



# RESILIENT SKOPJE

CLIMATE CHANGE  
STRATEGY





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# RESILIENT SKOPJE

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CLIMATE CHANGE  
STRATEGY

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# LIFE IS SHORT, SKOPJE IS FOREVER



## ADDRESS BY THE MAYOR

Dear Citizens of the City of Skopje,

Climate change is one of the greatest challenges we face today. Although climate change is a natural process that has been happening ever since our planet was created, human activities now influence the climate with unpredictable consequences. Extreme weather events are now happening more frequently and with greater intensity.

Regardless of the extent to which climate change is caused by human activities or is part of the planet's natural cycles, experts agree on two things:

- 1) Climate change must be understood as a serious threat to the environment and to people's health, wellbeing and quality of life, reducing access to natural resources and harming the economy and infrastructure.
- 2) The devastating consequences of climate change will have an impact on all people, regardless of the level of economic development or size of the communities in which they live.

Given that more than 60% of the world population now live in cities, it is to be expected that the people who will suffer the most severe consequences of climate change are those who live in urban environments. Climate change is a global problem, but the consequences are also felt at regional and local levels. Cities are vulnerable because of the concentration of people and buildings in a small space. People in cities are highly dependent on urban infrastructure, including transport systems, communication systems, water and energy distribution, wastewater drainage systems and waste collection. The concentration of people and goods and their dependence on these infrastructural systems make cities highly vulnerable to climate change.

One third of the total population of the Republic of Macedonia lives in Skopje, and there is also significant daily migration into the capital from the region and beyond. This causes problems for the city's sustainability as a system, since the new needs of the residents are difficult to satisfy and the city is faced with difficulties in its day-to-day functioning. Although the city of Skopje has been making great efforts to deal with the numerous problems, it is limited in its resources. This ecological footprint is unfavourable. We must all work together to improve it.

We are well aware of the possible climate change scenarios that could become reality for the city of Skopje. That is why we have accepted, with great pleasure, to cooperate with the United Nations Development Program (UNDP) on the project 'Resilient Skopje – Climate Change Strategy'. As part of this project, we have carried out a number of analyses resulting in recommendations and actions that are presented in this document.

Based on the Greenhouse Gas Inventory, potential targets have been established for reducing emissions in key areas for climate change mitigation, along with potential policies and measures that could help the process. The public, as active participants in the process of drafting the Strategy, have identified water and public health as priority sectors, and these have been reviewed in detail in order to establish climate change vulnerability and measures for climate change adaptation.

The Action Plan covers in detail the specific measures and activities that should become part of the annual programmes of activities of the City of Skopje Departments over the next five years. Only through the shared dedication and work of the City of Skopje, the city municipalities and the citizens will we be able to provide the healthy environment and level of public health the city needs. This is not only our shared goal but also an obligation since Skopje joined the World Health Organization's network of Healthy Cities.

The City of Skopje remembers its 2,000-year-long history. It is a history full of wars and natural disasters, as well as a history of perseverance, love and dedication to this city. That is why we rightfully say: 'Life is short, but Skopje is forever'.

Finally, I would like to quote Richard Dawson, an expert on climate change who paraphrased the words of Charles Darwin to highlight the challenges we face today:

*'It is not the strongest of the cities that will survive, but rather the ones most responsive to change.'*

I most sincerely hope and believe that Skopje will be one of those cities.

**Mayor**  
Koče Trajanovski

## SUMMARY

Scientists, business leaders and governments agree that climate change is one of the most serious problems our planet is facing and that there is a need for urgent action.

Efforts to address climate change in recent years, including actions aimed at tackling the causes of climate change as well as strategies for increasing resilience to the effects of climate change, are increasingly focusing on cities. And because the individual contributions of each city are necessarily limited, it is essential for all cities, states and nations to act together to achieve progress.

The current document, "Resilient Skopje – Climate Change Strategy" (or, "Resilient Skopje Strategy (RSS) for short) is our response to the need for joint action. The paper sets out the following components: (1) the competences of the City of Skopje and the municipalities on the territory of the City of Skopje; (2) an assessment of the potential for reducing greenhouse gas emissions; and (3) an assessment of the vulnerability of various sectors. The paper also reports on good examples, practices, and maps the way forward with recommended measures and actions to be taken over the next ten years to build capacity for urban resilience to cope with climate change.

The Strategy builds on numerous actions already undertaken in various areas, including energy efficiency, transport, air pollution, water, public health, utility services and public greenery. The Strategy also builds on innovative activities elaborated in detail in the document "What we have we done so far". The good practices implemented by the City of Skopje in certain sectors are also presented in this document in end-of-chapter sections entitled "We lead by example".

The document starts with a chapter on "Addressing Climate Change". This chapter presents a detailed Greenhouse Gas Inventory for 2008 and 2012, providing information about the total emissions of each sector and each type of gas, calculated with the application of a widely accepted methodology for compiling inventories at city-level. The total emissions of greenhouse gases in the City of Skopje amounted to 4,948 kt CO<sub>2</sub>-eq in 2008 and 5,343 kt CO<sub>2</sub>-eq in 2012, with stationary energy accounting for 75% of emissions.

The next chapter focuses on determining the potential for reducing emissions in key sectors such as energy supply, buildings and transportation, to mitigate climate change. Based on this assessment of potential, the chapter further establishes the appropriate mitigation goal for each sector. For this purpose, modelling and analyses have been carried out in combination with consultations and dialogue with policy-makers in the City of Skopje and municipalities, as well as other stakeholders such as representatives of public enterprises, the business sector, NGOs and citizens. Analysis of the various mitigation scenarios, each of which expresses a different level of ambition, shows that a 22% reduction of emissions could be achieved by 2020, which is a reduction 32% higher than the level of ambition of the reference scenario. The section “We lead by example” identifies the heat islands of Skopje, i.e. the areas of the city that are significantly hotter due to human activities than surrounding or rural areas.

The chapter entitled “Vulnerability and adaptation / climate resilience” starts by identifying the sectors that are most vulnerable to climate change. These areas were identified using the Foresight eXplorer tool and with the participation of more than 300 citizens of Skopje. Detailed analyses have been carried out on the vulnerability of three of these identified sectors: water resources, health, and disaster risk reduction. The modelling of possible floods in the region of Skopje, and #SkopjeAir – using data to reduce air pollution in Skopje, are practices from the water resources sector and the health sector respectively that are presented in the section “We lead by example”. In addition to the sectors identified in the Foresight eXplorer exercise, the Strategy also covers the tourism sector, with the example “How to spend a different – “green” day in Skopje?”, as well as the natural systems and urban green spaces sectors. The green cadastre is a good practice in the area of urban green spaces.

The final chapter paves the path ahead. The first section of the “What’s next?” chapter offers recommendations for improving the quality of the analysis and the implementation aspects for each of the sectors on individual topical areas, including the quality of the Greenhouse Gas Inventory and the implementation of climate change mitigation and adaptation. The second section provides a table of all the relevant institutional, legal, technical and soft measures, divided into three groups: general measures, measures for climate change mitigation (with an emphasis on greenhouse gas reduction) in the key sectors for mitigation and measures for climate change adaptation for all vulnerable sectors.

It should be emphasised that implementing the proposed measures and coping successfully with climate change not only requires efforts on the part of local self-governments and the national government but also the cooperation of all relevant stakeholders and of each and every citizen.

Each of us will be able to see the difference after making adequate changes in our habits and lifestyle, undertaking activities at home, at work and everywhere where we move and stay. This would be a small but important step that would lead us towards transformation into a “Resilient Skopje”.

# SCORCHING HOT SUMMERS & FREEZING COLD WINTERS

THE MOST RAINING YEAR IS

2014  
782.9mm

IN SEPTEMBER THAT YEAR SIMPLY FALL RAIN

167.5mm

EXTREME DRY PERIOD BEGAN IN 1988 AND LASTED  
MORE THAN 7 YEARS (UNTIL 1995/96).

THE DRIEST YEAR (WITH THE LEAST PRECIPITATION)

2000  
296.4mm

DURING THE HOT PERIODS OF THE YEAR THERE  
ARE FREQUENT HIGH INTENSITY RAINS,  
USUALLY IN THE AFTERNOON.

