	tCO_2 -eq/MWh	T*	Д**	Т&Д
Electricity	0.861	0,000009	0,000011	0,865	13,40%	1,20%	14,60%

*T=Transmission; **D= Distribution

Sectors of activity

The inventory is compiled based on the final energy consumption and emission factors for all emission sources (direct and indirect and non-energy related) by sector and energy carrier. The classification of sub-sectors is based on the competence of the different actors (municipal/ public and private), and it is not recommended to include greenhouse gas emissions generated by large industrial plants (covered by cap-and-trade schemes or similar).

Based on these principles, the local government reports on greenhouse gas emissions from the three main macro-sectors, namely buildings/stationary energy, transport and other non-energy sectors that contribute to the balance of total emissions, while the energy supply macro-sector is calculated based on the local emission factor for indirect emissions.

Guided by the above, the Municipality of Kumanovo, when compiling the inventory, included the following sectors: stationary energy, transport, industrial processes, waste, as well as agriculture, forestry and other land use.

Greenhouse Gas Inventory of the Municipality of Kumanovo

The stakeholders involved in the plan development agreed that the inventory compiled for 2019 was of adequate quality to ensure the quality of the necessary reference information. This inventory is also recommended for the preparation of other relevant programme documents such as energy efficiency programmes.

Hence, the updated inventory for 2019 is the baseline for compiling the baseline inventory in the context of the Sustainable Energy and Climate Action Plan, which is essentially presented later in the text. The detailed inventory is presented in Annex 2 of this document, while in Annex 3 of this document you can find the detailed "Baseline Greenhouse Gas Inventory and Risk and Vulnerability Assessment of the Municipality of Kumanovo", which present the methodology for compiling the inventory and the approach in the risk and vulnerability assessment of the municipality of Kumanovo. The agriculture, forestry and land use sector is the most dominant sector in the total inventory and has a share of ~85% in total greenhouse gas emissions in 2019.

Table 9 Baseline Greenhouse Gas Emissions Inventory 2019 (kt)

Sectors	CO_2	CH_4	N_2O	CO_2eq
Stationary energy	313.43	0.65	0.01	331.48
Transport	197.59	0.03	0.01	201.15
Waste	0.00	1.61	0.00	41.26
Industrial processes	0.00	0.00	0.00	0.00
AFOLU*	2,574.15	12.66	0.81	3,132.20
Total greenhouse gas emissions of the Municipality of Kumanovo	3,085.2	14.9	0.8	3,706.1

*AFOLU – Agriculture, forestry and other land use

The following three categories have been identified as key sources or largest emitters of greenhouse gases:

- Land-based emissions on the territory of the municipality
- Residential buildings
- Road transport

The most dominant gas in the Greenhouse Gas Inventory of the municipality of Kumanovo is CO2, with a share of 83% in the total emissions, while CH4 and N2O emissions have a share of about 10% and 7%, respectively.

Additionally, when analysing pollutants in the municipality, the "Plan for Improving Ambient Air Quality for the Municipality of Kumanovo 2022-2026" was also taken into account, which, although applied different methodological baseline and considered a wide range of pollutants, is still relevant for the analysis of the Baseline Emission Inventory in the Municipality of Kumanovo. According to this plan, the percentual share of the sectors in the pollutants emissions in the air in the Municipality of Kumanovo is shown in the following chart.

Based on the above, it can be concluded that in the Municipality of Kumanovo the critical emission sectors are the households, transport and agriculture, more specifically:

- The residential sources sector (households) has the largest share in CO, NMVOC, PM2.5, PM10, TSP emissions and a significant share in SOx emissions;
- The largest share in NOx emissions comes from the transport sector, which also has a significant share in CO, NMVOC and PM2.5 emissions.
- The largest share in NH3 emissions comes from agriculture, and
- The manufacturing industries have the largest share in SOx emissions, in which the household sector also has a significant share.

Figure 3 **Emissions share by sector**

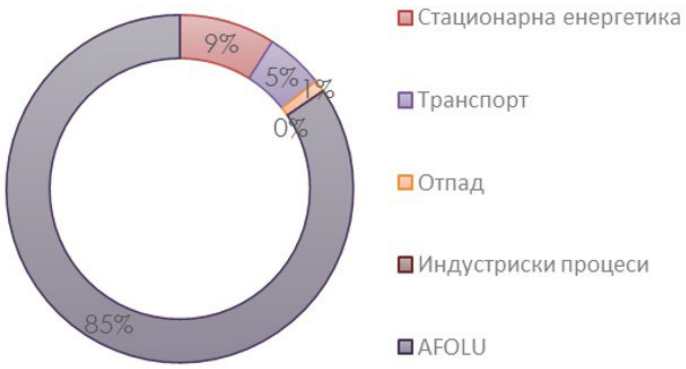
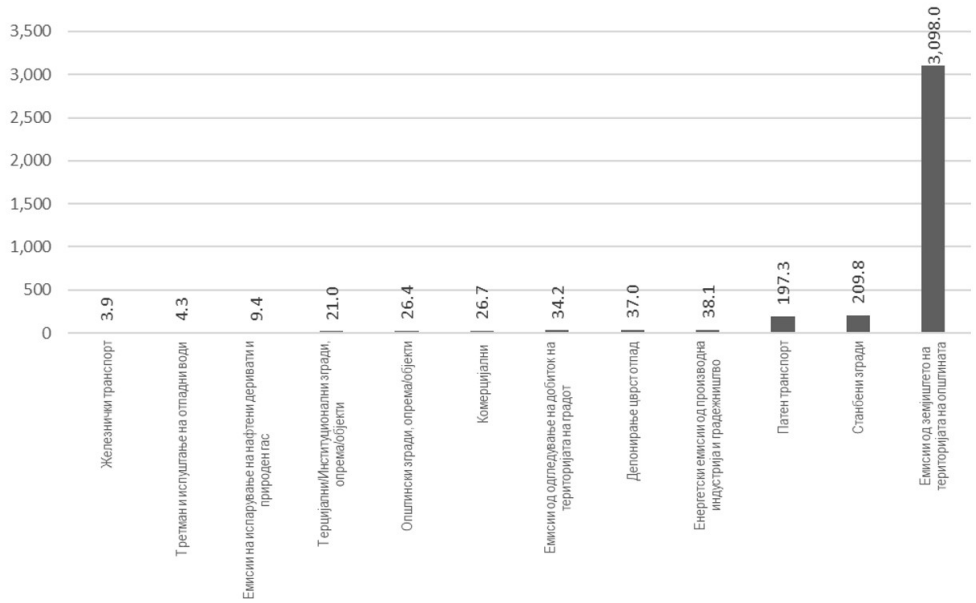
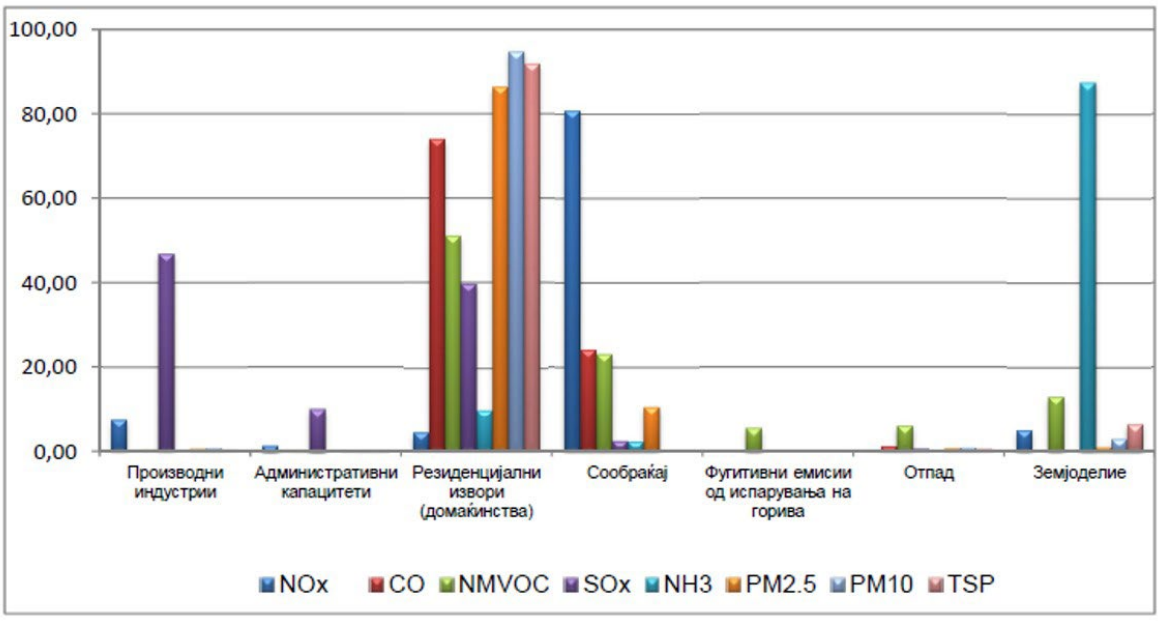


Figure 4 **Sources of greenhouse gas emissions**




100,00
80,00
60,00
40,00
20,00
0,00
Производни индустрии
Административни капацитети
Резиденцијални извори (домаќинства)
Сообраќај
Фугитивни емисии од испарување на горива
Отпад
Земјоделие
NOx
CO
NMVOC
SOx
NH3
PM2.5
PM10
TSP

3 RISK AND VULNERABILITY ASSESSMENT OF THE MUNICIPALITY OF KUMANOVO

Overview

The Vulnerability and Risk Assessment presented in this section is a summary of the information presented in Annex 3, Risk and Vulnerability Assessment of the Municipality of Kumanovo.

The Risk and Vulnerability Assessment for the Municipality of Kumanovo provides a historical overview of extreme weather events occurring in the municipality over a period of many years starting from 1935. Heat waves, extreme cold, drought, heavy rainfall and floods, as well as wildfires were analysed. The overview lists the vulnerabilities associated with various extreme weather events.

The identification of future climate threats was carried out based on climate scenarios prepared for the development of the Fourth National Communication on Climate Change in 2020. The RCP 4.5 scenario was taken as the baseline scenario for two periods: 2016-2035 and 2046-2065.

The future climate threats in the short, medium and long term were analysed. The predictions are based on the Report on Climate Change Projections and Changes in Climate Extremes in the Republic of North Macedonia, prepared within the framework of the Fourth National Climate Change Plan project and the Third Biennial Update Report on Climate Change under the UNFCCC. For the purposes of this report, the period 2016-2023 and the RCP 4.5 scenario for all relevant sectors were analysed for the Municipality of Kumanovo.

Municipality of Kumanovo's Risk and Vulnerability Assessment Methodology

The assessment focused on Municipality of Kumanovo sectors' vulnerabilities, determining to what extent the municipality's systems have managed to cope with adverse climate, extreme climate events and their impacts, by reflecting on historical climate change events and analysing the associated risks and identified opportunities.

These data were later used to project future vulnerabilities in the medium (2015-2035) and long term (2045-2065). The projections were performed using WCRP CORDEX with 1980-2020 as the reference period.

Based on the preliminary assessments and review of existing strategic documents, as well as on the data received from participants and users during the workshops, each of the sector experts for the risk and vulnerability assessment provided preliminary adaptation measures in order to address the climate vulnerability of the Municipality of Kumanovo.

As part of the Assessment process two workshops were held at which various participants and stakeholders were consulted (SECAP working groups, municipality representatives, NGOs, private sector, public utility enterprises, etc.). The aim of the workshops was to determine the priorities of the Municipality of Kumanovo, as well as to propose measures for climate change adaptation. The public was also involved in the prioritisation process using a publicly available questionnaire and a survey.

Climatic hazards

According to the assessments the risks with greatest impact in the Municipality of Kumanovo are:

- Floods
- Heat waves
- Frost days
- Droughts
- Wildfires

Further down you will find a brief overview of each of them.

Precipitation and floods

Observed climate trends (1990 – 2020)

According to available data, Kumanovo was flooded several times with serious consequences in the period between 1935 and 2016.

The critical points of urban flooding in the municipality are usually overpasses or any street in the city with a configuration to capture (retain) water during intense rains.

Before the regulation of the riverbeds in the city, the Kumanovo region had serious problems with river overflows from the Lipkovska River, the Slupchanska River, the Konjarka River, as well as the downstream part of the Kumanovska River, around the village of Dobroshane and the confluence with the Pchinja River. After the partial regulation of the Kumanovska River, these occurrences have been reduced, and the city is safer from river overflows. In addition, in the upper part of the Lipkovska River basin there are artificial reservoirs, Glaznja and Lipkovo, that can mitigate the spread of flood waves from the upper part of the basin and mitigate the effects of floods in the city of Kumanovo.

According to the average annual precipitation sums in the past, it is evident that the rivers in the region have not been particularly vulnerable to climate change and do not indicate major hazards or risks, in terms of average annual discharges.

In addition to massive river floods, the region has also been affected by flash floods caused by heavy and intense rainfall in the past. Most of the Municipality of Kumanovo

is located in areas with an average of 1.6-1.8 storms with precipitation over 40 mm. This is a high exposure to this weather extreme. However, a small part in the south of the municipality is less affected with an average number of 0-1.3 events/year, which is significantly lower exposure compared to other parts of the municipality.

Predicted climate change scenarios (short-term 2016-2035 and medium-term 2045-2065)

In the future, the average precipitation amounts are expected to remain the same.

In contrast, the projected trends of extreme precipitation events for the Municipality of Kumanovo indicate a significant increase in the short-term period compared to the baseline period. The expected increases are by 60 days in the eastern part of the municipality, while in the western part the increase is projected to be 10-30 days, and in the northern part about 30 days. In the medium-term period (2045-2065) there are no significant changes compared to the short-term period.