**SKOPJE HAS A MICRO CLIMATE,  
SCORCHING SUMMERS,  
FREEZING WINTERS**

(A verse from the well-known song "Skopje"  
by the band Leb i sol.)

Some beautiful refrains have been dedicated to Skopje  
— a city, which has risen like a phoenix, changes, grows  
and continues to be the inspiration for our artists.  
However, the 30-year old verse above no longer describes  
the current situation, since there are no more freezing  
cold winters.



## FLOODS

Since 1923, when hydrological monitoring of the flow of the River Vardar first began, five major floods have been recorded:

### DECEMBER 1935

a small area of the city was flooded.

### DECEMBER 1937

the downstream areas were flooded, while the city was protected with embankments.

### NOVEMBER 1962

with economic losses amounting to about 7% of GDP. The water level of the Vardar River was at its highest, at 1.310 m<sup>3</sup>/s. Some 6,752 ha of land were flooded

### NOVEMBER 1979

with economic losses amounting to about 7% of GDP. The water level of the Vardar River was 980 m<sup>3</sup>/s. Some 7,550 ha were flooded.

### AUGUST 2016

An intense flash flood in flooded the north-eastern area of the city, claiming 23 lives, destroying several settlements and causing economic losses of about 30 million Euros.

## HEAT WAVES

In Skopje there are usually short heat waves that last for up to six days.

25 cases – Skopje with a heat wave of 6 days.

Heat waves have been most frequent in the last ten years.

2012 was the year with the biggest number of heat waves. Heat waves have been more frequent during the cold period of the year (November – April) than during the warm period of the year (May – October).

In addition, heat waves are not equally distributed throughout the year.

The largest number of heat waves have been recorded in the month of March (22 cases in Skopje), while the least number in April.

The years with the highest occurrence of heat waves per year were as follows: May 2003, July 2003, July 2007 and October 2012.

The longest heat wave was from 29 April until 15 May 2003.

Analyses conducted by the World Health Organisation show that in comparison to 1986–2005 period, the duration of heat waves would increase to 18 heat waves per year in the period 2026–2045, and up to 60 heat waves per year in 2081–2100.

## COLD WAVES

Unlike heat waves, the occurrence of cold waves in Skopje is falling.

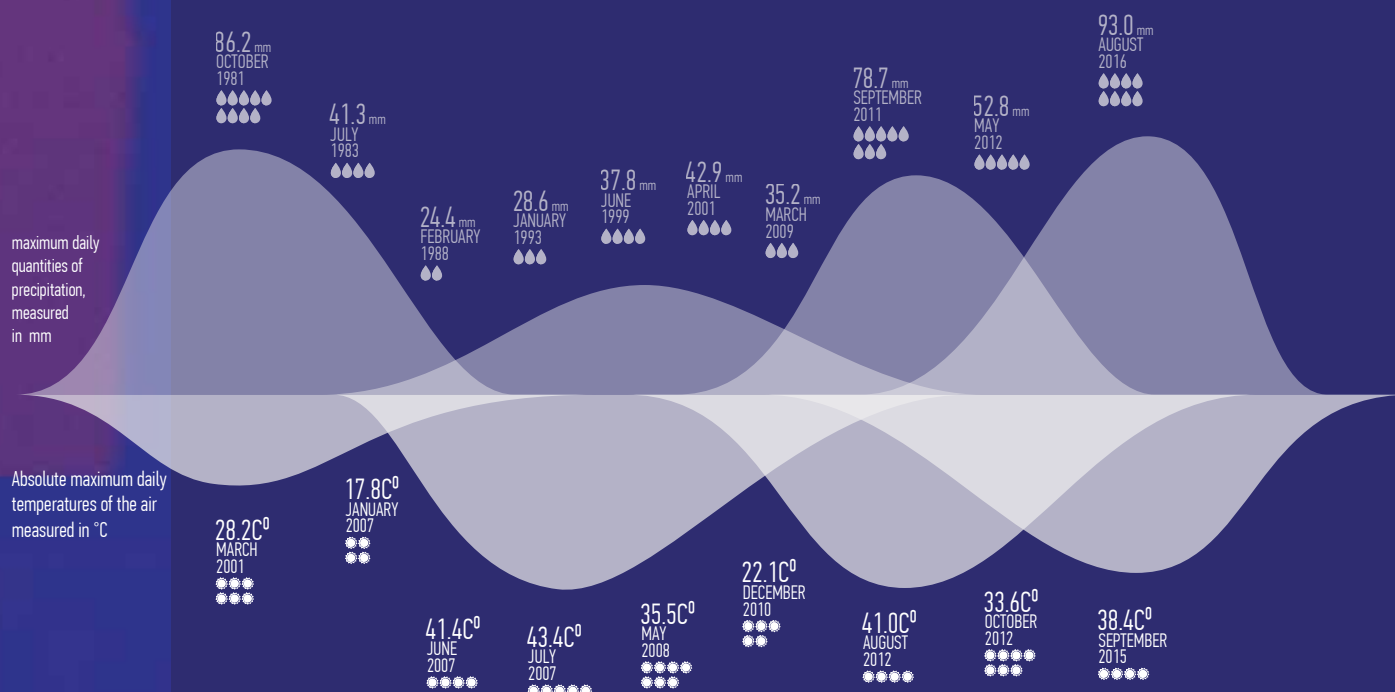
The total number of recorded cases of cold waves for the entire period 1961–2012 was 27, while the total number of recorded cases of heat waves for the same period was 87.

Cold waves occur most frequently in January and February.

The years with highest occurrence of cold waves per year (4 cases) were 1991 and 1967. The longest cold wave in

Skopje was of 22 days between 17 December 2001 and 7 January 2002.

## EXTREME WEATHER EVENTS IN SKOPJE 1981–2015



# FACTS ABOUT SKOPJE

## LOCATION

The city of Skopje is located in the central part of the Skopje Valley, covering an area of 571 km<sup>2</sup>. The city is surrounded by high mountains: Skopska Crna Gora to the north; Zeden and Osjo to the west; Jakupica to the south; and Katlanovski Rid to the east. The basic orientation of the valley is from northwest to southeast, shaped by the flow of the River Vardar.

## GEOLOGY

The wider area of the Skopje basin consists of Neogene-Pliocene sediments and Quaternary-alluvial deposits. Most of the soil in the Skopje Valley is a mixture of clay and alluvium with a high content of organic substances.

The soil in the lower parts of the valley is fertile and of high agricultural value.

## CLIMATE

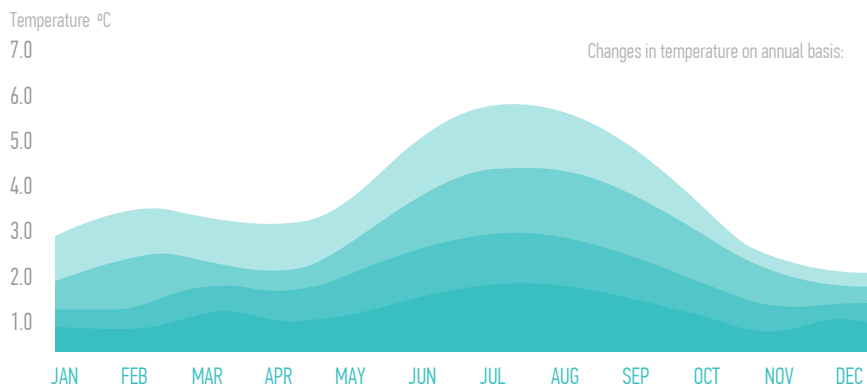
The climate of the Skopje Valley is influenced by the continental and Mediterranean climate, as well as the mountain climate in the areas at higher altitudes. The lower parts of the valley have warm and dry summer periods and averagely cold and wet winters.

The average annual temperature for the period 1978–2015 was 12.9°C. The highest average monthly temperatures have been recorded in July and August, while the lowest temperatures have been recorded in January.

Precipitation is not equally distributed either in time or in area. This is true whether we analyse precipitation in multi-year periods or on an annual basis.

## CLIMATE CHANGE

Within the framework of the Third National Plan for Climate Change (2013) there are scenarios for changes in temperature and precipitation in the country as a result of climate change. These scenarios are used in this Strategy.

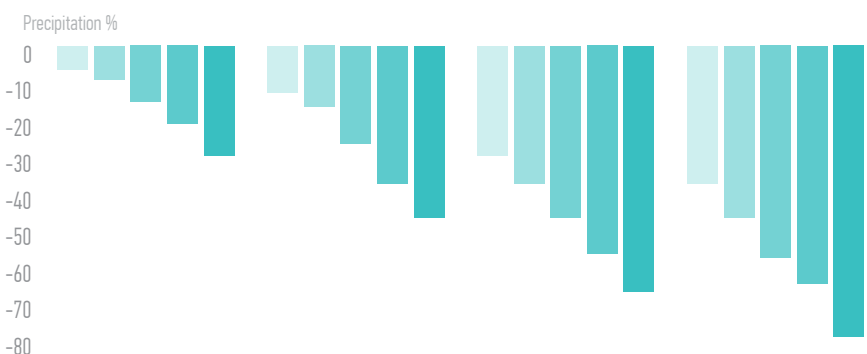


2025  
+1.2°C<sup>0</sup>

2050  
+2.0°C<sup>0</sup>

2075  
+3.1°C<sup>0</sup>

2100  
+3.9°C<sup>0</sup>



Changes in precipitation on an annual basis:

2025  
-4%

2050  
-10%

2075  
-15%

2100  
-19%

According to the central weather station of Zajcev Rid in Skopje the average annual precipitation quantity for the period 1978–2015 was 484.8 mm. The average monthly variations of precipitation reach maximum values in May and November/December, while the lowest are in January/February and August. The dry period lasts from July until September, often continuously for more than 60 days. The occurrence of intensive rainfall is frequent in the valley, especially during the warmer period of the year.

The year with the highest level of precipitation was 2014, with 782.9 mm, while the driest year was 2000, with 296.4 mm. The volume of precipitation is lower during the warmer period of the year (vegetation period), when the water consumption of the sectors identified as the major water consumers is at its highest. According to the drought index proposed by De Martonne, most of the years could be categorised as dry and semi-dry climate. In addition, the drop in the annual values of the De Martonne Index is also very important, showing a trend of increasing dryness in the region.

# INTRODUCTION

Until recently, the efforts of most cities to address climate change were focused on reducing greenhouse gas emissions. Activities were undertaken primarily to increase energy efficiency, to develop the use of renewable energy, to improve public transportation and to develop low carbon projects.

However, it has become clear that these long-term planning measures to reduce the greenhouse gases emitted by cities are not enough to solve our problems. This is because even in the unlikely event that we manage to suddenly stop all greenhouse gas emissions, climate change will still continue in the future. The greenhouse gases accumulated in the atmosphere will continue changing the climate. This is why it is vital to undertake measures to reduce the population's vulnerability to current and future climate impacts. For this, it is necessary to predict what will happen in our environment and to undertake activities for reducing the consequences of those events, instead of repairing them post festum, turning disasters into figures of lost lives, injured and displaced persons and economic losses.

The effects from heat waves will intensify in densely populated urban areas with a high level of sealed soil and areas that absorb heat, with insufficient night-cooling and poor air exchange. Even though most of the health consequences will most probably happen in urban centres, we know little about the possible effects on health from future changes in the infrastructure because of heat. Many European countries have installed heat-wave warning systems, but the evidence for the effectiveness of such measures is still limited.

With regard to climate change and the possible – perhaps even inevitable – consequences for the residents of the City of Skopje, some of the key problems we need to address include:

- 1 FLOOD HAZARDS. ALTHOUGH THE RIVERBED OF THE RIVER VARDAR WAS REGULATED AFTER THE FLOOD IN 1962 AND THE CATASTROPHIC EARTHQUAKE OF 1963, THERE ARE STILL TWO WEAK POINTS IN THE REGULATION DOWNSTREAM FROM THE CITY. THESE WEAK POINTS WILL BE REPAIRED IN COOPERATION WITH THE LOCAL MUNICIPALITY. HOWEVER, THE ANTICIPATED INCREASE IN THE INTENSITY OF PRECIPITATION CREATES AN ADDITIONAL RISK OF FLOODS.
- 2 INCREASED RISK OF FLOODING OF THE BUILDINGS NEAR THE RIVER VARDAR. THIS IS DUE TO INCREASED LEVELS OF UNDERGROUND WATERS IN THE SKOPJE VALLEY.
- 3 INSUFFICIENT SEPARATION OF FAECAL SEWERAGE AND INADEQUATE STORM SEWERS.
- 4 EROSION, SUBSIDENCE AND LANDSLIDES. OCCURRENCES OF THIS TYPE HAVE ALREADY BEEN RECORDED ON THE SLOPES OF MOUNT VODNO AND THE SKOPSKA CRNA GORA MOUNTAINS.
- 5 DANGER OF STRONG WINDS DAMAGING THE CITY'S GREENERY AND BUILDINGS.
- 6 OCCURRENCE OF HEAT WAVES AND URBAN HEAT ISLANDS IN THE CITY.
- 7 EXPOSURE OF BUILDINGS WITH WESTERN AND SOUTH-WESTERN ORIENTATION TO STRONG SOLAR RADIATION.
- 8 HIGH LEVEL OF EXPOSURE TO THE SUN OF THE BOULEVARDS AND PEDESTRIAN ZONES IN THE CITY CENTRE. THIS IS ESPECIALLY SEVERE IN THE ABSENCE OF TALL GREENERY, INCLUDING IN RESIDENTIAL AREAS WITHOUT FOLIAGE PLANTS, ETC.

All these changes will disrupt the life of the citizens and have an impact on infrastructure, meaning the economy will need to adapt to new conditions. In addition, climate change will bring about major changes in biodiversity.

Efforts to tackle climate change at city-level with measures to reduce the causes and activities to increase the city's resilience to climate change are supported by national legislation as well as global agreements and their goals.

The basic legal framework for building urban resilience capacities and coping with climate change is contained in the Law on the City of Skopje (Official Gazette of the Republic of Macedonia Nos. 55/2004 and 158/2011). This law regulates the City of Skopje's organisation as a separate local self-government unit, its competences and financing, as well as of the municipalities within the City of Skopje and cooperation between the City of Skopje and its municipalities, as well as other issues of significance for the City of Skopje.

The key competences encompass planning and landscaping, environment and nature protection, local economic development, public utilities, social and child protection, healthcare, protection and rescue and fire protection. The municipalities on the territory of the

City of Skopje have the same competences (in accordance with the Law on Self-Government), and the City of Skopje and the Skopje municipalities have to cooperate while performing these competences.

In addition, the City complies with the Covenant of Mayors to which it acceded in 2008, as well as the Global Sustainable Development Goals.

Goal 11 refers to sustainable cities and communities, and 11b requires that cities adopt and implement integrated policies and plans aimed at increasing inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and the development and implementation of holistic disaster risk management at all levels in accordance with the Sendai Framework for Disaster Risk Reduction 2015-2030. In addition, goal 13 demands urgent action to combat climate change, focusing on adaptation and resilience capacities and on climate change mitigation, both at national level and at the level of cities and communities.

Equally important is the role of cities, since the Paris Agreement demands the inclusion of cities, regions, businesses and civil society in the realisation of national contributions to climate change.

# WHAT HAS BEEN DONE SO FAR



## 1 TRANSFORMING THE EXISTING TRANSPORT SYSTEM INTO A SYSTEM THAT SUPPORTS THE ECONOMIC, SOCIAL AND ENVIRONMENTAL NEEDS OF SOCIETY.

### ACTION

Plan for a sustainable transportation system for the City of Skopje, adopted by the Council in 2011. Measures and actions envisaged in the Plan have been implemented in phases in the recent years.

### BENEFITS

All the segments of the transport system and the proposed measures for developing a sustainable system have been covered and have been carried out gradually during the period of implementation.



## 2 INTELLIGENT MANAGEMENT OF CITY TRAFFIC

### ACTION

The Traffic Management and Control Centre of the City of Skopje (TMCC) started operating at 28 intersections in 2013 as part of the RENAISSANCE Project.

Currently the TMCC covers 90 intersections.