Heat waves

Observed climate trends (1990 – 2020)

The area of the Municipality of Kumanovo is seriously affected by heat waves. Most of the territory falls into the category with the longest duration of heat waves, ranging from 13-15 days. Certain small parts of the municipality in the north and west are somewhat less affected, but still the estimated duration is 11-13 days.

Based on the analysis of climate events in the period from 1990 to 2020, it can be concluded that the average number of heat events increases towards the east. The largest number of heat waves is detected in the central and southeastern parts of the municipality, with an average number of 2.15-2.57 and 2.57-3.12 events, respectively.

Predicted climate change scenarios (short-term 2016-2035 and medium-term 2045-2065)

By comparing the projections of future trends of annual and air temperatures for two periods 2016-2035 and 2046-2065, it can be concluded for the Municipality of Kumanovo that the average air temperatures are expected to increase in the short and medium term by about 1-1.5oC. Unlike some parts of the country (central region) the differences between the two compared periods for the Municipality of Kumanovo are expected to be somewhat higher.

No significant changes are expected in terms of future trends in heat waves. The expected changes in the short term (2016-2035) are evenly distributed throughout the municipality and the increase in the number of heat waves in this period compared to the baseline period 1985-2005 is expected to be only one additional event (for a period of 20 years). In the medium term, the trend remains the same compared to the 2016-2035 period, with an increase of only one additional event compared to the baseline period.

Frost days

Observed climate trends (1990-2020)

No specific vulnerabilities to frost days have been identified in the region, so there is a possibility of a winter minimum occurring on some of the rivers (mostly smaller ones) in the event of prolonged dry summer and autumn periods, but the occurrence of frost days in November and December in the region was very low. The Kumanovska River, due to the artificial influence from the upper artificial dams and reservoirs, has a lower probability of occurrence of the winter minimum.

The total number of cold days is quite low and in most of the municipality is 76-87 days. Only a small part of the central part of the municipality has a lower number of cold days ranging from 62-76 days.

Predicted climate change scenarios (short-term 2016-2035 and medium-term 2045-2065)

The number of frost days is expected to drop by about 5 days in the short term (2016-2035) and by about 10 days in the medium term (2046-2065). The decrease in the number of frost days will be evenly distributed over the entire area of the Municipality of Kumanovo.

Droughts

Observed climate trends (1990-2020)

The disturbed precipitation regime with more frequent drought events and an extension of its duration, along with a net decrease in annual precipitation sums, are the main outcomes of the negative impact of climate change on the precipitation regime.

In terms of the duration of drought periods, the Municipality of Kumanovo is severely affected. In the north, east and southeast, the duration of drought events is at its peak of 16.3-17.9 days on average for the analysed period, while the western parts and the west-northwest with large agricultural land are less affected with an average duration of 14.5 -15.5oC.

A similar pattern can be observed with the number of drought events. The number of drought events has the highest values in the central and southeastern part of the municipality with an average number of 9.7-10.1 events. Some parts in the north and south of the municipality are less affected, but the number of events is still high (8.5-9.7 events).

Predicted climate change scenarios (short-term 2016-2035 and medium-term 2045-2065)

The dry period in the Municipality of Kumanovo is expected to increase in the short term by about 10-20 days. The central and eastern parts of the Municipality of Kumanovo are particularly affected areas in the short term, while the southern parts of the municipality are projected to be less affected, with a 10-day increase of dry periods. In the medium term, dry periods are expected to remain the same, except for a certain decrease in the eastern parts of the municipality by additional 10 days.

Wildfires and open fires

Observed climate trends (1990-2020)

A number of fires have been recorded in the municipality. According to the municipality's data, the total number of fires registered in the period 2019-2022 was 1375 fires and the total burned area was 3079 ha. Most of the burned area was agricultural land, and 522 hectares were forests. This is a large area, but fortunately most wildfires occur far from populated areas and do not pose a major risk to infrastructure. The greatest risk of wildfires is in forests close to populated areas, e.g. Biljanovce Forest Park.

Predicted climate change scenarios (short-term 2016-2035 and medium-term 2045-2065)

Climate change scenarios predict longer dry periods in summer, longer heat waves and higher temperatures. This will actually increase the vulnerability of forests to wildfires.

The following table provides a brief overview of climate events and their impact in the past, as well as projected climate scenarios in the short and medium term.

Table 10 **Historical and projected climate events that have an impact on the Municipality of Kumanovo**

Climate event	Observed trends (1990-2020)	Projected Climate Scenarios (2016-2035 and 2045-2065)
Precipitation and floods	According to the average annual precipitation sums in the past, it is evident that the rivers in the region have not been particularly vulnerable to climate change and do not indicate major hazards or risks, in terms of average annual discharges. The region has also been affected by flash floods caused by heavy and intense rainfall in the past. Most of the Municipality of Kumanovo is located in areas with an average of 1.6-1.8 storms with precipitation over 40 mm.	In the future, average precipitation sums are expected to remain the same. In contrast, the projected trends of extreme precipitation events for the Municipality of Kumanovo indicate a significant increase in the short-term compared to the baseline period. The expected increases are by 60 days in the eastern part of the municipality, while in the western part the increase is projected to be 10-30 days, and in the northern part about 30 days. In the medium-term period (2045-65) there are no significant changes compared to the short-term period.
Heat waves	The area of the Municipality of Kumanovo is seriously affected by heat waves. Most of the territory falls into the category with the longest duration of heat waves, ranging from 13-15 days. Certain small parts of the municipality in the north and west are somewhat less affected, but still the estimated duration is 11-13 days.	By comparing the projections of future trends of annual and air temperatures for two periods 2016-2035 and 2046-2065, it can be concluded for the Municipality of Kumanovo that average air temperatures are expected to increase in the short and medium term by about 1-1.5ºC. No significant changes are expected in terms of future trends in heat waves.
Cold Waves	No specific vulnerabilities to frost days have been identified in the region. The total number of cold days is quite low and in most of the municipality is 76-87 days.	The number of frost days is expected to drop by about 5 days in the short term (2016-2035) and by about 10 days in the medium term (2046-2065).
Droughts	In terms of the duration of drought periods, the Municipality of Kumanovo is severely affected. In the north, east and southeast, the duration of drought events is at its peak with 16.3-17.9 days on average for the analysed period, while the western parts and the west-northwest with large agricultural land are less affected with an average duration of 14.5 -15.5 ºC. A similar pattern can be observed with the number of drought events.	The dry period in the Municipality of Kumanovo is expected to increase in the short term by about 10-20 days. In the medium term, dry periods are expected to remain the same, except for a certain decrease in the eastern parts of the municipality by additional 10 days.
Wildfires and open fires	A number of fires have been recorded in the municipality. According to the municipality's data, the total number of fires registered in the period 2019-2022 was 1375 fires and the total burned area was 3079 ha. Most of the burned area was agricultural land, and 522 ha were forests.	Climate change scenarios predict longer dry periods in summer, longer heat waves and higher temperatures. This will actually increase the vulnerability of forests to wildfires.

Based on the above review of historical and projected extreme weather events in the Municipality of Kumanovo, the probability and impact of current risks and the expected change in the intensity and frequency of hazards have been assessed. The assessment is presented in the following table:

Table 11 **Assessment of current and future climatic hazards and risks in Kumanovo**

Climatic hazards and risks	Current risks		Future risks		Time framework
	Hazard probability	Hazard's impact	Expected change in the intensity	Expected change in the frequency	
Extreme heat	High	Medium	Increase	Increase	Short-term/ Medium-term
Extreme cold	Medium	Low	Decrease	Decrease	Short-term/ Medium-term
Extreme precipitation	Medium	Medium	Increase	Increase	Short-term/ Medium-term
Floods	Medium	Medium	Increase	Increase	Short-term/ Medium-term
Droughts	High	Medium	Increase	Increase	Short-term/ Medium-term
Storms	Low	Medium	Unknown	Unknown	Short-term/ Medium-term
Wildfires	Medium	Low	Increase	Increase	Short-term/ Medium-term

Vulnerable Sectors

The following sectors have been identified as the most relevant in terms of assessing risks and vulnerabilities in the Municipality of Kumanovo:

- Water
- Healthcare
- Agriculture
- Forestry and
- Economy

For each of them, the impact of previously defined climate phenomena has been determined.

Water Sector

According to the average annual precipitation sums in the past, it is evident that the rivers in the region have not been particularly vulnerable to climate change and do not indicate major hazards or risks, in terms of average annual discharges. However, it should be emphasised that the researched data are average annual data for the period 1991-2020 and that even in an average year or a year with precipitation and discharges below average, it is possible to have periods (days) with extreme amounts of precipitation, which will not affect the average annual precipitation or discharge, but would be a potential flood hazard on the rivers (Lipkovska River, Slupchanska River, Konjarka River, Kumanovska River) that cause floods and flooded areas.

On the other hand, in the past period there were also urban floods that occurred in the Municipality of Kumanovo, mostly due to the intense precipitation, the asphalt on the streets, the lack of green spaces, as well as the inability to channel the large amount of water that falls in short time intervals during which intense precipitation of short duration was registered. In those cases, there was uncontrolled water runoff along the streets, causing flooding, especially at some of the known critical points in the town.

Healthcare Sector

Although there are no specific studies available on the direct link of climate change with health among the Kumanovo population, indirect socio-demographic indicators and risk predictions confirm that the occurrence of high temperatures and heat waves, especially in the summer period (in the short and long term), floods (in the

short and long term), droughts (in the medium and long term) and wildfires (although the municipality does not have huge forest areas) in the medium to long term, will be the priority climate change related risks for the population of Kumanovo (with a high and moderate probability of occurrence).

Agriculture sector

Annual average air temperatures and the sum of annual precipitation are of particular importance for agricultural production, as these two parameters provide an initial assessment in the process of designing the model of resettlement in certain areas and the selection of agricultural crops and varieties.

The dynamics of average annual air temperatures was estimated based on the available spatial data for monthly averages for the period 1980-2020 (WCRP CORDEX). Most of the territory of Kumanovo has average annual air temperatures in the interval of 12.2-13.5 ºC, only the northern parts and some areas in the southwest of the municipality have lower annual air temperatures (11.2-12.2 ºC). Most of the agricultural land is in the zone with lower air temperatures.

The annual precipitation sums are quite lower than in neighbouring areas and vary in the range of 310-360 mm in the western and southern parts, to 365-428 mm, which is still a fairly low sum of precipitation. However, it should be emphasised that these sums refer to the vegetation period and are somewhat lower than the annual sums.

In general, based on these two key meteorological parameters, it can be concluded that the climatic conditions are not in favour of agricultural production.

The number of cold days and their occurrence during winter and spring defines the length of the growing season because the start of vegetation for autumn crops is considered to be the period with three consecutive days above 5°C. However, another weather extreme period with “late frosts” in spring significantly affects agricultural crops. The total number of cold days is quite low and in most of the municipality is 76-87 days.

Of particular importance for agricultural plants, especially fruits, is the date of the last frost in spring, when they are in a very sensitive phase of flowering and bud formation. The last occurrences of temperatures below -2 ºC were detected on 24 April 1994 when the air temperature was -2.51 ºC; in 2007, the last spring frost was on 15 April 2007 with a temperature below -2.6 ºC, while in 2018 temperature of -4.51 ºC were recorded on 30 April.

Most agricultural plants are highly sensitive to heat waves. To evaluate the exposure of agricultural crops to heat waves, two parameters were analysed: the average duration of the longest heat waves and the average number of events per year.

The area of the Municipality of Kumanovo is seriously affected by heat waves. Most of the territory falls into the category with the longest duration of heat waves, ranging from 13-15 days. Certain small parts of the municipality in the north and west are somewhat less affected, but still the estimated duration is 11-13 days.

The average number of heat events increases towards the east. The largest number of heat waves is detected in the central and southeastern parts of the municipality, with an average number of events of 2.15-2.57 and 2.57-3.12, respectively. It is of exceptional importance that most of the agricultural land is located in these areas, which makes them significantly exposed to the harmful effects of this climate extreme.

The absence of precipitation for a longer period, along with high air temperatures when evaporation is at its peak, can cause serious water deficits for plants, causing serious stress and poor crop yields. Drought events during the growing season pose a serious risk to agricultural crops, especially in certain phases of plant development.

Regarding the length and appearance of drought events, it can be concluded that the majority of drought events occur in the months of the growing season. The average duration of drought events is particularly important because long periods without rain can have a serious negative effect even on irrigated crops.

In terms of the duration of drought periods, the Municipality of Kumanovo is severely affected. In the north, east and southeast, the duration of drought events is at its peak with 16.3-17.9 days on average for the analysed period, while the western parts and the west-northwest with large agricultural land are less affected, with an average duration of 14.5 -15.5 ºC. However, periods of 2 weeks without precipitation during the growing season pose a serious risk for agricultural plants. In general, the entire municipality is under serious threat of drought, with greater exposure to the east. A similar pattern can be observed with the number of drought events. The number of drought events has the highest values in the central and southeastern part of the municipality with an average number of 9.7-10.1 events.

Most of the Municipality of Kumanovo as well as most of the agricultural land is located in areas with an average of 1.6-1.8 storms with precipitation over 40 mm. This is a rather high exposure to this weather extreme.

However, a small part of the south of the municipality is less affected with an average number of 0-1.3 events/year, which is significantly lower exposure compared to other parts of the municipality.

Economy Sector

Sectors that are extremely vulnerable to extreme weather conditions have a small relative share in the overall local economy. Construction employs 6% of the total workforce, generates 7% of revenues and 11.5% of profits. The Agriculture, Forestry and Fisheries sector employs 1% of the total number of employees, generating only 0.8% of total revenues and 1.6% of profits.

No high vulnerabilities were detected in the trade sector, but they are medium or low. The construction sector is assessed to be highly vulnerable to heat waves and extreme precipitation. Agriculture is a marginal economic activity in the Municipality of Kumanovo. Therefore, focusing on the vulnerabilities of the dominant branches, the general assessment is that the local economy of the Municipality of Kumanovo is moderately to lowly vulnerable to extreme weather events.