### BENEFITS

Reduced waiting time for traffic lights, decreasing air pollution from traffic by 20%.

Ilinden Boulevard: westbound by 11%; eastbound by 23%.

Partizanski Odredi Boulevard: westbound by 21%; eastbound by 27%.



## 3 IMPROVED TRAFFIC CONDITIONS

### ACTION

Modern traffic solutions and more roundabouts. Expanding existing streets and constructing new ones has continued in order to improve conditions for pedestrians. New bridges have been constructed.

### BENEFITS

Better traffic efficiency.  
More economical consumption of fuel.  
Reduction of traffic jams and gas emissions.



## 4 PUBLIC TRANSPORTATION DEVELOPMENT

### ACTION

Renewed fleet vehicles with 312 new buses with EURO 4 and EURO 5 engines. Electronic card system Introduced. A system for automatic vehicle location (AVL) in real time has been introduced.

### BENEFITS

Fuel saving.  
Reduced air pollution.  
Simplified means of payment, with the possibility for the electronic card to become a city card that could be used to pay for the cable-car, parking, the zoo, cinemas, museums, libraries and other institutions in the City of Skopje.  
Regular, safe, punctual and efficient public transportation.



## 5 NEW TYPE OF TRANSPORTATION HAS BEEN INTRODUCED

### ACTION

A cable-car was built from Sredno Vodno to the top of Vodno. Initiated infrastructural project for completing the cable-car system from Kozle to Sredno Vodno.

### BENEFITS

Reduced pollution and greater nature protection.



## 6 STRENGTHENING THE BICYCLE TRAFFIC

### ACTION

Implementing the project "Skopje, a Cycle-Town", encompassing the reconstruction of existing bicycle routes and the building of new routes and interconnections. A bicycle-hire system was created in 2010 with four bike stations. There are plans to add more.

### BENEFITS

Improved conditions for bicycle traffic.  
Reduced air pollution.  
Reducing the number of traffic accidents



## 7 ELECTROMOBILITY

### ACTION

Procurement of five electric scooters, five electric bicycles and one electric car for the public administration within the framework of the ELEKTRA project.

The City of Skopje has procured 12 electric vehicles for tourist sightseeing, as well as 10 electric bicycles and five electric scooters.

Together with PE City Parking, the first charging stations for electric vehicles have been set up in Skopje in two multi-storey car parks.

Four electric public hygiene vehicles have been procured for the central area of the city.

Within the ELEKTRA project in November 2015 a feasibility study on the possibility for introducing electric-mobility in the City of Skopje was prepared

### BENEFITS

Raised awareness among citizens and tourists of the need to change their travelling habits.

Reduced air pollution.

Reduced travelling times.

Reduced travelling expenses.

Developing innovative means of transportation



## 8 INNOVATION PROJECT - "SOCIAL CAR"

### ACTION

As part of the Social Car Project funded by the EU Research and Innovation Programme – Horizon 2020, "carpooling" was introduced as a new means of transport, i.e. organised joint travelling to the same destination at the same time.

### BENEFITS

Promotion of an intelligent transportation system based on an innovative approach to transport management related to the service of "carpooling" in the outskirts of the city. Raised awareness raising of carpooling opportunities.



## 9 AWARENESS RAISING ABOUT ALTERNATIVE MEANS OF TRANSPORT AND REDUCED USE OF VEHICLES

### ACTION

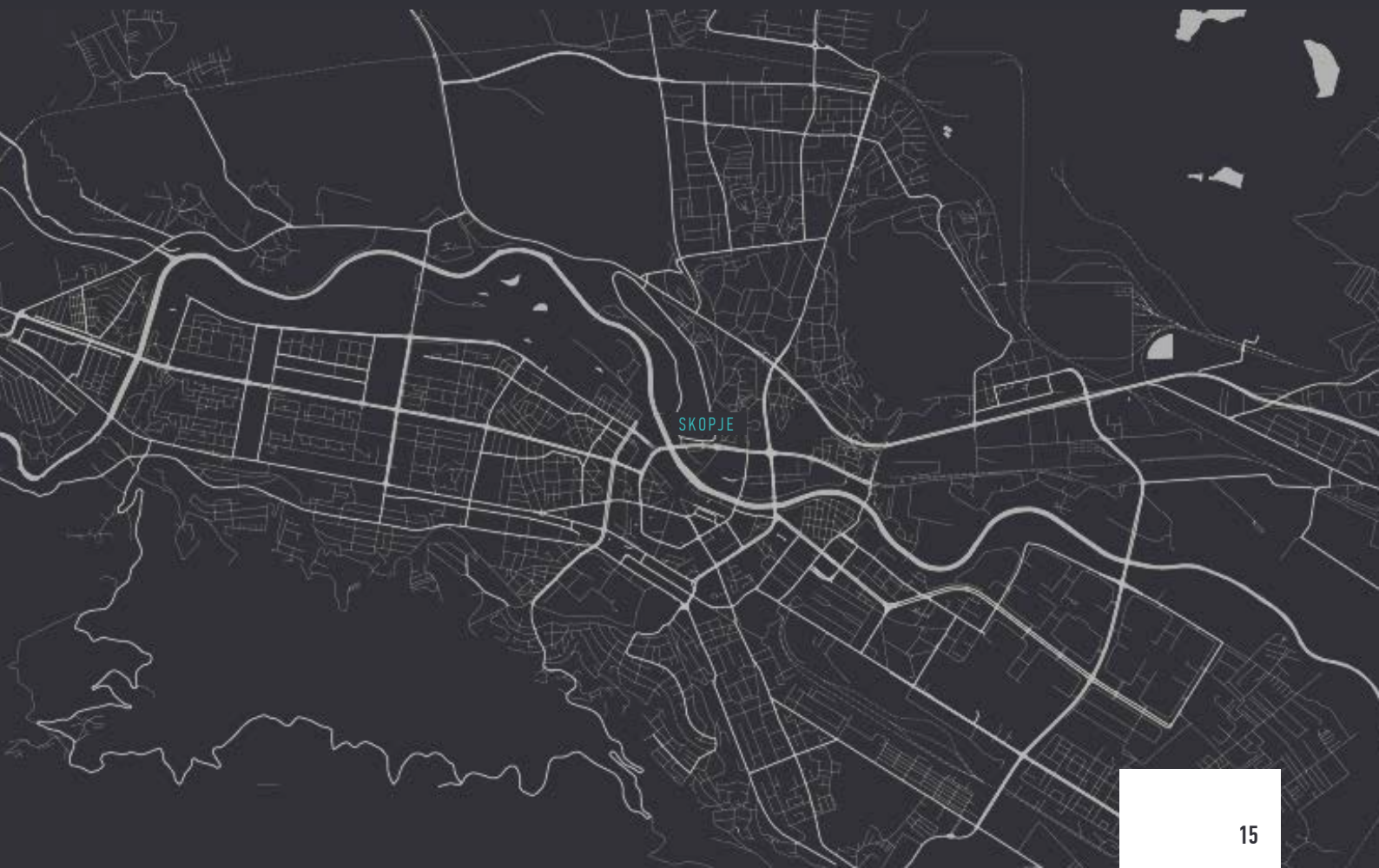
Traditional organising of the European Week of Mobility, a European event promoting alternative transportation.

### BENEFITS

Raised awareness of the advantages of using public buses.

Using bicycles as alternative transport.

Encouraging the citizens to use their vehicles sustainably.





## 1 BEGINNINGS

### ACTION

The City of Skopje signed the Covenant of Mayors. The City of Skopje is a member of the Network of Energy-Efficient Capitals in South-East Europe, which are members of the European Initiative –the Covenant of Mayors.

### BENEFITS

Guidelines for measures and activities.

## 2 PREPARED DOCUMENTS

### ACTION

In 2009, the City produced a study on the energy efficiency of the City of Skopje facilities. The City of Skopje prepared the Sustainable Energy Action Plan (SEAP) 2020, and this was adopted by the City Council in 2011.

### BENEFITS

68 cultural, educational and administrative buildings, as well as the city lighting and traffic lights, were covered. Analysis conducted of energy consumption and the benefits of energy-related construction activities on these buildings to reduce emissions and costs and increase savings. Specific measures in the sectors of energy, transport and buildings were planned, with calculated benefits from the actions undertaken.

## 3 RENEWABLE ENERGY

### ACTION

Within the Re-CEETies Project, in 2014 a feasibility study was carried out on the potential for using renewable energy in the City of Skopje.

### BENEFITS

Possibilities for the City to use renewable energy sources (RES):

TYPE OF RES	ANNUAL POTENTIAL
HYDROPOWER	111 GWH/YEAR
CITY WASTE	190-370 GWH/YEAR
WOOD WASTE	13 – 17 GWH/YEAR
SOLAR POWER	16 GWH/YEAR

## 4 SPECIFIC MEASURES FOR FACILITIES UNDER THE COMPETENCE OF THE CITY

### ACTION

Gasification of the secondary school buildings with individual furnaces. Replacement of windows in all secondary schools and other facilities.

All facilities under the City's competence are connected to the central heating system and have a system for a second level of regulation, i.e. economic regulation of the heating stations.

### BENEFITS

Elimination of sulphur dioxide and soot emissions, reducing nitrogen oxides and significantly reducing carbon dioxide. 45%-50% savings on schools' heating bills.

Increased energy efficiency of the facilities. Reduced consumption of heat by the facilities and lower heating bills, thus saving money.

## 5 ENERGY-EFFICIENT LIGHTING

### ACTION

Over 95 percent of street lighting with mercury light bulbs has been replaced with sodium energy-efficient lights. Lighting with photovoltaic panels that convert solar power into electricity have been installed at two Bellevue locations on Mount Vodno. Illumination of facades and monuments in the central city area with LED lights Activities currently being finalised for placing LED-lights in the city's traffic lights. A solar charger for mobile phones has been set up in the city centre and is available to citizens.

### BENEFITS

35 to 50 percent reduction of electricity consumption. Reduced consumption of energy. Participation in climate change mitigation.





## 1 PLANNED AND PROGRAMME ACTIVITIES

### ACTION

A Plan for improving the quality of the ambient air for the Skopje region agglomeration in 2016.

Operational Programme for reducing the ambient air pollution with PM10 with a chemical analysis from 2014.

Introduced integrated cadastre of environment polluters in 2016.

A study for evaluating the ecological capacity of the city, using the 2016 ecological footprint.

### BENEFITS

Guidelines for predicting measures and activities.

## 2 INDICATIVE MEASURING OF THE AMBIENT AIR POLLUTION

### ACTION

Air quality and noise levels analysis for the city during and after the 2012 and 2016 heating season.

Indicative measuring of the ambient air at specific locations (i.e. the settlements of Novo Lisice and Zelezara, and the industrial zone around the cement factory TITAN) with chemical analysis of the composition of the polluting particles.

A project for measuring personal exposition to suspended particles (daily exposure to overall dust) has been implemented on randomly selected residents in various parts of the city. There are two projects underway funded by the City of Skopje: a study establishing the ambient air pollution from burning firewood and air pollution from traffic.

### BENEFITS

Collecting additional data on the causes of air pollution.



## 3 LEGAL PROCEDURES (IPPC) DIRECTIVE

### ACTION

36 B-integrated ecological licences and permits for alignment with the operational plan have been issued. 438 proposals for environmental protection have been approved.

### BENEFITS

Oversight of plants and other economic entities, providing them with guidelines for:

- Minimising and controlling the emissions polluting the environment media (air, water, soil)
- Sustainable waste management
- Minimising and controlling noise and vibration emissions
- Energy efficiency

## 4 TRANSPORTATION RELATED MEASURES

### ACTION

Special traffic regime for large trucks whose final destination is not the City of Skopje (use of the ring road). Vehicles with permits to deliver goods during morning hours (by 10:00 AM at the latest).

### BENEFITS

Reducing hazardous gas emissions from vehicles.



## 5 PUBLIC HYGIENE

### ACTION

Cleaning and washing the streets, especially around building-sites.

During better weather conditions the streets are washed with a 10% solution of calcium magnesium acetate.

### BENEFITS

Reducing PM10 emissions.

## 6 INSPECTIONS

### ACTION

Reinforced inspection oversight of plants during periods of increased air pollution.

Reinforced inspection oversight and control of building-sites in the City of Skopje when trucks are leaving the sites with dirty wheels: covering truck trailers with tarpaulin.

### BENEFITS

Oversight for the purpose of reducing city pollution.

O<sub>2</sub>

## 1 PLANNING AND PROGRAMME ACTIVITIES

### ACTION

Conducted a study in 2015 on how to make the City of Skopje greener.

### BENEFITS

Guidelines for developing a greener infrastructure within the urban environment, which will be continuous, linked to the surrounding developing areas that should create values in the urban space to be measured in terms of improved living conditions.

The document will introduce a new aspect in the city perspectives by making green facades and roof parks as part of efforts for climate change adaptation.

## 2 GREEN CORRIDORS

### ACTION

Currently we are working on a study for creating green corridors along the rivers Lepenec and Serava.

### BENEFITS

The study will provide guidelines for specific activities to establish green corridors for which funds are allocated in next year's budget



## 3 THE CITY OF SKOPJE GREEN CADASTRE

### ACTION

Work is underway on the Green Cadastre for the City of Skopje, including the public greenery with all its attributes.

### BENEFITS

The GIS Platform for improved management, protection and planning of public greenery in a contemporary and transparent manner.

## 4 MAINTAINING AND GROWING PUBLIC GREENERY

### ACTION

Continued activities for maintaining and improving public greenery.

Reconstructing and creating new green spaces.

### BENEFITS

In the last four years, 46,253 deciduous, evergreen and shrubby plants have been planted. Tree avenues have been renewed along the boulevards. 308,000 m<sup>2</sup> of green spaces, with a 37 km long hydrant network, have been constructed or reconstructed, and 1,000,000 flowers and 30,000 roses have been planted.



## 1 SUSTAINABILITY REVIEW

### ACTION

In cooperation with the Swedish International Development Cooperation Agency (SIDA), a Sustainability Review of the City of Skopje has been conducted.

### BENEFITS

Some guidelines for sustainable development have been established.



## 2 NETWORK OF HEALTHY CITIES

### ACTION

The City of Skopje became a member of the Network of Healthy Cities.

### BENEFITS

Designing and implementing adequate projects that will improve living conditions for the citizens of Skopje.



## 3 UNDERGROUND WATERS MONITORING

### ACTION

With the MEPP, the city is working on getting investments from IPA funds for the construction of a wastewater treatment plant and of a wastewater collection system.

### BENEFITS

Resolving problems with communal wastewaters.





## 4 UNDERGROUND WATERS MONITORING

### ACTION

Continued monitoring underground waters in the Skopje Valley and the waters that feed the springs that supply the City of Skopje with water.

### BENEFITS

Continued supply, with data on water quality.



## 5 ALTERNATIVE WATER SUPPLY RESOURCES

### ACTION

Research undertaken into potential alternative resources for the supply of good quality water.

### BENEFITS

Establishing a baseline in order to find new water supply resources.



## 6 VARDAR RIVER WATER QUALITY

### ACTION

A project has been implemented for monitoring the water quality of the River Vardar, including at the outlets of factories into the river.

### BENEFITS

Developing indicators about the level of pollution and the reasons for water pollution in the River Vardar.



## 7 FLOOD MANAGEMENT

### ACTION

A study on the City of Skopje's Flood Model was conducted in cooperation with UNDP.

### BENEFITS

The study ensures improved flood protection and response management on the territory of the City of Skopje.



## 8 RECLAIMING VARDARISTE

### ACTION

The first phase of the project for rehabilitating and reclaiming the former Vardariste landfill.

### BENEFITS

Protection and development of the land.



## 9 CLIMATE MEASURING

### ACTION

Mezzo-meteorological measuring is being performed annually, and the Hydro-meteorological Service is working on building a network of automatic weather stations for this purpose.

### BENEFITS

Climate statistical processing of the collected results will establish basic indicators about weather conditions in the urban zone in the course of the year. After many years of continued measuring, we will get indicators of changes in climate conditions in the Skopje Valley.