Forestry Sector

The main identified risks that are weakly related to climate change and forests within the Municipality of Kumanovo are: wildfires, flash floods and soil erosion, increased urbanisation. These problems arise in the absence of forest cover to protect bare soil.

The Municipality of Kumanovo has been under intense urbanisation pressure in recent years. The city itself is being built intensively, removing green areas and reducing permeable areas, subsequently turning them into impermeable areas in a process called soil sealing. This affects less permeable areas and reduces the ability of the surface to absorb precipitation and in turn, after each rain, the streets are covered with a layer of water and if the rains are more intense, to greater flooding. On the other hand, the urban part of the city is expanding its borders, and increasingly into the green areas.

Forests in the vicinity of settlements pose a risk of wildfires, therefore they need to be constantly monitored and protected. Wildfires have been a constant occurrence in the past. With the increase in dry periods, the risk of wildfires increases.

Several fires have been recorded in the municipality. According to the municipality's data, the total number of fires registered in the period 2019-2022 is 1375 fires and the total burned area is 3079ha. Most of the burned area was agricultural land, and 522 hectares were forests. This is a large area, but fortunately most wildfires occur far from populated areas and do not pose a major risk to infrastructure. The greatest risk of wildfires is in forests close to populated areas, e.g. Biljanovce Forest Park.

Flash floods have been a common occurrence over the years. Much work has been done on this issue in the last 70 years. Typically, intense rainfall occurs in the higher parts of the basin, and damage occurs in the lower parts of the basin where settlements are usually located. To remediate the situation, significant work should be carried out in the upper catchment area. The best protection of the soil is by planting trees that will ultimately form a stable forest ecosystem. The Municipality of Kumanovo is faced with a risk transfer situation. This means that activities take place in other municipalities and the risk is transferred to the Municipality of Kumanovo through the river system.

Table 12 **Assessment of hazards' impact on specific sectors in the Municipality of Kumanovo**

Hazard's impact	Agriculture	Forestry	Water	Health	Economy
Extreme heat	High	Medium	Low	High	Medium
Extreme cold	Low	Low	Low	Medium	Low
Extreme precipitation	Low	Medium	Medium	Medium	Medium
Floods	Low	Low	Medium	Medium	Low
Droughts	High	High	Medium	Medium	Medium
Storms	Low	Medium	Low	Unknown	Medium
Wildfires	Low	High	Low	Low	Low

Vulnerable population

Among the different population groups, the most vulnerable to the impacts of climate change are:

- Patients with chronic cardiovascular and respiratory diseases
- Elderly (65+)
- Single pensioner households and elderly people placed in institutions
- Homeless
- Communal, agricultural and other workers working outdoors.
- Population living in poor households at risk and/or in affected locations

Table 13 Vulnerable population

Climatic hazards (extremes)	Vulnerable groups	RVA health risk/impact assessment indicators	Other vulnerability and adaptative capacity indicators*
Extreme heat (increasing temperatures, prolonged number and duration of heat waves, heat islands in central urban areas, tropical nights, prolonged summer days)	Patients with chronic cardiovascular and respiratory diseases Elderly (65+) Single pensioner households and elderly people placed in institutions Homeless Communal, agricultural and other workers working outdoors. Population living in poor households at risk and/or in affected locations	All-cause and cause-specific mortality associated with extreme heat/heat waves disaggregated by sex, age and geographical location (Source: SSO, PHI, PHC) Spreading and trend of infectious and water-borne diseases, heat stress and pollen allergies (Source: PHC) Daily and monthly data on emergency calls during (climatic extremes) heat events (Source: EMS)	Quality of drinking water, especially in rural areas (Source: PHC) Air quality indicators and warnings (Source MEPP, PHI) Accessibility of HC services (average time to reach HC service) (Source MH, LSGU) Socio-economic indicators: Population density per km² compared to the national average (Skopje 341/ km²) (Source: SSO) Percentual share of vulnerable groups (65+) compared to the national average (Source: SSO) Number of single pensioner households and elderly people placed in institutions (Source: SSO, LSGU, DKS) Percentage and structure of the population living in households at risk or in affected areas (Source: LSGU)
Low temperature and cold waves	Patients with chronic cardiovascular and respiratory diseases People living in poor households Elderly (65+)	All-cause and cause-specific mortality associated with extreme cold/cold waves disaggregated by sex, age and geographical location (Source: SSO, PHI, PHC)	Percentual share of vulnerable groups (65+) compared to the national average (Source: SSO) Number of single pensioner households and elderly people placed in institutions (Source: SSO, LSGU, DKS)

Extreme precipitation and accumulation of rain Floods	Population living in risky or affected areas	Daily and monthly data on the trend of waterborne diseases, injuries and deaths, monitoring the epidemiological situation in the region due to the deterioration of the drinking water supply and sanitation (Source: PHC)	Quality of drinking water, especially in rural areas (Source: PHC) Percentage and structure of the population living in households at risk or in affected areas (Source: LSGU)
Droughts	Population living in risky or affected areas	Daily and monthly data on the trend of waterborne diseases (Source: PHC)	Quality of drinking water, especially in rural areas (Source: PHC) Percentage and structure of the population living in households at risk or in affected areas (Source: LSGU)
Wildfires	Elderly and patients with chronic diseases Remote and socially disadvantaged groups of people, especially in rural areas	Daily and monthly data on healthcare and emergency calls, during events in the affected regions (Source EMS)	Regular data/information on the affected areas with the structure of groups of people at risk (Source LSGU)

4 ACTION PLAN

Table 14 Sustainable Energy and Climate Action Plan

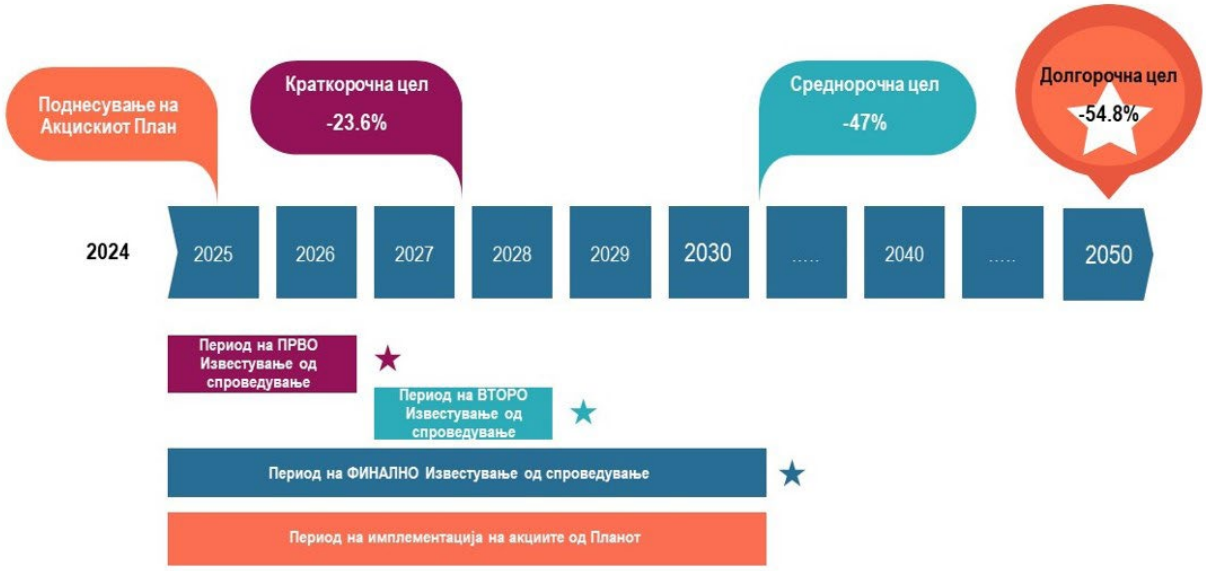
PLANNED MITIGATION ACTIONS (MA)	Mitigation	Adaptation	Energy Poverty	Implementation period
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES				
Sector: Municipal buildings, equipment/facilities				
MA1 – Developing and implementing an Energy Efficiency Programme of the Municipality of Kumanovo	√			2025-2030
Sector: Residential buildings				
MA2 - Subsidies for connecting to the gas network for households	√			2025-2030
MA3 - Efficient heating and cooling with heat pumps in households	√		√	2025-2030
MA4 - Increased use of renewable energy in households by installing solar thermal collectors	√			2025-2030
MA5 - Implementation of the programme for annual cleaning of chimneys (subsidies)	√		√	2025-2030
MA6 - Raising public awareness about the significance of climate change	√			2025-2030
TRANSPORT				
Sector: Private and commercial transport				
MA7 - Improving urban mobility	√		√	2025-2030

PLANNED MITIGATION ACTIONS (MA)	Mitigation	Adaptation	Energy Poverty	Implementation period
WILDFIRES				
Sector: Agriculture and forestry				
AA1 - Procurement of vehicles and equipment for urban, rural and wildfires coping and management	√	√		2025-2030
FLOODS				
Sector: Water				
AA2 - Conducting a study for improving the hydrotechnical infrastructure		√		2025-2030
AA3 - Development and maintenance of storm sewar		√		2025-2030
OTHER				
Sector: Energy				
AA4 - Expanding the gas network	√	√		2025-2030
AA5 - Promotion of green energy use opportunities	√	√		2025-2026
Sector: Land use planning				
AA6 - Integration of climate change in urban planning	√	√		2025-2030
Sector: Waste				
AA7 - Waste management programme				

PLANNED MITIGATION ACTIONS (MA)	Mitigation	Adaptation	Energy Poverty	Implementation period
URBAN MOBILITY				
Vulnerable category: Low-income households, unemployed persons				
EP1 - Introducing free transport	√		√	2025-2030

4.1. Timeframe for the implementation of the Action Plan

Figure5 **Timeframe for the implementation of the Action Plan**



4.2. Mitigation

4.2.1. Overview of incorporated actions

In response to the urgent need to address climate change, mitigation actions aim to reduce greenhouse gas emissions and minimise the impacts of climate change-related risks. These actions cover different sectors and strategies, emphasising the importance of collective efforts to achieve sustainability and resilience to future climate challenges.

The plan contains 7 mitigation actions, most of which are in the residential buildings sector. According to the Greenhouse Gas Inventory, this sector is also the largest emitter of greenhouse gases with great potential for their reduction. The listed actions have been selected after prior selection and prioritisation in accordance with the process outlined in chapter 1.4.2.

The selected actions are ranked by sectors of action by designating key actions as well as their interaction with other actions proposed in the adaptation and energy poverty sections. Some of the actions have already been launched, while the rest are planned for implementation in the period up to 2030.

Each of the actions is explained in accordance with the guidelines in the Guidebook "How to Develop a Sustainable Energy and Climate Action Plan (SECAP)" from the Covenant of Mayors initiative by providing:

- Action description
- Implementation timeframe
- Responsible authority
- Cost estimate (Investment and current costs)
- Estimated impact (the estimated energy savings / increased production of renewable energy per target year and the estimated reduction of greenhouse gases per target year).
- Monitoring indicators

Additionally, the stakeholders covered by the given action are presented, as well as the financing opportunities for each action.

Each of the actions is defined by its own identification number where the letters MA indicate that the action belongs to the section on mitigation actions, while the number indicates the action.

Table 15 Mitigation Actions Overview

Mitigation action	Mitigation	Adaptation	Energy Poverty
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES			
Sector: Municipal buildings, equipment/facilities			
MA1 – Developing and implementing an Energy Efficiency Programme of the Municipality of Kumanovo	√		
Sector: Residential buildings			

MA2 - Subsidies for connecting to the gas network for households	√		
MA3 - Efficient heating and cooling with heat pumps in households	√		√
MA4 - Increased use of renewable energy in households by installing solar thermal collectors	√		
MA5 - Implementation of the programme for annual cleaning of chimneys (subsidies)	√		√
MA6 - Raising public awareness about the significance of climate change	√		
TRANSPORT			
Sector: Private and commercial transport			
MA7 - Improving urban mobility	√		√

4.2.2. Buildings, Equipment/Facilities and Industries

This chapter presents actions developed to help mitigate the impacts of the buildings sector on global climate change, primarily through measures aimed at reducing greenhouse gas emissions and resource consumption. The main objective of these actions is to improve the energy efficiency of existing and future buildings, promoting the widespread adoption of sustainable construction techniques and the use of sources of renewable energy.

Six actions are included in this sector, covering municipal and residential buildings. In these measures, the municipality appears primarily as a promoter of good practices and commitments in tackling climate change.

Of the total emissions inventory, the buildings sector (residential, institutional and commercial) accounts for ~8% of total greenhouse gas emissions.

Although the buildings sector represents a small part of the total emissions, with the proposed actions, greenhouse gas emissions within the sector itself can be reduced significantly and thus have a significant effect on the improvement of air quality in the urban part of the municipality. In residential buildings alone, with the implementation of the proposed actions, a 53% reduction in greenhouse gas emissions could be achieved.

In the area of municipal buildings, equipment/facilities, one action is proposed, which is a legal obligation and is crucial in the future planning of interventions in this sector. It refers to the development of an Energy Efficiency Programme that would cover the sectors in which the municipality has direct jurisdiction. The Programme is expected to plan future actions in municipal buildings, equipment and facilities with the implementation of energy efficiency measures and greater use of renewable energy. It is proposed that the actions from the Programme be included in the first revision of the Action Plan, which is planned for the second year of implementation. This would complement the proposed actions and revise the goals set for 2030.