## 10 COOPERATION WITH THE RED CROSS DURING HEAT AND COLD WAVES

### ACTION

Providing bottles of drinking water to passers-by.  
Aid station for accommodating homeless people on a daily basis, providing them with premises for maintaining hygiene and providing food and medical care.  
Social aid packages are distributed to the most endangered individuals and families.

### BENEFITS

Protection of vulnerable groups.



## 11 COPING WITH HEAT WAVES

### ACTION

Installing drinking water taps throughout the entire territory of the city.  
Continued and timely collection of communal waste.  
Maintaining the open channels.

### BENEFITS

Намалување на условите за развивање заразни болести.



## 12 PUBLIC UTILITIES

### ACTION

Some improvements have been made in the communal waste collection service, which has been extended to the rural parts of the city.

### BENEFITS

Environmental protection.

# INNOVATIVE ACTIVITIES



1

Spraying the city streets with calcium magnesium acetate for the purpose of controlling and reducing dust (PM10 and PM2.5 particles) and for road stabilisation. This is a practice copied from cities like London, Vienna, Klagenfurt, Linz, Helsinki, Bruneck, Stuttgart, Stockholm, Goteborg, etc.

2

The Skopje Green Route application has been promoted as an interactive navigation tool for selecting the fastest route to a certain destination, providing data about the duration, expenses and pollution that would be caused depending on the means of transport used(car, bus, bike). The application monitors CO2 concentration at three intersections in the city and is constantly updated.

3

The "Skopje Bus Hackathon" was organised, during which an innovative software solution was designed for improving public satisfaction with public transport in Skopje by optimising the number of passengers on the bus lines 2, 5, 19, 22 and 57.

The Hackathon has been opened for all creative individuals, teams and start-ups who want to work on this kind of project and are knowledgeable about software development.

The Hackathon was organised by the Public Transportation Enterprise Skopje in partnership with the following entities: the Innovations and Technological Development Fund; the City of Skopje; UNDP; the Faculty of Computer Science and Engineering in Skopje (FINKI); the Technical Faculty in Bitola; SEEUTechPark, the Faculty of Computer Science in Stip; and the Faculty of Information and Communication Technologies in Bitola.

4

A competition called "Smart Bus Stop" was organised to encourage innovative and smart design ideas for a bus stop at Dimitrie Cupovski Str. NN (Rekord-Centar). An additional aim of the competition is to promote innovations, stimulate cooperation among the scientific research and university institutions and the business sector, as well as to promote the laboratories at the universities. The competition was organised by the Innovation and Technology Development Fund, the Ministry of Education and Science, PTE Skopje and the City of Skopje, in cooperation with the Faculty of Computer Science and Engineering in Skopje (FINKI), the Faculty of Mechanical Engineering, and UNDP.



## WE LEAD BY EXAMPLE: THE CITY OF SKOPJE INNOVATION CENTRE

In 2016, the first Innovation Centre was opened in the City of Skopje with the support of UNDP and the governments of Turkey and Slovakia. This Centre helps the citizens and the local administration to work together on designing prototypes and testing new public services and products aimed at resolving challenges in the field of environment protection and increasing urban resilience.

The active involvement of citizens and civil society organisations and the support of international and domestic experts in using the most modern methodologies in the world of innovations (such as design thinking and big data) will result in more informative policies and better quality services that are accessible to all.



# 1.1 GREENHOUSE GAS INVENTORY

## CHAPTER 1

## ADDRESSING CLIMATE CHANGE

THE TOTAL GREENHOUSE GAS EMISSIONS

2008

ARE

4948 kt CO<sub>2</sub>-eq

THE TOTAL GREENHOUSE GAS EMISSIONS

2012

ARE

5343 kt CO<sub>2</sub>-eq

The main emitters of greenhouse gases identified for both years fall into the following seven categories

- RESIDENTIAL BUILDINGS • MANUFACTURING INDUSTRIES AND CONSTRUCTION • ROAD TRANSPORTATION • EMISSIONS FROM THE INDUSTRIAL PROCESSES WITHIN THE CITY LIMITS • COMMERCIAL BUILDINGS/FACILITIES • ENERGY INDUSTRIES • DISPOSAL OF SOLID WASTE

A Database with calculated quantities of greenhouse gases (in tons and kilotons CO<sub>2</sub>-eq) emitted or removed from the atmosphere in the course of a year.



## SCOPE

Total greenhouse gas emissions (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, PFCs, HFCs and SF<sub>6</sub>) of the City of Skopje for 2008 and 2012 from stationary energy, transportation, industrial processes, waste, agriculture, forestry and other uses of land.

## METHODOLOGY

The inventory was compiled using the global protocol for calculating local greenhouse gas emissions (GPC), defined also as Accounting and Reporting Standard at local level, which is in compliance with the methodology for the national inventories of the Intergovernmental Panel on Climate Change.

## NEED

In order to respond to the climate- and energy-related requirements of the Covenant of Mayors and convert these into specific measures and projects, the City of Skopje in 2011 prepared a Reference Greenhouse Gas Inventory and an Action Plan for Sustainable Energy Development. The Plan contains the main activities that need to be undertaken to reduce greenhouse gas emissions, though only for buildings, public lighting and transportation. The detailed Greenhouse Gas Inventory was created for the needs of this strategy. The main objective of the inventory is to provide consistent calculation for the two selected years in order to monitor the trends of greenhouse gas emissions in the city. This database will be used as the basis of the climate change strategy for the City of Skopje.

## BENEFITS FROM THE GREENHOUSE GAS INVENTORY

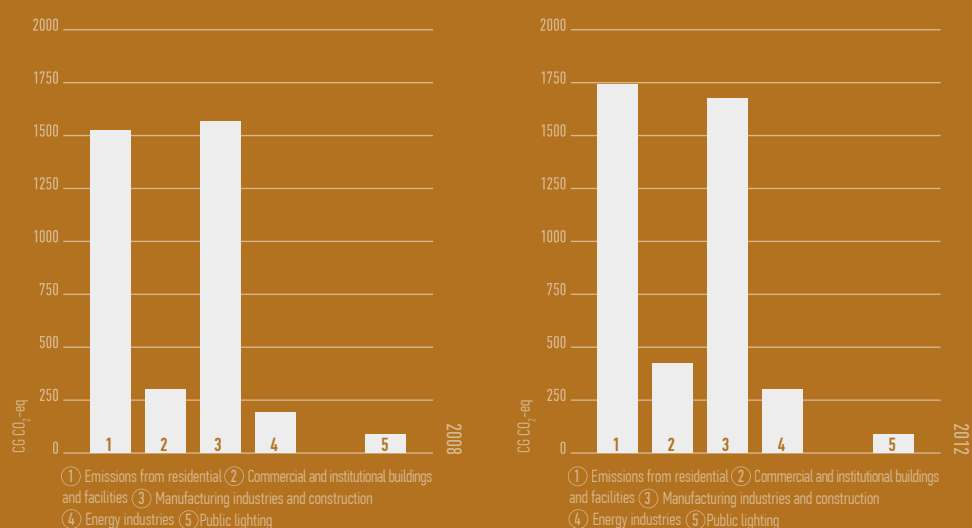
The inventory enables the identification of adequate measures for climate change mitigation in Skopje and the preparation of a strategy for the sustainable reduction of greenhouse gas emissions. Benefits from the inventory include:

- Monitoring progress while developing a sustainable urban community.
- Meeting the obligations arising from signing the Covenant of Mayors.
- Using the disaggregated figures for the emissions of some subsectors for updating and expanding the Greenhouse Gas Inventory.

## FINDINGS

The total greenhouse gas emissions in the City of Skopje were 4948 kt CO<sub>2</sub>-eq in 2008 and 5343 kt CO<sub>2</sub>-eq in 2012.