☑ Mitigation ☒ Adaptation ☒ Energy poverty	**MA1 – Developing and implementing an Energy Efficiency Programme of the Municipality of Kumanovo**	
Action description	In accordance with the Law on Energy Efficiency, the Municipal Council, based on a proposal by the Mayor and after a prior opinion provided by the Energy Agency, adopts an Energy Efficiency Programme for a period of three years. In addition, an Action Plan for the implementation of the Programme is prepared annually. This Programme would present the current situation and energy needs at the sector level, then indicative energy saving targets at the local level, measures for improving and promoting energy efficiency, the objectives to be achieved with those measures, the sources of financing the investments needed to implement the measures, the activities and deadlines for implementing the measures, the bearers of the activities and other necessary data. By implementing this action, the Municipality of Kumanovo will first prepare a planning document with prioritised measures in the area of energy efficiency, which will serve as a guideline for future investments in the period 2025-2027 with the possibility of their implementation in the following period until 2030. After the adoption of the Programme, it will move towards its implementation, which will directly affect the reduction of energy consumption as well as the reduction of greenhouse gases emitted into the atmosphere from the municipal buildings, equipment/facilities sector.	
Implementation timeframe	2025-2030	
Financing opportunities	-Own resources -Regional funds and programmes -National funds and programmes -EU funds and programmes	
General section		
Responsible authority	**Stakeholders**	**Costs**
Municipality of Kumanovo	National bodies and/or agencies Subnational bodies and/or agencies NGOs and civil society Citizens	3.3 million EUR of which 5,000 EUR for the EEP development
Mitigation		
Sector	Sector: Municipal buildings, equipment/facilities Tools/Area of intervention: Integrated actions Action policies/instruments: Public procurements	
Assessed impact	Energy savings: 1,882 MWh for 2030 Production of renewable energy 1,848 MWh for 2030 CO_2 emissions reduction: 2.44 ktCO_2 for 2030	
Indicators	-Developing an Energy Efficiency Programme -Energy saving (MWh) -Production of renewable energy (MWh) -Emissions reduction (ktCO_2-eq)	

☑ Mitigation ☒ Adaptation ☒ Energy poverty	**MA2 - Subsidies for connecting to the gas network for households**
Action description	The Municipality of Kumanovo is among the first municipalities to invest in the construction of a secondary and tertiary gas pipeline network. It is managed by the PE "Kumanovo Gas" and is constantly expanding and upgrading, covering both public and residential and commercial buildings. In recent years, the municipality has been stimulating households to get connected to gas by subsidising the connection fee to the gas pipeline network. In this way, the municipality improves the living conditions of citizens, but also contributes in addressing polluted air and environmental protection. By enabling connections to residential buildings, the opportunity is open for a larger number of people to use clean energy, which will ultimately have a positive effect on the municipality and its population. The action consists of subsidising the connection for 90 families annually in the amount of 15,000 MKD, which is 30% of the total cost of the connection investment. Additionally, there is financial support from the central government for compensation of the remaining costs for the connection, which is an additional incentive for citizens to join this action. Moreover, an expansion of the gas pipeline network by ~40 km is planned in the next 5 years, which would include additional buildings, at least 300 residential buildings and about 10 other managed by the local government.
Implementation timeframe	2025-2030
Financing opportunities	- Own resources - National funds and programmes

General section		
Responsible authority	**Stakeholders**	**Costs**
PE “Kumanovo Gas” under the Municipality of Kumanovo	National bodies and/or agencies Subnational bodies and/or agencies NGOs and civil society Citizens	0.43 million EUR

Mitigation	
Sector	Sector: Residential buildings and other Tool/Area of intervention: Other; Actions policies/instruments: Grants and subsidies
Assessed impact	CO_2 emissions reduction: 6.4 ktCO_2 for 2030 CO_2-eq emissions reduction: 6.5 ktCO_2-eq for 2030
Indicators	- Emissions reduction (ktCO_2-eq)

☑ Mitigation ☒ Adaptation ☒ Energy poverty	MA3 - Efficient heating and cooling with heat pumps in households	
Action description	Heat pumps are efficient alternatives to traditional heating and cooling systems that contribute to energy savings and increased comfort in the space. In addition, this action has an impact on reducing greenhouse gas emissions, which directly affects the climate protection and air quality in the municipality. This action provides for the replacement of existing inefficient heating devices in households with heat pumps (including inverter air conditioners such as air-to-air heat pumps) in order to heat and cool the space more efficiently.	
Implementation timeframe	2025-2030	
Financing opportunities	- Own resources -Regional funds and programmes -National funds and programmes -EU funds and programmes -Private investments	
General section		
Responsible authority	**Stakeholders**	**Costs**
Municipality of Kumanovo	National bodies and/or agencies Subnational bodies and/or agencies NGOs and civil society Citizens	12 million EUR
Mitigation		
Sector	Sector: Residential buildings Tool/Area of intervention: Energy efficiency for space and water heating Action policies/instruments Grants and subsidies	
Assessed impact	Energy savings: 40,119 MWh for 2030 CO_2 emissions reduction: 26.3 ktCO_2 for 2030 CO_2-eq emissions reduction: 26.6 ktCO_2-eq for 2030	
Indicators	-Energy saving (MWh) -Emissions reduction (ktCO_2-eq)	
Energy Poverty		
Target macro area / Vulnerable category	Buildings, housing / Low-income households	
Indicator	Reducing heating costs for low-income households: 15,000 MKD per household per heating season. Number of households with efficient heating and cooling system: 200 households	
Remarks	Subsidies aimed at supporting the transition from wood stoves and extra light household oil to heat pumps and inverter air conditioners play a key role in overcoming financial barriers for low-income families to access more affordable and sustainable heating and cooling options. Furthermore, by providing financial assistance for replacing outdated heating systems with efficient heat pump systems, the subsidies alleviate the financial burden on vulnerable households, and further contribute to long-term energy cost savings, improved indoor air quality and reduced greenhouse gas emissions. This integrated approach impacts energy poverty by improving energy affordability and fosters a transition to cleaner and more sustainable energy systems, which have an impact on the households' quality of life and on the environment.	

☑ Mitigation ☒ Adaptation ☒ Energy poverty	**MA4 - Increased use of renewable energy in households by installing solar thermal collectors**	
Action description	Solar thermal collectors represent a renewable and sustainable technology that can significantly reduce energy costs and greenhouse gas emissions compared to conventional heating systems. Heating sanitary hot water in households by using electric water heaters are one of the largest energy consumers in the total energy balance in households. With the installation of solar thermal collectors on the territory of the Municipality of Kumanovo, over 50% of the annual hot water needs can be met. They, in addition to hot water, can also be used in combination with electricity and central heating systems. Over the last decade, the prices of these systems have decreased drastically, making investment in solar collectors even more profitable. This action provides support for about 100 households per year for the purchase of solar thermal collectors with a 50% subsidised investment.	
Implementation timeframe	2025-2030	
Financing opportunities	- Own resources - Regional funds and programmes - National funds and programmes - EU funds and programmes - Private investments	
General section		
Responsible authority	**Stakeholders**	**Costs**
Municipality of Kumanovo	National bodies and/or agencies Subnational bodies and/or agencies NGOs and civil society Citizens	14 million EUR
Mitigation		
Sector	Sector: Residential buildings Tool/Area of intervention: Renewable energy for space and water heating Action policies/instruments Grants and subsidies	
Assessed impact	Energy savings: 20,107 MWh for 2030 CO_2 emissions reduction: 17.3 ktCO_2 for 2030 CO_2-eq emissions reduction: 17.4 ktCO_2-eq for 2030	
Indicators	- Energy saving (MWh) - Emissions reduction (ktCO_2-eq)	

☑ Mitigation ☒ Adaptation ☒ Energy poverty	MA5 - Implementation of the programme for annual cleaning of chimneys (subsidies)	
Action description	The aim of this action is to reduce air pollution in the municipality, especially the particulate matter (PM10 and PM2.5) pollution. These particles are most often emitted when heating buildings, primarily due to incomplete and inadequate combustion of firewood, inadequate quality of the wood and the method of its storage, use of old, worn-out and technically defective stoves, as well as irregular cleaning and maintenance of chimneys. It is a known fact that neglected and uncleaned chimneys pose a great threat. Not only is the pollution and emission of PM 10 particles high, but the safety of users is also affected if the chimney is not cleaned regularly. It is recommended for chimneys to be cleaned 3 times a year, twice during the heating season and once when it is over. With the action, the Municipality of Kumanovo will support the cleaning of approximately 250 chimneys per year, with 1,200 MKD per household.	
Implementation timeframe	2025-2030	
Financing opportunities	-Own resources	
General section		
Responsible authority	**Stakeholders**	**Costs**
Municipality of Kumanovo	National bodies and/or agencies Subnational bodies and/or agencies NGOs and civil society Citizens	5,000 EUR
Mitigation		
Sector	Sector: Residential buildings Tool/Area of intervention: Energy efficiency for space and water heating Action policies/instruments Grants and subsidies	
Assessed impact	Energy savings: 228 MWh for 2030 CO_2 emissions reduction: 0.1 ktCO_2 for 2030 CO_2-eq emissions reduction: 0.1 ktCO_2-eq for 2030	
Indicators	- Emissions reduction (ktCO_2-eq)	
Energy Poverty		
Target macro area / Vulnerable category	Buildings, housing / Low-income households	
Indicator	Reducing heating costs for low-income households: 7800 MKD per household per heating season. Subsidised low-income households – 250 households	
Remarks	Reducing heating costs for low-income households – it measures the financial relief provided to vulnerable households by reducing heating costs with regular chimney cleaning. This initiative aims to reduce the economic burden on this target group by improving heating efficiency, reducing fuel consumption, increasing safety and minimising maintenance costs associated with heating systems, thereby improving the availability and access to reliable and adequate heating for low-income families. Subsidised low-income households - with targeted support of 250 households, this programme seeks to alleviate energy poverty and promote equitable access to reliable and adequate heating solutions for targeted social groups.	

☑ Mitigation ☒ Adaptation ☒ Energy poverty	MA6 - Raising public awareness about the significance of climate change
Action description	Raising public awareness about the significance of climate change is key to building responsibility and action to protect our planet. This action includes a campaign to increase energy efficiency in the residential sector in order to raise awareness and familiarity among citizens about the importance and benefits of energy-efficient practices and technologies. The campaign will include various activities, such as educational workshops, information sharing sessions, distribution of promotional materials, and use of media to disseminate information. The emphasis will be placed on specific measures that households can take, such as improving the elements of the external envelope of buildings, replacing old devices with energy-efficient ones, replacing electrical appliances with highly efficient ones, phasing out incandescent bulbs and using renewable energy sources, such as photovoltaic panels. This campaign is expected to reduce energy consumption in the residential sector, which will lead to a greenhouse gas emissions reduction and energy cost savings, contributing to sustainable development and a better environment. With the implementation of this action, it is expected that a 5% renovation of the housing stock will be achieved by 2030, which coincides with the Energy Development Strategy until 2040 and the projected annual renovation rate of 1%.
Implementation timeframe	2025-2030
Financing opportunities	- Own resources - Regional funds and programmes - National funds and programmes - EU funds and programmes

General section		
Responsible authority	**Stakeholders**	**Costs**
Municipality of Kumanovo	National bodies and/or agencies Subnational bodies and/or agencies NGOs and civil society Citizens	- A campaign - 10,000 EUR - Investment in EE and RES

Mitigation	
Sector	Sector: Residential buildings Tool/Area of intervention: Integrated actions Action policies/instruments: Public awareness raising
Assessed impact	Energy savings: 27,072 MWh in 2030 Production of renewable energy: 45,291 MWh in 2030 CO_2 emissions reduction: 59.8 ktCO_2 in 2030 CO_2-eq emissions reduction: 60.1 ktCO_2-eq in 2030
Indicators	-Energy saving (MWh) - Production of renewable energy (MWh) -Emissions reduction (ktCO_2-eq)

4.2.3. Transport

This section presents actions developed to help mitigate the impacts of the transport sector in the Municipality of Kumanovo on global climate change. In general, this includes promoting sustainable modes of transport and reducing emissions from existing modes of transport. Thus, the aim is to increase sustainable modes of urban transport systems and at the same time improve the efficiency of current modes in order to increase the quality of life for all citizens.

The transport sector is the third largest source of emissions in the Municipality of Kumanovo with 201.15 kt CO2-eq which represents ~5% of the total inventory. In the total greenhouse gas inventory in this sector, road transport contributes to over 98% of emissions, while the remaining minor part is rail transport.

Two actions have been selected in this sector, covering public and private transport. The first action is free public transport and is a measure that is ongoing, and that the municipality has been implementing in recent years as one of the most successful in the fight for cleaner air and an organised traffic regime in the central city area.

It is planned to be implemented in the coming period fully subsidised by the municipality. This action also covers low-income households and unemployed people and is a measure that has a huge positive impact on these socially vulnerable groups. Therefore, the introduction of free public transport as an action is included in section 4.4. - Actions to reduce energy poverty, where the impact of this action on climate change mitigation is also elaborated in detail.

The second action refers to subsidising citizens' purchases of bicycles with integrated action and the development of pedestrian and bicycle paths, while interacting with the vision and strategic goals reflected in the Sustainable Urban Mobility Plan of the Municipality of Kumanovo.

Both actions in the transport sector are designated as key in this Action Plan and contribute for a ~3% reduction in greenhouse gas emissions in that sector in 2030 compared to the 2019 reference inventory.

☑ **Mitigation** ☒ **Adaptation** ☒ **Energy poverty**	**MA7 - Improving urban mobility**
Action description	This action consists of subsidising citizens in the Municipality of Kumanovo for: - purchasing bicycles - bicycle servicing and - procurement of spare parts. Construction of 1.5 km long pedestrian zones in the central city area, as well as bicycle lanes planned in the wider city area with a total length of 34.4 km is also planned. The aim of this action is to improve the quality of the environment, i.e. improve the air quality in Kumanovo and promote people's health, by stimulating citizens to use bicycles that would reduce the pollution caused by the traffic. Between 2025 - 2030 the Municipality of Kumanovo is planning to award 100 subsidies/year or a total of 600 subsidised bicycles by 2030 by conducting public calls.
Implementation timeframe	2025-2030
Financing opportunities	-Own resources -Private investments

General section		
Responsible authority	**Stakeholders**	**Costs**
Municipality of Kumanovo	NGOs and civil society Citizens	- Procurement of bicycles worth 0.09 million EUR - Construction of sidewalks and bicycle lanes worth 5 million EUR
Mitigation		
Sector	Sector: Transport Tool/Area of intervention: Change towards riding bicycles Action policies/instruments Grants and subsidies	
Assessed impact	Energy savings: 1,250 MWh for 2030 CO_2 emissions reduction: 0.3 $ktCO_2$ for 2030 CO_2-eq emissions reduction: 0.3 $ktCO_2$-eq for 2030	
Indicators	- Energy saving (MWh) - Emissions reduction ($ktCO_2$-eq)	
Energy Poverty		
Target macro area / Vulnerable category	Mobility/Low-income households, unemployed persons	
Indicator	Number of supported persons: 180	
Remarks	The goal is to provide social care and protection to citizens from socially vulnerable categories, residents of Kumanovo, by stimulating them to use bicycles, in order to improve the quality of their lives. In this regard, the Municipality of Kumanovo undertakes activities to increase the level of health and social education, raise public awareness and improve citizens' familiarisation with socially sensitive issues. It promotes healthy lifestyles and raises public awareness and healthcare culture in order to reduce dangers and health problems among citizens.	

4.3. Adaptation

4.3.1. Overview of incorporated actions

As global temperatures continue to rise due to harmful greenhouse gas emissions, the need for climate change adaptation is becoming increasingly emphasised. Climate change adaptation activities are essential for mitigating the harmful impacts of climate change on society, economy and natural ecosystems. Most sectors are threatened by changes in temperature, precipitation and extreme weather events, which will potentially lead to significant economic losses, changes in disease patterns and resource availability. Adapting to these changes requires a holistic interdisciplinary approach that encompasses a blend of policymaking, engineering and social mobilisation to ensure resilience in the face of ever-increasing climate change.

As can be seen from the risks and vulnerabilities analysis, Kumanovo is most affected by extreme heat and wildfires, but also by floods and rainfall, as well as droughts. Of the identified sectors, climate change has the greatest impact on health, followed by agriculture and forestry. Therefore, the activities that are proposed have the greatest impact on these climate phenomena and sectors.

This plan contains 6 actions for climate change adaptation, most of which are in the energy sector (2 actions), a sector that has a horizontal impact on all identified climate phenomena. In addition, actions are proposed in the water (2 actions), agriculture and forestry (1 action) sectors, as well as land use planning (1 action). The listed actions have been selected after prior selection and prioritisation in accordance with the process outlined in chapter 3.

The selected actions are ranked by sectors of action by designating key actions as well as their interaction with other actions proposed in the mitigation and energy poverty sections. Some of the actions have already been launched, while the rest are planned for implementation in the period up to 2030.

Each of the actions is explained in accordance with the guidelines in the Guidebook "How to Develop a Sustainable Energy and Climate Action Plan (SECAP)" from the Covenant of Mayors initiative by providing:

- Action description
- Implementation timeframe
- Responsible authority
- Cost estimate (Investment and non-investment expenditures)
- Monitoring indicators
- Basic economic indicators, such as cost avoidance, return on investment, and job creation.

Additionally, the stakeholders covered by the given action are presented, as well as the financing opportunities for each action.

Each of the actions is defined by its own identification number where the letters AA indicate that the action belongs to the section on adaptation actions, while the number indicates the action.

Table 16 **Climate Change Adaptation Actions Overview**

Adaptation action	Mitigation	Adaptation	Energy Poverty
Wildfires			
Sector: Agriculture and forestry			
AA1 - Procurement of vehicles and equipment for urban, rural and wildfires coping and management	√	√	
Floods			
Sector: Water			
AA2 - Conducting a study for improving the hydrotechnical infrastructure		√	
AA3 - Development and maintenance of storm sewar		√	
Other			
Sector: Energy			
AA4 - Expanding the gas network	√	√	
AA5 - Promotion of green energy use opportunities	√	√	
Sector: Land use planning			
AA6 - Integration of climate change in urban planning	√	√	
Sector: Waste			
AA7 - Waste management programme		√	

4.3.2. Urban and rural fires and wildfires

Fires are a common occurrence among current risks in the Municipality of Kumanovo according to the analysis of historical events. Additionally, according to the analysis of future risks, this phenomenon is expected to increase in intensity, but also in frequency in the short and medium term.

In terms of the baseline inventory of greenhouse gas emissions, this sector is the primary polluter in the municipality.

Wildfires, but also urban and rural fires, as a climatic phenomenon, are usually related to heat waves, as well as periods of drought.

The analysis of these two climatic phenomena among future risks is unfavourable, and therefore, it is necessary to increase the capacity of the municipality and the relevant services for dealing with fires.

It has been identified that it is necessary to apply one measure for adapting to climate change - fires: increasing the capacity for extinguishing fires by procurement of vehicles and equipment for coping with and managing wildfires and urban and rural fires. By increasing the rapid response capability of the services, it is expected to impact both the intensity and frequency of fires and reduce them significantly compared to the increase defined in the climate change risks and vulnerabilities analysis.

☑ **Mitigation** ☒ **Adaptation** ☒ **Energy poverty**	**AA1 - Procurement of vehicles and equipment for urban, rural and wildfires coping and management**	
Action description	In response to the increased threat of urban and rural fires and wildfires in Kumanovo, an action is envisaged to increase the capacities of the firefighting units, with a special emphasis on wildfires and urban areas near forests. This action also includes procurement of a special vehicle with a hydraulic ladder (or platform), especially in the context of the numerous high-rise residential buildings in the city, and in the vicinity of forests and procurement of a new tilting vehicle with a water capacity of 4 to 6 tons, the procurement of a technical vehicle equipped for rescue operations in traffic accidents and other natural disasters. This would address the existing gaps in emergency response capabilities and rapid reactions, ensuring a holistic approach to the challenges caused by climate and fires, with a special emphasis on wildfires. The procurement of the equipment would be done gradually. This action highlights Kumanovo's commitment to adaptation and building resilience in the face of the increasing number of fires and their impact on environmental pollution, as can be seen from the 2019 BEI of the Municipality of Kumanovo.	
Implementation timeframe	2025-2030	
Financing opportunities	Donations National funds and programmes European funds and programmes Municipality of Kumanovo's Budget	
General section		
Responsible authority	**Stakeholders**	**Costs**
Territorial Firefighting Unit - TFFU Kumanovo, PE National Forests	Kumanovo Territorial Firefighting Unit (TFFU) PE National Forests CMC Kumanovo National and regional authorities Local communities Environmental NGOs and nature protection organisation Academic and research institutions International organisations	0.5 million EUR

Mitigation	
Sector	Sector: Other Tool/Area of intervention: Agriculture and forestry Action policies/instruments Other
Assessed impact	CO_2 emissions reduction: 1,056 $ktCO_2$ for 2030 CO_2-eq emissions reduction: 1,567 $ktCO_2$-eq for 2030
Indicators	CO_2 emissions reduction Greenhouse Gas Emissions Reduction ($ktCO_2$-eq)
Adaptation	
Climatic hazard/Sector	Wildfires/Agriculture and forestry
Indicators description	he indicator “Forest area”, when considered in relation to wildfires, provides insight into the potential impact and vulnerability of forest areas to wildfires. Monitoring this indicator together with wildfires data allows for the identification of high-risk regions and facilitates the implementation of targeted fire management strategies. In addition, changes in areas under forest can reflect the consequences of wildfires, such as post-fire land cover changes, which are key to understanding the long-term environmental and socioeconomic impacts of wildfires.
Indicators	Forest area: 7.12 kha
Economic indicators	/

4.3.3. Floods

With the risk and vulnerability assessment, the climatic phenomena of extreme precipitation and floods have a medium impact in the current risks but tend to increase in terms of the medium and long-term analysed periods.

According to the available data, Kumanovo was flooded several times with serious consequences in the period from 1935 to 2016.

The critical points of urban flooding in the city are usually overpasses or any street in the city with a configuration to capture (retain) water during intense rains.

Due to the insufficiently developed infrastructure, both in terms of water supply and sewage systems and regulation of riverbeds, an action is foreseen in this section for the preparation and implementation of a comprehensive study for the improvement of the hydrotechnical infrastructure of the municipality.

☑ Mitigation ☒ Adaptation ☒ Energy poverty	AA2 - Conducting a study for improving the hydrotechnical infrastructure	
Action description	This action foresees conducting a Study for the Improvement of Hydrotechnical Infrastructure at the municipal level in Kumanovo, which highlights the municipality's approach to climate adaptation by addressing critical water management challenges and strengthening resilience to climate-related hazards. By focusing on ensuring access to clean drinking water in all settlements and strengthening the capacity of local communities in rural areas to effectively manage water resources, the municipality aims to mitigate climate change impact on water availability and quality. Additionally, through campaigns, water loss analysis and construction of wastewater drainage systems, the action plan seeks to minimise the risk of water-related disasters, such as floods and contamination, and thereby strengthen the municipality's resilience to extreme weather events. By creating a registry of septic tanks and a plan for their connection to the existing sewage system, along with regular maintenance and cleaning of septic tanks, the Study contributes to the reduction of water pollution and the protection of water resources from contamination, and alignment with broader climate adaptation goals.	
Implementation timeframe	2025-2030	
Financing opportunities	Own resources EU funds	
General section		
Responsible authority	**Stakeholders**	**Costs**
Municipality of Kumanovo / PE Vodovod	Municipality of Kumanovo PE Vodovod Crisis Management Centre NGOs and civil society Citizens Business community, international organisations	>50 million EUR (the Study will provide a detailed assessment)
Adaptation		
Climatic hazard/Sector	Floods/Water	
Indicators description	Length of the constructed water supply network in km - This indicator measures the total length of new water supply pipelines constructed within the municipality. It reflects the extent of infrastructure development aimed at expanding access to drinking water and improving the efficiency of water distribution. Number of inhabitants connected to the water supply network - This indicator quantifies the total population gaining access to the municipal water supply network due to infrastructure development efforts. It provides insight into the extent of increased access to safe drinking water and improved public health outcomes. Reduced drinking water consumption in rural settlements - This indicator monitors the reduction in per capita drinking water consumption in rural settlements following the implementation of water conservation measures or infrastructure improvements. It reflects efforts to promote efficient water use and reduce waste in rural communities. Reduced % of losses in the water supply system - This indicator measures the percentual reduction in water losses in the municipal water supply system, including leaks, cracks and unauthorised consumption. It highlights improvements in infrastructure integrity, maintenance practices and water management efficiency. Number of septic tanks - This indicator counts the total number of septic tanks installed or in use in the municipality. It provides insight into the prevalence of decentralised wastewater treatment systems and the potential environmental impact of untreated wastewater. Number of newly connected households to the sewerage network - This indicator quantifies the number of households gaining access to the municipal sewerage network via new connections or infrastructure expansion projects. It reflects the efforts to improve sanitation, reduce pollution and protect water quality. Length of regulated riverbeds - This indicator quantifies the total length of regulated or controlled riverbeds. It reflects efforts to manage surface water runoff, prevent erosion, and maintain adequate drainage in urban and rural areas.	
Indicators	Length of the constructed water supply network in km Number of inhabitants connected to the water supply system Reduction of drinking water consumption in rural settlements Reduced % of losses in the water supply system Number of septic tanks Number of newly connected households to the sewerage network Length of regulated riverbeds	
Economic indicators	/	

☑ Mitigation ☒ Adaptation ☒ Energy poverty	AA3 - Development and maintenance of storm sewar	
Action description	The stormwater sewer system has a total length of approximately 30 km, through which storm wastewater is drained. The length of the stormwater sewer system within the Municipality of Kumanovo, more precisely in the central city area of the city of Kumanovo makes about 20% of the total required length - i.e. the municipality has a low percentage of storm sewer coverage. The measure to increase stormwater sewer system and its maintenance aims to improve stormwater management and reduce the risks of floods and erosion. This measure includes several key actions: preparation of project documentation for priority settlements and populated areas, construction of new stormwater sewer systems, and developing plans for regular maintenance of these systems. By preparing technical documentation, a detailed plan and guidelines for the construction and optimisation of the stormwater sewer network will be provided. The construction of new systems will increase the capacity for stormwater drainage, which will contribute to reducing floods and improving the safety and quality of life of citizens. Regular maintenance plans will ensure that systems remain functional and efficient, ensuring the long-term protection of infrastructure and the environment.	
Implementation timeframe	2025-2030	
Financing opportunities	Budget of the Municipality of Kumanovo / International financial institutions	
General section		
Responsible authority	**Stakeholders**	**Costs**
Municipality of Kumanovo / PE Vodovod	Municipality of Kumanovo PE Chistota i zelenilo PE Vodovod Local residents Nongovernmental organisations (NGOs) Construction companies Utility and infrastructure companies	It will be determined after preparing the technical documentation and determining the required length and diameters. Evaluated at: 15 million EUR
Adaptation		
Climatic hazard/Sector	Floods/Water	
Indicators description	Length of constructed stormwater sewers - this indicator measures the volume of newly constructed or rehabilitated stormwater sewer networks, which is a direct indicator of progress in improving stormwater management in the municipality. This indicator is key to assessing the effectiveness of measures taken to reduce the risk of floods and erosion, improve urban infrastructure and increase the safety and quality of life of citizens. Increasing the length of storm sewers means improved stormwater drainage capacity, resulting in reduced flood damages, improved hygiene and sanitation, and increased resilience of the municipality to extreme weather conditions and climate change.	
Indicators	Length of the stormwater sewer system	
Economic indicators	/	

4.3.4. Other/All climatic phenomena

This section covers actions that affect other climate phenomena, or horizontally affect a larger number of climate phenomena, such as measures in the energy sector (with a focus on climate change adaptation, but also with an impact on mitigation), urban planning, etc.