### STATIONARY ENERGY SECTOR EMISSIONS



DEPARTMENT	EMISSIONS IN 2008 (kt CO <sub>2</sub> -eq)	EMISSIONS IN 2012 (kt CO <sub>2</sub> -eq)
STATIONARY ENERGY	3650,91	4030,20
TRANSPORTATION	544,48	565,74
WASTE	208,18	214,06
INDUSTRIAL PROCESSES	500,01	413,75
AGRICULTURE, FORESTRY AND OTHER USES OF THE LAND	44,32	118,97
<b>TOTAL GREENHOUSE GAS EMISSIONS</b>	<b>4947,90</b>	<b>5342,72</b>

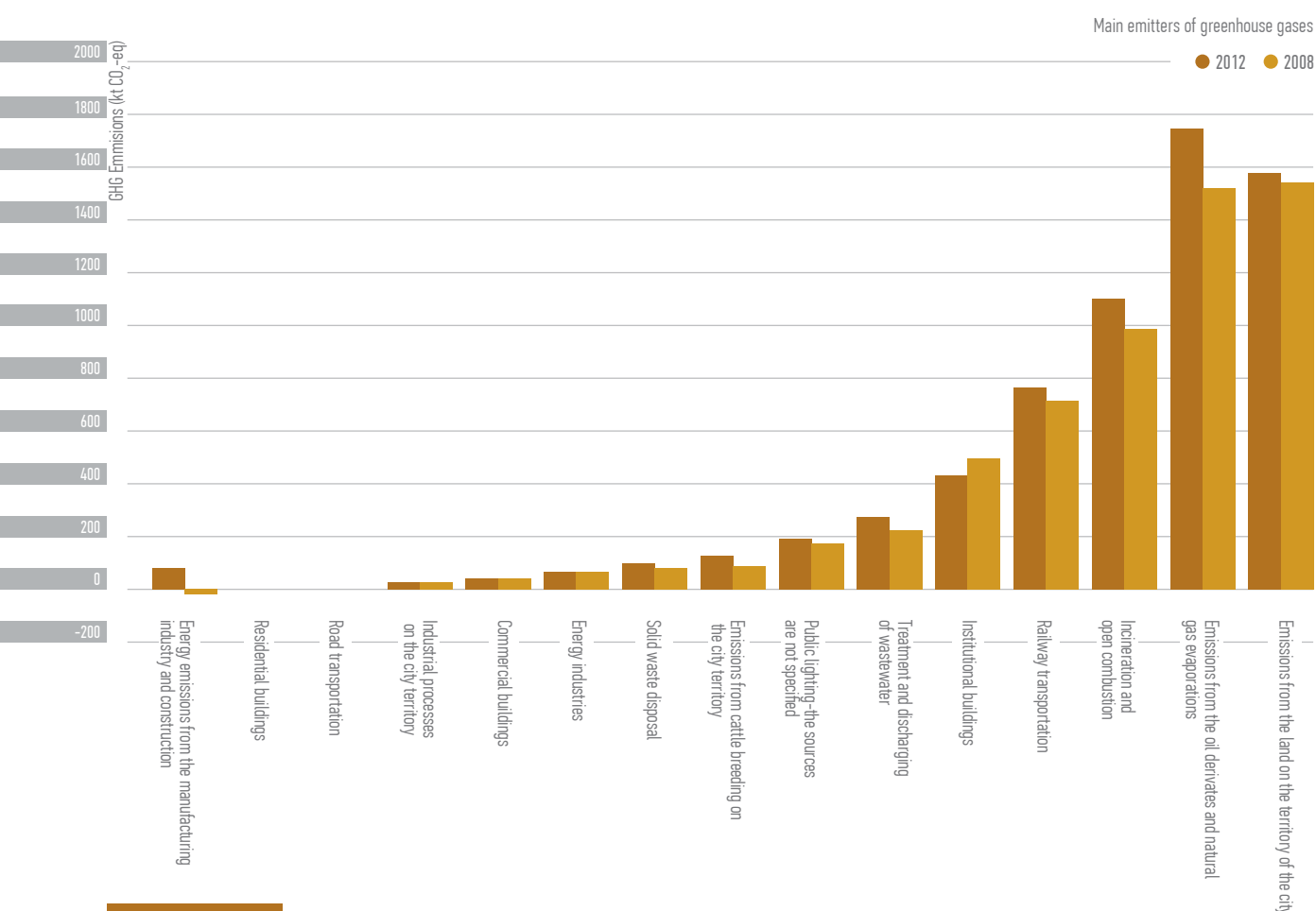
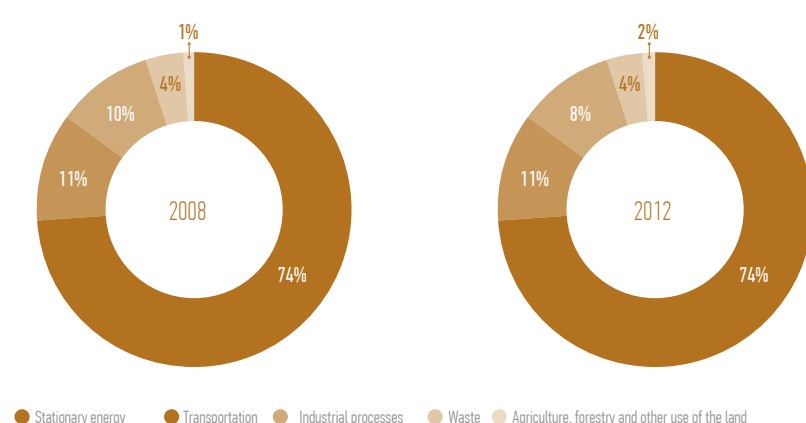
The 8% increase in emissions since 2008 is mainly due to the increased production and consumption of energy in 2012, as well as the fires that damaged some of the land in the course of that year.

The sector of stationary energy (i.e. emissions from residential, commercial and institutional buildings and facilities, manufacturing industries and construction, energy industries and public lighting) accounted for about 74% of total greenhouse gas emissions in 2008 and 75% of the total in 2012.

CO<sub>2</sub> accounted for 93% of the share in total emissions and is the most dominant gas in the Greenhouse Gas Inventory of the City of Skopje, while emissions of CH<sub>4</sub> and N<sub>2</sub>O accounted for about 6% and 1% in 2008 and in 2012.

The main emitters of greenhouse gases identified for both years fall into the following seven categories:

- Residential buildings
- Manufacturing industries and construction
- Road transportation
- Emissions from the industrial processes within the city limits
- Commercial buildings/facilities
- Energy industries
- Disposal of solid waste









# 1.2 CLIMATE CHANGE MITIGATION POLICIES AND MEASURES



## FOCUS

Climate change mitigation entails the adoption of policies and the undertaking of measures to reduce or prevent greenhouse gas emissions.

The energy needs of the City of Skopje are mainly supplied with the use of fossil fuels. Some fossil fuels are combusted for direct accumulation of heat and other are used for transportation, though electricity, which is produced mainly by thermal power stations using lignite, also has a significant share. For those reasons, carbon dioxide (CO<sub>2</sub>) is the dominant greenhouse gas, accounting for more than 90% of the total emissions of the city. There is significant potential for reducing CO<sub>2</sub> emissions in the sectors of energy supply, buildings and transportation. These sectors are crucial sectors for mitigation.

There are no proposed measures to be undertaken in the industry sector.

This is because the city cannot influence the consumption of fuels resulting in greenhouse gas emissions from this sector. In addition, one needs to take into consideration the fact that efforts for installing filters have no impact on the reduction of greenhouse gas emissions.

The main objective of the climate change mitigation section in the RSS is to establish the potential for reducing emissions in the key sectors for mitigation and, on this basis, to establish an appropriate goal for reducing emissions.

It is important to mention that the implementation of the proposed measures requires cooperation among all the relevant factors and not only between the City and the municipalities. This requires dedication and action not only from the local self-governments and the national government but also from each citizen and company in the city, since each plays a critical role in joint efforts to deal with the challenges brought by climate change and to choose the path towards building a "Resilient Skopje".

## HOW WAS THE MITIGATION POTENTIAL DETERMINED?

The mitigation potential was determined in five detailed steps, as presented below. The calculation was based on modelling and analytical activities, combined with consultations and dialogue with the stakeholders, i.e. policy-makers in the City of Skopje and in the 10 municipalities within the General Urban Plan (GUP), as well as other stakeholders that encompass the public enterprises, the business sector, NGOs and citizens.