ENERGY

Energy plays a key role in climate change adaptation efforts as a cross-cutting measure with a common impact on a variety of extreme climate events. The complex interaction between energy systems and climate dynamics highlights the importance of integrating energy actions into adaptation strategies. Whether enhancing resilience to extreme weather events with secure energy supply systems or facilitating the transition to renewable energy sources to mitigate greenhouse gas emissions, energy intersects with almost every aspect of climate adaptation. By adopting a holistic approach to energy management,

policymakers, communities and stakeholders can improve their capacity to adapt to the challenges posed by climate change, fostering a more resilient and sustainable future for all.

This section has two actions targeting the energy sector: expanding the gas network and promoting green energy opportunities.

☑ Mitigation ☒ Adaptation ☒ Energy poverty	AA4 - Expanding the gas network	
Action description	In view of the increasing risks and vulnerabilities caused by climate change, the Municipality of Kumanovo is taking actions to strengthen its resilience and adaptability. This action incorporates expansion of the natural gas network, which aims to foster a more climate-resilient energy infrastructure. With the completion of four projects setting up gas networks on five streets in 2023, the municipality has demonstrated its commitment to reducing carbon emissions and mitigating the impact of climate change. In the future, the emphasis will be placed on expanding the gas network to include industrial zones and vital public facilities such as schools and kindergartens. The length of the gas network is expected to increase by 40km. With this strategic extension with a priority on introducing cleaner energy sources, Kumanovo is strengthening its resilience against climate-related risks by introducing reliable and clean energy sources, while contributing to global efforts in combating climate change.	
Implementation timeframe	2025-2030	
Financing opportunities	Municipality of Kumanovo's Budget	
General section		
Responsible authority	**Stakeholders**	**Costs**
PE Kumanovo Gas	Municipality of Kumanovo PE Kumanovo Gas Citizens Energy suppliers NGO sector Business community Academic and research institutions Governmental agencies and bodies	1 million EUR
Mitigation		
Sector	Sector: Buildings, equipment/facilities -Industry Tool/Area of intervention: Energy efficiency of buildings Action policies/instruments Other	
Assessed impact	CO_2 emissions reduction: 9.79 ktCO_2 in 2030 (only public facilities) CO_2-eq emissions reduction: 9.84 ktCO_2-eq in 2030 (only public facilities)	
Indicators	CO_2 emissions reduction Greenhouse Gas Emissions Reduction (ktCO_2-eq)	
Adaptation		
Climatic hazard/Sector	Other/Energy	
Indicators description	Energy diversity/Gas share in the energy mix - increasing the diversity of energy sources used in the municipality, including the percentual share of natural gas in the overall energy mix. Greater diversity of energy sources increases resilience to disruptions and price fluctuations related to climate change impacts. Number of connected users - The number of connected natural gas users is 30 legal entities, around 180 units in collective residential buildings and the rest are public institutions, kindergartens, primary and secondary schools, public enterprises, collective residential buildings and 72 individual natural gas connections for natural persons. The percentage of households using natural gas in the Municipality of Kumanovo is currently around 1%.	
Indicators	Energy diversity/Gas' share in the energy mix: 30% Increased number of natural gas users: 250 new users	
Economic indicators	/	

☑ Mitigation ☒ Adaptation ☒ Energy poverty	AA5 - Promotion of green energy use opportunities	
Action description	As part of its climate adaptation strategy, the Municipality of Kumanovo is taking a significant initiative to promote the production of green energy. By installing photovoltaic systems on all its buildings, the municipality aims to reduce its carbon footprint while increasing its resilience to the climate change impact. In addition to mitigating climate change by reducing carbon emissions and strengthening energy security, the installation of PV systems on all municipal buildings in Kumanovo also contributes to climate adaptation by fostering local resilience. By decentralising energy production and promoting local production, the municipality reduces its dependence on centralised electricity grids vulnerable to climate-related disturbances, such as storms or heat waves. Furthermore, by producing clean energy locally, Kumanovo ensures constant access to electricity during emergencies, thereby strengthening the city's adaptive capacity and increasing its overall resilience to the impacts of climate change.	
Implementation timeframe	2025-2030	
Financing opportunities	European funds and programmes Municipality of Kumanovo's Budget	
General section		
Responsible authority	**Stakeholders**	**Costs**
Municipality of Kumanovo	Municipality of Kumanovo Citizens Energy suppliers NGO sector Business community Academic and research institutions Governmental agencies and bodies	2.5 million EUR
Mitigation		
Sector	Sector: Buildings, equipment/facilities Tool/Area of intervention: Electricity production Action policies/instruments Other	
Assessed impact	Production of renewable energy for 2030: 3,008 MWh CO_2 emissions reduction: 2.75 ktCO_2 for 2030	
Indicators	Production of renewable energy CO_2 emissions reduction	
Adaptation		
Climatic hazard/Sector	Other/Energy	
Indicators description	Increased use of renewable energy by demonstrating examples and success stories – The citizens of the Municipality of Kumanovo are the main users of public buildings, from schools to services that are part of their everyday lives. By using clean and green energy in public buildings as a practical example, increased use of this measure is expected in other sectors of society. Increased sustainability (by reducing of grid-supplied energy) and increased use of local green energy - Local energy production increases the availability of energy for the citizens of the municipality and socially vulnerable categories. In addition, the availability of clean and green energy in the municipality is increasing, and with the practical examples, its increased use by citizens is expected. Local improvement of air quality - by monitoring the improvements in local air quality that result from the reduced use of energy sources based on fossil fuels.	
Indicators	Energy diversity/Gas' share in the energy mix: 30% Increased number of natural gas users: 250 new users	
Economic indicators	Avoided cost: 700,000 EUR per year Return on investment: 28.85%	

LAND USE PLANNING

In addition to energy, land use planning also serves as a key horizontal measure with a significant impact on climate adaptation in various extreme events. Careful management and allocation of land plays an important role in mitigating the impacts of climate change, ranging from extreme weather events to changes in temperature and precipitation. Through strategic land use planning, municipalities can minimise exposure to hazards such as floods and wildfires by avoiding high-risk areas, anticipating climate and nature-based solutions such as green infrastructure and preserving natural resources. Furthermore, land use planning can promote sustainable urban development practices such as green zoning and improve resilience to heat waves and floods. By integrating climate into land use planning processes, municipalities can proactively adapt to changing environmental conditions and improve the economic situation and health of citizens.

☑ Mitigation ☒ Adaptation ☒ Energy poverty	AA6 - Integration of climate change in urban planning
Action description	This action includes comprehensive integration of climate change within the municipal urban planning, which includes the development of Detailed Urban Plans (DUP) and the adoption of the General Urban Plan (GUP) for the city of Kumanovo for 2023-2033. These plans will include solid measures aimed at strengthening climate change resilience, with a special focus on increasing the presence of green areas across the municipality, mapping the potential for the use of renewable energy sources, etc. By integrating green infrastructure and sustainable design principles into the scope of urban planning, the municipality is prepared to create more resilient and adaptive urban environments capable of withstanding the impacts of climate change. This action includes integrating data related to greenery, in order to better adopt appropriate measures and decisions, establishing an IT system for integrating data related to greenery, developing a Green Cadastre, protecting and promoting urban green areas on the territory of the Municipality of Kumanovo, maintaining and restoring public green areas, planed and specific activities to increase public green areas in the Municipality, with special attention to the type of seedlings depending on the location and purpose of the space, as well as the role of greenery, introducing new initiatives such as public urban gardens, green roofs, green facades, etc. It is also expected that there will be less concrete in the city by introducing norms for mandatory greenery when building new buildings. In addition, it is expected that urban forests and the area under forests near the city will increase, as a response to increased air pollution.
Implementation timeframe	2025-2030
Financing opportunities	Municipality of Kumanovo's Budget

General section		
Responsible authority	**Stakeholders**	**Costs**
Municipality of Kumanovo / PE Chistota i zelenilo / PE Kumanovo Plan	Municipality of Kumanovo PE Chistota i zelenilo PE Kumanovo Plan Local residents NGOs Construction companies Utility and infrastructure companies Academic and scientific institutions working on urban planning and climate adaptation	0.5 million EUR

Mitigation	
Sector	Sector: Other Tool/Area of intervention: Urban regeneration Policies/instruments for action: land use planning regulations
Assessed impact	CO_2 emissions reduction: 44 ktCO_2 for 2030
Indicators	CO_2 emissions reduction CO_2 emissions reduction
Adaptation	
Climatic hazard/Sector	Other/Land use planning
Indicators description	Developed GUP with integrated climate change - The development of the GUP and DUPs include elements related to climate change and climate change adaptation, such as green areas, potential for the use of renewable energy sources, etc. Green cadastre is created - Development of a Green Cadastre of the Municipality of Kumanovo, which will include the greenery of public, educational and other institutions, as part of the city's green reserves. Increased urban green area - expansion of green areas in the Municipality of Kumanovo, reflecting efforts to improve urban resilience and promote sustainability. Currently, Kumanovo has approximately 250,000 square meters of green area. As part of ongoing climate adaptation and urban planning initiatives, this green area should be increased by an additional 30,000 square meters. This expansion represents a commitment to fostering a greener, more resilient urban environment, providing numerous benefits such as improved air quality, biodiversity conservation and increased recreational opportunities for residents. By strategically increasing the urban green space, Kumanovo aims to mitigate the impacts of climate change, enhance urban biodiversity and create healthier, more sustainable and resilient communities. Increased area under forest in the vicinity of the city - due to the possibility of increasing the forest near the city and the areas that allow it, an expansion with additional 200 ha of forest is planned. Reduced area under concrete in the city - this indicator will be achieved by increasing the urban forests, but also by implementing norms for a mandatory share of greenery with newly built buildings.
Indicators	GUP with integrated climate change elements: 1 plan Green Cadastre; 1 plan Increased green urban area: 30,000 m2 Increasing the area under forest in the vicinity of the city: 200 ha Reducing the areas under concrete in the city: 20%
Economic indicators	/

WASTE

The Waste Sector, or more specifically Waste Management, plays a key role in maintaining public health, protecting the environment and promoting sustainable development. Effective waste management involves systematic collection, transport, treatment and disposal of waste, along with strategies to reduce waste generation and encourage recycling and reuse. As urbanisation and population increase the volume of generated waste, innovative and efficient waste management practices are essential to mitigate environmental impacts, reduce greenhouse gas emissions and conserve natural resources. By implementing waste management systems, municipalities can improve the quality of life of residents, improve environmental sustainability and contribute to the fight against climate change.

☑ Mitigation ☒ Adaptation ☒ Energy poverty	AA7 - Waste management programme	
Action description	The Waste Management Programme aims to transform the waste management system in Kumanovo by promoting waste reduction, strengthening recycling efforts, and ensuring sustainable waste disposal and reuse. This programme includes the following key components: Waste Segregation and Recycling Campaign – Educating residents on the importance of waste segregation, recycling, and composting. Increasing Recycling Capacity - Establishing and improving recycling facilities for various types of materials, including plastic, paper, glass, and metal. Incentive Programmes – Introducing incentive programmes for households and businesses to actively participate in recycling efforts. Organic Waste Management and Composting Programmes – Implementing community composting programmes for organic waste management, such as providing composters and training for the inhabitants. Improved Waste Collection Services – Improving the frequency and efficiency of timely and regular collection of segregated waste by using waste collection points and similar methods. Sustainable landfill management and waste-to-energy initiatives - Sustainable landfill management and waste-to-energy initiatives are key to reducing harmful emissions and creating energy from waste. Waste management policies - developing policies that mandate segregation, recycling, and responsible waste disposal practices for households, businesses, and industries.	
Implementation timeframe	2025-2030	
Financing opportunities	Municipality of Kumanovo's Budget	
General section		
Responsible authority	**Stakeholders**	**Costs**
Municipality of Kumanovo PE "Chistota i zelenilo"	Municipality of Kumanovo PE "Chistota i zelenilo" Citizens NGO sector Business community Academic and research institutions Governmental agencies and bodies	0.3 million EUR (non-investment expenditures)
Adaptation		
Climatic hazard/Sector	Other/Waste	
Indicators description	Increased waste segregation and increased recycling rates - More households and businesses will recycle regularly. Reduced volume of landfilled waste - Increased recycling and composting will reduce the amount of waste going to landfills. Increased awareness and citizen participation in waste management - Citizens will be better informed and more engaged in sustainable waste practices. Improved environmental quality and reduced greenhouse gas emissions - Effective waste management will lead to a cleaner environment and lower greenhouse gas emissions.	
Indicators	Increased waste segregation and increased recycling Reduced volume of landfilled waste Raised awareness and participation of citizens in waste management Improved environment quality and reduced greenhouse gas emissions	
Economic indicators	/	

4.4. Energy Poverty Reduction Actions Overview

Climate change and extreme climate events disproportionately affect certain groups in society. For example, extreme climate events such as floods, high temperatures and cold have a significantly greater impact on socially vulnerable categories than on other stakeholders, because this group has limited access to energy and financial resources.

By implementing measures targeting socially vulnerable groups and energy poverty, such as improving access to clean energy sources, improving energy efficiency and promoting renewable energy technologies, we can mitigate climate change impact while also tackling energy poverty as a more prevalent phenomenon in society.

Therefore, integrating climate actions in dealing with energy poverty is essential for building fairer and more resilient societies.

This plan contains one action with its main focus on energy poverty, although the entire action plan contains 4 measures that in addition to mitigation, also target energy poverty.

The envisaged action is aimed at the target macro area Mobility, while the vulnerable category covered by this measure is low-income households and unemployed persons.

Each of the actions is explained in accordance with the guidelines in the Guidebook "How to Develop a Sustainable Energy and Climate Action Plan (SECAP)" from the Covenant of Mayors initiative by providing:

- Action description
- Implementation timeframe
- Responsible authority
- Cost estimate (Investment and non-investment expenditures)
- Monitoring indicators

Additionally, the stakeholders covered by the given action are presented, as well as the financing opportunities for each action.

Each of the actions is defined by its own identification number where the letters EP indicate that the action belongs to the section on energy poverty, while the number indicates the action.

Table 17 **Energy Poverty Reduction Actions Overview**

Adaptation action	Mitigation	Adaptation	Energy Poverty
Mobility			
Vulnerable category: Low-income households, unemployed persons			
EP1 - Introducing free transport	√		√

☑ Mitigation ☒ Adaptation ☒ Energy poverty	EP1 - Introducing free transport	
Action description	In the Municipality of Kumanovo, public transport operates with a total of 28 lines. In order to reduce city traffic congestion and solve parking problems in the central city area, the Municipality introduced free public transport for all categories of citizens. This measure also has an additional impact on environmental protection and the reduction of air pollution in the city. With the introduction of this measure, the number of public transport users has increased dramatically from 7,000 users to 20,000 users. The action is expected to remain in the coming period, with 100% subsidisation of public transport, which is expected to reduce private transport, and thus reduce greenhouse gas emissions from the transport sector.	
Implementation timeframe	2025-2030	
Financing opportunities	- Own resources	
General section		
Responsible authority	**Stakeholders**	**Costs**
Municipality of Kumanovo	National bodies and/or agencies Citizens	6 million EUR
Mitigation		
Sector	Sector: Transport Tool/Area of intervention: Change in the public transport Action policies/instruments Grants and subsidies	
Assessed impact	Energy savings: 19,605 MWh for 2030 CO_2 emissions reduction: 5.2 ktCO_2 for 2030 CO_2-eq emissions reduction: 5.2 ktCO_2-eq for 2030	
Indicators	- Energy saving (MWh) - Emissions reduction (ktCO_2-eq)	
Energy Poverty		
Target macro area / Vulnerable category	Mobility/Low-income households, unemployed persons	
Indicator	Number of beneficiaries from the socially vulnerable categories: 6,000 persons Total number of beneficiaries: 20,000 persons per month	
Remarks	Transport poverty is a concept often discussed in relation to energy poverty. According to the European Parliament, transport poverty refers to the lack of adequate transport services necessary to access general services and work, or the inability to pay for these transport services. Transport energy poverty is a part of transport poverty that refers specifically to vulnerability to rising fuel prices. This action includes transport poverty as a challenge to be addressed in coordination with energy poverty and the reduction of CO_2 emissions.	

5 SOURCES OF FUNDING AND FINANCIAL PLANNING

Local authorities have a range of financing options available to them, and the choice of sources of funding depends on factors such as project requirements, financial capacity, risk tolerance and strategic priorities. It is essential to carefully assess and plan financing strategies to ensure sustainable implementation of projects that benefit the local community.

In general, three types of financing options are available for the implementation of the Sustainable Energy and Climate Action Plan:

(i) Core financing capability i.e. the ability to finance actions from one's own budget or with one's own resources.

The Municipality of Kumanovo generates revenues through local taxes, fees and charges levied on residents, businesses and property owners. These can be allocated to finance and invest in the implementation of the Plan. These sources of funding also include the budgets of public enterprises under the Municipality.

(ii) Capacity to secure funding i.e. the ability to use additional finances through grants and/or loans.

In the case of grant funds, they can be provided by the national government or international organisations by financing specific projects. North Macedonia as a candidate country for EU membership has access to various funding programmes provided by the EU. Local governments can apply for grants and financial assistance from EU funds to support projects related to sustainable energy and climate. In addition, development banks and international financial institutions provide loans, grants and technical assistance for development of projects in various sectors.

Local governments also have the opportunity to borrow funds through loans or by issuing municipal bonds. Loans can be obtained from banks or financial institutions, while bonds involve the sale of debt securities to investors. Repayment can be structured over a certain period of time, and interest rates can vary based on market conditions and the creditworthiness of the city.

(iii) Expanded financing opportunities – i.e. the possibility of additional financing through innovative means (Public-Private Partnerships (PPPs), concessions, taxation, green bonds, etc.).

Local authorities can collaborate with private sector entities to jointly finance and implement projects. PPPs can be useful for sharing risks, accessing private sector expertise and leveraging private sector financing. These partnerships can cover a wide range of projects, including energy efficiency, renewable energy, infrastructure development and urban regeneration.

In some cases, local governments can explore crowdfunding platforms or community financing initiatives to raise funds for specific projects. This approach involves engaging with local residents, businesses and stakeholders to contribute financially to initiatives that benefit the community.

Another option is to conclude revenue-sharing agreements with private entities involved in revenue-generating projects, such as tolls, parking facilities and public transport or lighting systems. These agreements allow municipalities to receive a share of the revenues generated by the project, which can be reinvested in other municipal initiatives.

To implement the Plan, local authorities can use a single type of financing or make a financial structure from several available financing options.

Currently, different financing options for Sustainable Energy and Climate Action Plans are available and can be found on the platform1 on the official website of the "Covenant of Mayors" initiative.

The platform is a generator of financial opportunities that can be searched by: (i) the type of requested support (technical assistance, plan development or implementation of actions); (ii) the country/region in which the Local Self-Government Unit is located; (iii) the sector to which the action belongs; (iv) type of financing (loan, grant, technical support); and (v) scope of the action. Additionally, it is possible to choose whether to include co-financing of the action as well as the type of financial security.

Each of the offered financing opportunities is explained in detail in the application process description and conditions, eligible examples and useful links.

1. https://eu-mayors.ec.europa.eu/en/resources/funding_guide

6 CONCLUSIONS

The implementation of mitigation actions results in energy savings, increased energy production from renewable energy sources, as well as greenhouse gas emission reduction. In addition, some of the adaptation measures also have impact on greenhouse gas emissions. Their impact is estimated for the target year of 2030 compared to the 2019 reference year for which the Baseline Greenhouse Gas Emissions Inventory of the Municipality of Kumanovo was compiled.

Furthermore, a cross-section of the impacts is provided for 2027 as a short-term target when the first report on the implementation of the Plan is expected to be drafted, as well as for 2040 as an additional medium-term target. In reference to the EU vision for decarbonisation, estimated impact of the given measures is also provided for 2050 as the long-term target of the Plan.

For 2030, the total reduction in greenhouse gas emissions is expected to be 1,742 $ktCO_{2\text{-}eq}$, which represents 47% compared to the 2019 Baseline Greenhouse Gas Inventory and amounts to 3,706 $ktCO_{2\text{-}eq}$. The following table presents the emission reductions by sector.

Figure 6 **Greenhouse Gas Emissions Reduction in 2027, 2030, 2040 and 2050 in comparison to the 2019 as a reference year**

Table 18 **Greenhouse Gas Emission Reduction in 2030 compared to 2019 ($ktCO_2$-eq)**

Sector	Greenhouse Gas Emissions Reduction in 2030	2019 Baseline Greenhouse Gas Inventory	Greenhouse Gas Reduction in 2030 in reference to 2019
Stationary energy	170.0	331.5	51.2%
Transport	5.5	201.2	2.7%
Waste	0	41.3	0.0%
Industrial processes	0	0.0	0.0%
AFOLU*	1567	3,132.2	50.0%
TOTAL	1,742	3,706	47.0%

*AFOLU – Agriculture, forestry and other land use

Of the total emission reductions, the largest share of 1,567kt kt $CO_{2\text{-eq}}$ or 90% is expected in the "Agriculture, forestry and other land use" sector. This result is logical due to the fact that this sector's share in the total baseline inventory is 85% and implementing actions to reduce it is more than necessary.

When the analysis is conducted by sector, the "Stationary Energy" sector's impact is largest with 51.2% resulting from the inclusion of both actions in the residential sector as well as some of the actions proposed in the area of climate change adaptation. This emphasises the need for investments in energy efficiency in the buildings sector and greater use of renewable energy.

Of all the proposed actions, the greatest effect in 2030 results from the measure "AA1 - Procurement of vehicles and equipment for urban, rural and wildfires coping and management" as a key action for climate change adaptation and the measure "MA6 - Raising public awareness about the significance of climate change", a measure that is key in the residential buildings sector.

In terms of climate change adaptation measures, the Risk and Vulnerability Assessment clearly identifies the extreme climate events that have the greatest impact on the territory of the Municipality of Kumanovo, as well as the most vulnerable sectors, both now and in the future, in the medium and in the long term. Based on the risk and vulnerability analysis, priority measures have been identified that the Municipality of Kumanovo should implement to deal with the consequences of climate change, despite efforts to mitigate them. The key measures are defined as Procurement of vehicles and equipment for dealing with and managing wildfires and Promotion of opportunities for the use of green energy.

By implementing actions aimed at adaptation, the Municipality of Kumanovo aims to improve the quality of the environment and improve air and water quality, by increasing urban greenery and forests, to deal with surface and groundwater pollution, but also to integrate climate change in urban planning.

Simultaneously, the Municipality of Kumanovo wants to increase the resilience in every sphere of society, by implementing measures aimed at preventing floods and extreme climate events such as wildfires, but also by increasing the resilience of its infrastructure, especially in the energy sector, expansion of the gas network and having a more diverse energy mix, including promoting "green" energy from renewable energy sources.

The goal of creating a resilient Kumanovo with a clean environment will ensure improved well-being and increased quality of life for all citizens on the territory of the municipality, but it will also represent a role model for other local governments in the country.

From the perspective of energy poverty, a special focus is placed on improving the economic situation of socially vulnerable categories of citizens by providing targeted subsidies for key problems related to reliable access to energy sources as well as increased mobility to access basic services for this target group, such as schools, greater job opportunities and free public transport. The vulnerable social categories are particularly affected by climate change, especially because these target groups do not have adequate capacity to cope with climate events, such as extreme heat and cold, and therefore the Sustainable Energy and Climate Action Plan places special emphasis on this target group.

The general conclusion of all stakeholders is that this Action Plan is not a wish list but a realistically achievable framework that will lead the city towards achieving the vision of low-carbon development. However, the municipality calls on citizens' associations, businesses and the international community with an active energy and climate portfolio, to continue and upgrade the cooperation with the Municipality of Kumanovo in order to strengthen the resilience of the municipality and move closer to the long-term strategy for a climate-neutral municipality with a significantly improved quality of life.

Figure 7 **Potential Greenhouse Gas Emissions Reduction in 2030 by action (kt CO_2-eq)**

7 REFERENCES

1. Стратегија за развој на енергетиката во Република Северна Македонија до 2040 година, МАНУ, (2019) (Energy Development Strategy in the Republic of North Macedonia 2040)
2. Long-term Strategy on Climate Action of the Republic of North Macedonia, GFA CONSULTING, (2021)
3. Греење и Климатизација, Реклегер, Спренгер и Срамек, (2004) (Heating and Air Conditioning, Rekleger, Sprenger and Sramek)
4. Прирачник за енергетско сертифицирање на згради, повеќе автори, (2010) (Manuel for Energy Certification of Buildings, multiple authors)
5. ASHRAE, a global community for advancing human well-being with the help of sustainable technologies. Editions:
    - 2023 ASHRAE Handbook — HVAC Applications
    - 2022 ASHRAE Handbook — Refrigeration
    - 2021 ASHRAE Handbook — Fundamentals
    - 2020 ASHRAE Handbook — HVAC Systems and Equipment
6. Gas distribution network in North Macedonia, Grant Thornton, funded by EBRD, (2020)
7. Правилник за субвенционирање на колективните станбени згради за уредување на дворните површини во Општина Куманово за 2023 година, „Службен гласник на Општина Куманово“ бр. 15/2022, (2022) (Rulebook on Subsidising Collective Residential Buildings for Yards Landscaping in the Municipality of Kumanovo for 2023, "Official Gazette of the Municipality of Kumanovo" No. 15/2022, (2022))
8. Програма на активности од областа на заштитата на животната средина и природата на Општина Куманово за 2023 година, („Службен гласник на Општина Куманово бр. 13/03, 13/07, 08/15, 11/19 и 12/21, (2022) (Programme of activities in the field of environmental and nature protection of the Municipality of Kumanovo for 2023, ("Official Gazette of the Municipality of Kumanovo Nos. 13/03, 13/07, 08/15, 11/19 and 12/21, (2022))
9. Програма за субвенционирање на граѓани за приклучок на гасификациона мрежа на подрачје на Општина Куманово за 2023 година, „Службен гласник на Општина Куманово бр. 13/03, 13/07, 08/15, 11/19 и 12/21, (2022) (Programme for Subsidising Citizens to Connect to the Gas Network in the Area of the Municipality of Kumanovo for 2023, "Official Gazette of the Municipality of Kumanovo Nos. 13/03, 13/07, 08/15, 11/19 and 12/21, (2022))
10. Локален акционен план за животна средина на Општина Куманово (2022-2028) (Local Environment Action Plan of the Municipality of Kumanovo (2022-2028)), Друштво за технички консултантски Услуги “Екомозаик” ДООЕЛ Куманово, (2021)
11. План за одржлива урбана мобилност, Општина Куманово, (2021) (Sustainable Urban Mobility Plan, Municipality of Kumanovo, (2021))
12. План за подобрување на квалитетот на амбиенталниот воздух за Општина Куманово за период 2022-2026 (Plan for Improving the Ambient Air Quality for the Municipality of Kumanovo 2022-2026), Технолаб ДОО Скопје, 2021

Annex 1: Estimated impact of the planned measures in 2030

Actions	Estimated impact in 2030			
	Energy savings	Production of renewable energy	CO_2 emissions reduction	Greenhouse Gas Emissions Reduction
	MWh	MWh	$ktCO_2$	$ktCO_2$-eq
MITIGATION				
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES	155,622	1,848	128.7	129.7
Municipal buildings, equipment/facilities				
MA1 – Developing an Energy Efficiency Programme of the Municipality of Kumanovo	1,882	1,848	2.4	2.4
Residential buildings	87,526	45,291	110	111
MA2 - Subsidies for connecting to the gas network for households			6.4	6.5
MA3 - Efficient heating and cooling with heat pumps in households	40,119		26.3	26.6
MA4 - Increased use of renewable energy in households by installing solar thermal collectors	20,107		17.3	17.4
MA5 - Implementation of the programme for annual cleaning of chimneys (subsidies)	228		0.1	0.1
MA6 - Raising public awareness about the significance of climate change	27,072	45,291	59.8	60.1
TRANSPORT	**1,250**	**0**	**0.3**	**0.3**
Private and commercial transport	1,250		0.3	0.3
MA8 - Improving urban mobility	1,250		0.3	0.3
TOTAL MITIGATION	**90,658.2**		**112.7**	**113.4**

ADAPTATION				
Wildfires			1,056.0	1,567.0
AA1 - Procurement of vehicles and equipment for urban, rural and wildfires coping and management			1,056.0	1,567.0
Other		3,008.0	56.5	56.6
AA3 - Expanding the gas network (for public facilities)			9.8	9.8
AA4 - Promotion of green energy use opportunities		3,008.0	2.8	2.8
AA5 - Integration of climate change in urban planning			44.0	44.0
TOTAL ADAPTATION		3,008	1,112.5	1,623.6

ENERGY POVERTY				
Urban Mobility	19,605.2		5.2	5.2
EP1 - Introducing free transport	19,605.2		5.2	5.2
TOTAL ENERGY POVERTY	19,605.2		5.2	5.2
TOTAL MITIGATION AND ADAPTATION	**110,263.4**	**3,008.0**	**1,230.4**	**1,742.1**
BEI 2019			**3,085.2**	**3,706.1**
Reduction in reference to BEI 2019 in %			**39,9%**	**47,0%**

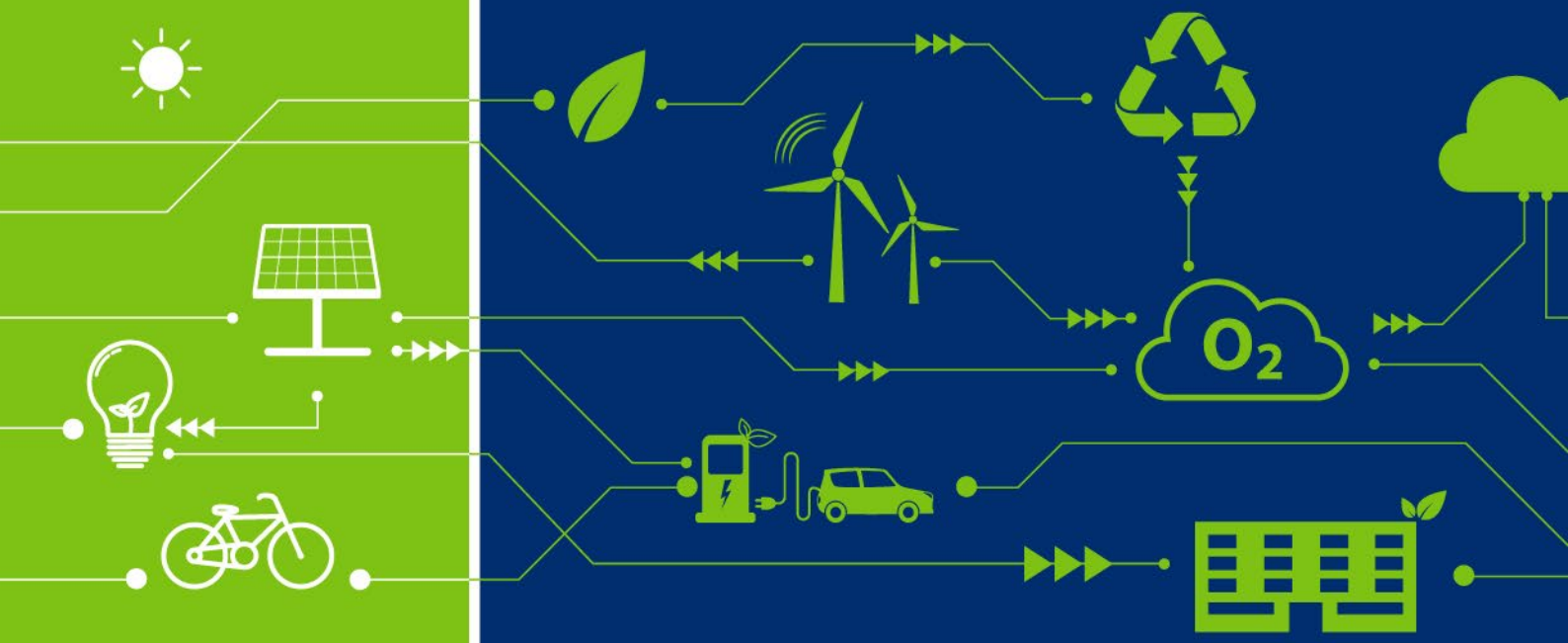
Annex 2: Baseline Greenhouse Gas Inventory, all sectors, 2019

GPC Ref No.	Range	Sources of greenhouse gas emissions	Gases (kt)			Gases (kt CO_2eq)				
			CO_2	CH_4	N_2O	HFC	PFC	SF6	NF3	Total CO_2 -eq
I		**STATIONARY SOURCES OF ENERGY**								331,48
I.1		**Residential buildings**								209,85
I.1.1	1	Emissions from internal combustion of fuel	50.40	54,29	0,00	No	No	No	No	54,29
I.1.2	2	Emissions from grid-supplied energy consumption	135.19	135,75	0,00	No	No	No	No	135,75
I.1.3	3	Losses in transmission and distribution of grid-supplied energy	19.74	19,81	0,00	No	No	No	No	19,81
I.2		**Institutional buildings/facilities**								0,00
I.2a		**Municipal buildings and facilities**								26,40
I.2a.1	1	Emissions from internal combustion of fuel	20.43	21,94	0,00	No	No	No	No	21,94
I.2a.2	2	Emissions from grid-supplied energy consumption	3.88	3,89	0,00	No	No	No	No	3,89
I.2a.3	3	Losses in transmission and distribution of grid-supplied energy	0.57	0,57	0,00	No	No	No	No	0,57
I.2b		**Public lighting**								0,00
I.2b.1	1	Emissions from internal combustion of fuel	t.e	t.e	t.e	No	No	No	No	0,00
I.2b.2	2	Emissions from grid-supplied energy consumption	t.e	t.e	t.e	No	No	No	No	0,00
I.2b.3	3	Losses in transmission and distribution of grid-supplied energy	t.e	t.e	t.e	No	No	No	No	0,00
I.2c		**Tertiary/Institutional buildings and equipment/facilities**								21,00
I.2c.1	1	Emissions from internal combustion of fuel	1.08	1,11	0,00	No	No	No	No	1,11
I.2c.2	2	Emissions from grid-supplied energy consumption	17.28	0,00	0,00	No	No	No	No	17,35
I.2c.3	3	Losses in transmission and distribution of grid-supplied energy	2.52	0,00	0,00	No	No	No	No	2,53
I.3		**Commercial**								26,68
I.3a.1	1	Emissions from internal combustion of fuel	0.09	0.09	0,00	No	No	No	No	2,33

I.3a.2	2	Emissions from grid-supplied energy consumption	21.16	0,00	0,00	No	No	No	No	21,25
I.3a.3	3	Losses in transmission and distribution of grid-supplied energy	3.09	0,00	0,00	No	No	No	No	3,10
I.4		**Manufacturing industry and construction**								38,14
I.4.1	1	Emissions from internal combustion of fuel	NE	NE	NE	No	No	No	No	0,00
I.4.2	2	Emissions from grid-supplied energy consumption	33.15	0,00	0,00	No	No	No	No	33,28
I.4.3	3	Grid-supplied energy	4.84	0,00	0,00	No	No	No	No	4,86
I.5		**Energy industries**								0,00
I.5.1	1	Emissions from internal energy production used in auxiliary operations	No.	No.	No	No	No	No	No	0,00
I.5.2	2	Emissions from grid-supplied energy consumption	No.	No.	No	No	No	No	No	0,00
I.5.3	3	osses in transmission and distribution of grid-supplied energy	No.	No.	No	No	No	No	No	0,00
I.5.4	1	Emissions from internal production of grid-supplied energy	No.	No.	No	No	No	No	No	0,00
I.6		**Agriculture, forestry and fishery**								0,02
I.6.1	1	Emissions from internal combustion of fuel	0.02	0,00	0,00	NE	NE	NE	NE	0,02
I.6.2	2	Emissions from grid-supplied energy consumption	t.e	t.e	t.e	NE	NE	NE	NE	0,00
I.6.3	3	Losses in transmission and distribution of grid-supplied energy	t.e	t.e	t.e	NE	NE	NE	NE	0,00
I.6		**Unspecified sources**								0,00
I.6.1	1	Emissions from internal combustion of fuel	No.	No.	No	No	No	No	No	0,00
I.6.2	2	Emissions from grid-supplied energy consumption	No.	No.	No	No	No	No	No	0,00
I.6.3	3	Losses in transmission and distribution of grid-supplied energy	No.	No.	No	No	No	No	No	0,00
I.7		**Fugitive emissions from mining, manufacturing, storage and transport**								0,00
I.7.1	1	Within the fugitive emissions limits	No.	No.	No	No	No	No	No	0,00
I.8		**Fugitive emissions from oil and natural gas systems**								9,39
I.8.1	1	Within the fugitive emissions limits	0,000855	0,375704	NE	No	No	No	No	9,39
II		TRANSPORT								201,15

II.1		Road transport								197,30
II.1.1	1	Internal transport emissions	193.77	0.03	0.01	No	No	No	No	197,30
II.1.2	2	Emissions from grid-supplied energy consumption	No.	No.	No	No	No	No	No	0,00
II.1.3	3	Cross border journeys emissions	NE	NE	NE	No	No	No	No	0,00
II.2		Railway								3,86
II.2.1	1	Internal transport emissions	0.11	0.00	0.00	No	No	No	No	0,13
II.2.2	2	Emissions from grid-supplied energy consumption	3.24	0.00	0.00	No	No	No	No	3,26
II.2.3	3	Cross border journeys emissions	0.47	0.00	0.00	No	No	No	No	0,48
II.3		Navigation								0,00
II.3.1	1	Internal transport emissions	No.	No.	No	No	No	No	No	0,00
II.3.2	2	Emissions from grid-supplied energy consumption	No.	No.	No	No	No	No	No	0,00
II.3.3	3	Cross border journeys emissions	No.	No.	No	No	No	No	No	0,00
II.4		Aviation								0,00
II.4.1	1	Internal transport emissions	No.	No.	No	No	No	No	No	0,00
II.4.2	2	Emissions from grid-supplied energy consumption	No.	No.	No	No	No	No	No	0,00
II.4.3	3	Cross border journeys emissions	No.	No.	No	No	No	No	No	0,00
II.5		Offroad								0,00
II.5.1	1	Internal transport emissions	t.e	t.e	t.e	No	No	No	No	0,00
II.5.2	2	Emissions from grid-supplied energy consumption	t.e	t.e	t.e	No	No	No	No	0,00
III		WASTE								41,26
III.1		Solid waste disposal								36,97
III.1.1	1	Emissions from waste generated and treated in the city	No.	1.48	No	No	No	No	No	36,97
III.1.2	3	Emissions from waste generated in, but treated outside the city	No.	No.	No	No	No	No	No	0,00
III.1.3	1	Emissions from waste generated outside the city limits, but treated in the city	No.	No.	No	No	No	No	No	0,00
III.2		Biological waste treatment								0,00
III.2.1	1	Emissions from waste generated and treated in the city	No.	No.	No	No	No	No	No	0,00
III.2.2	3	Emissions from waste generated in, but treated outside the city	No.	No.	No	No	No	No	No	0,00

III.2.3	1	Emissions from waste generated outside the city limits, but treated in the city	No.	No.	No	No	No	No	No	0,00
III.3		Incineration and open burning								0,00
III.3.1	1	Emissions from waste generated and treated in the city	БР	БР	БР	БР	БР	БР	БР	0,00
III.3.2	3	Emissions from waste generated in, but treated outside the city	NE	NE	No	No	No	No	No	0,00
III.3.3	1	Emissions from waste generated outside the city limits, but treated in the city	No.	No.	No	No	No	No	No	0,00
III.4		Wastewater treatment and discharge								4,29
III.4.1	1	Emissions from wastewater generated and treated in the city	No.	0.13	0,00	No	No	No	No	4,29
III.4.2	3	Emissions from waste generated in, but treated outside the city	No.	No.	No	No	No	No	No	0,00
III.4.3	1	Emissions from wastewater generated outside the city limits, but treated in the city	No.	No.	No	No	No	No	No	0,00
IV		IPPU								0,00
IV.1	1	Internal emissions from industrial processes								0,00
IV.2	1	Internal emissions from product use	NE	NE	NE	NE	No	No	No	0,00
B		Agriculture, foOtherry and other land use (AFOLU)								3132,2
V.1	1	Internal emissions from livestock	No.	1.14	0,02	No	No	No	No	34,22
V.2	1	Internal land-based emissions	2574.15	11.52	0,79	No	No	No	No	3097,99
V.3	1	Internal emissions from other farming activities	NE	NE	NE	No	No	No	No	0,00
		AFOLU sub-total	2574.15	12.66	0,81	0.00	0.00	0.00	0.00	3132,2
VI		Other indirect emissions								
VI.1	3	Other indirect emissions								
		TOTAL EMISSIONS FOR KUMANOVO	**3085.18**	**14.94**	**0.83**					**3706,09**



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