### 1 SELECTING AND VALIDATING MITIGATION POLICIES AND MEASURES

#### METHODOLOGY

Overview of existing and future policies and strategic plans relevant for the key sectors for mitigation as established in the most recent strategic and planning documents, including:

- Local strategy and action plan for sustainable energy development of the City of Skopje
- Local plans of the municipalities and their strategic documents
- National contributions to climate change
- The national strategy for energy development
- The national energy efficiency strategy and action plans
- National strategy and action plans for renewable energy sources
- Consultations and dialogue with stakeholders
- Mainstreaming of gender practices in mitigation policies and measures

### 2 DEFINING A REFERENCE SCENARIO AND MODELLING THE IDENTIFIED MITIGATION MEASURES AND POLICIES

#### METHODOLOGY

- Consultations and dialogue with stakeholders regarding the premises and input data
- The MARKAL model

### 3 PRIORITISATION OF THE MITIGATION MEASURES AND POLICIES

#### METHODOLOGY

- Cost-benefit analysis
- Mitigation marginal costs curve
- Consultations and dialogue with stakeholders regarding the priorities

### 4 DEFINING AND MODELLING MITIGATION SCENARIOS

#### METHODOLOGY

- The MARKAL model

### 5 ESTABLISHING AN ADEQUATE GOAL FOR EMISSION REDUCTIONS

#### METHODOLOGY

- Comparative scenario analysis
- Consultations and dialogue with stakeholders

## RESULTS OF EACH STEP

A total of 21 measures from the key sectors (energy supply, buildings and transportation) have been reviewed in order for the city to continue developing with less greenhouse gas emissions. The proposed measures are not under the competence only of the local self-government but also of all organisations/institutions and residents of Skopje.

## STEP 1 | POSSIBLE MITIGATION POLICIES AND MEASURES

ENERGY  
SUPPLY

- 1 Solar thermal collectors on the buildings of the City of Skopje and the municipalities.
- 2 Facilitating the instalment of solar thermal collectors for households.
- 3 Reducing losses in electric power distribution (in 2012 the losses were 18%).
- 4 Solar power plants (installed on city, municipal and private buildings).
- 5 5% share of bio-fuels in transportation by 2020.
- 6 10% share of bio-fuels in transportation by 2020.

## BUILDINGS

- 7 Creating conditions for stimulating measures for greater penetration of heat pumps in households and the commercial and service sectors.
- 8 Creating conditions for stimulating measures for improving the heat insulation of the commercial and service sectors' buildings of the City of Skopje and the municipalities.
- 9 Replacing incandescent light bulbs (modernisation of lighting in educational institutions, the buildings owned by the City of Skopje and the municipalities, as well as households and commercial and service sectors' buildings).
- 10 Measures for changing habits (Awareness-Raising Campaign and Energy Efficiency Information Centres).
- 11 Penetration of devices with higher class of efficiency.
- 12 Application of the Energy Efficiency Rulebook for Buildings and the 2010/31/EU Directive when renovating residential buildings.
- 13 Applying energy efficiency measures when renovating hospitals.
- 14 Application of the Energy Efficiency Rulebook for Buildings and the 2010/31/EU Directive when building residential buildings.
- 15 Creating conditions for stimulating measures for the construction of passive residential buildings.
- 16 Gasification of households and the commercial sector.

## TRANSPORTATION

- 17 Construction of city and municipal roads for reducing the amount of kilometres travelled.
- 18 Procurement of hybrid and electric vehicles for the City of Skopje and the public companies.
- 19 Electrification of transportation (the vehicles of the city, the municipalities and the public companies, as well as the private vehicles of the citizens).
- 20 Increased use of bikes, walking and days without cars.
- 21 Renewal of fleet vehicles.

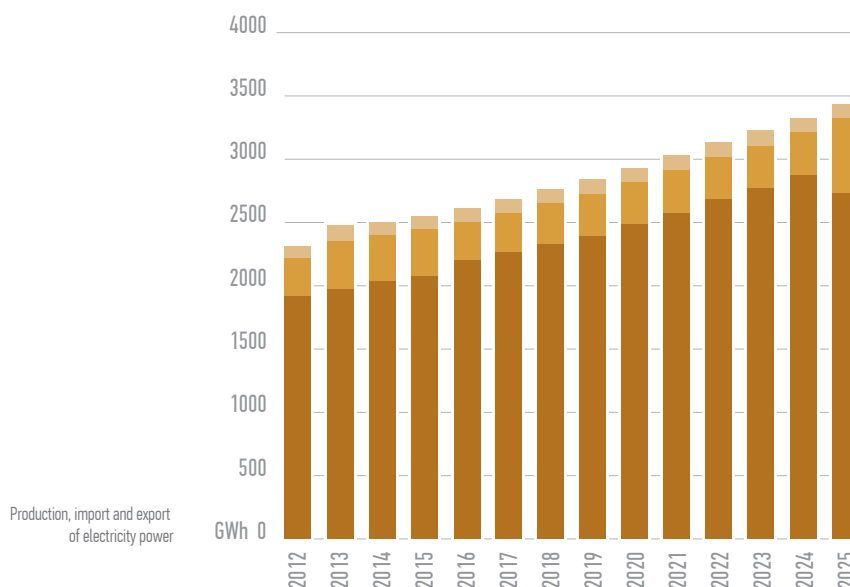
## STEP 2 | THE REFERENCE SCENARIO AND THE ENVIRONMENTAL AND ECONOMIC EFFICIENCY OF THE MITIGATION POLICIES AND MEASURES

The reference scenario, which is also called the scenario without measures, covers the period until 2025 and takes into consideration the basic characteristics of the City of Skopje energy system, as well as certain features of the energy system at national level, since these are mutually interconnected and cannot be reviewed separately.

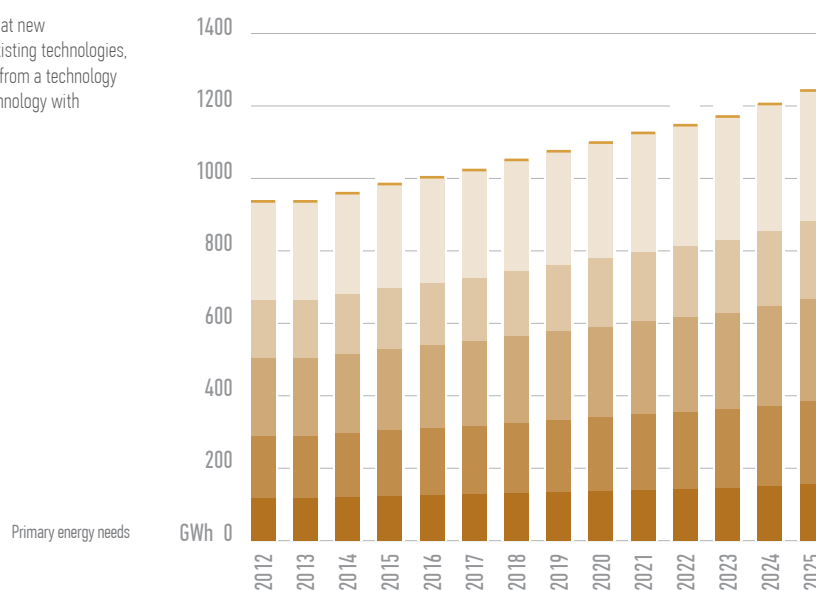
The reference scenario has been developed in accordance with the reference scenario from the 2035 Energy Development Strategy. The data used for compiling the 2012 City of Skopje Inventory is used as input data. Concerning energy supply, the reference scenario starts from the premise that no new electric energy and heat production plants will be constructed within the Skopje city limits. The existing thermal power heating plants will continue operating as before, i.e. only during the winter period. The electric power that is used for the needs of the city but produced outside of the Skopje city limits is considered as imported electric power. On the consumption side, it is considered that new technologies have the same efficiency as existing technologies, with the possibility for the model to switch from a technology that uses one energy source to another technology with another energy source.

## Reference scenario

Referent scenario is a development path of the system under consideration without measures for decrease of the emissions from the greenhouse gasses to be included.



On the consumption side, it is considered that new technologies have the same efficiency as existing technologies, with the possibility for the model to switch from a technology that uses one energy source to another technology with another energy source.



Total greenhouse gas emissions for the three sectors of energy supply, buildings, and transportation, as well as for the waste sector, are estimated to grow from 4,830 kt in 2012 to 6,028 kt in 2020 and 7,048 in 2025.

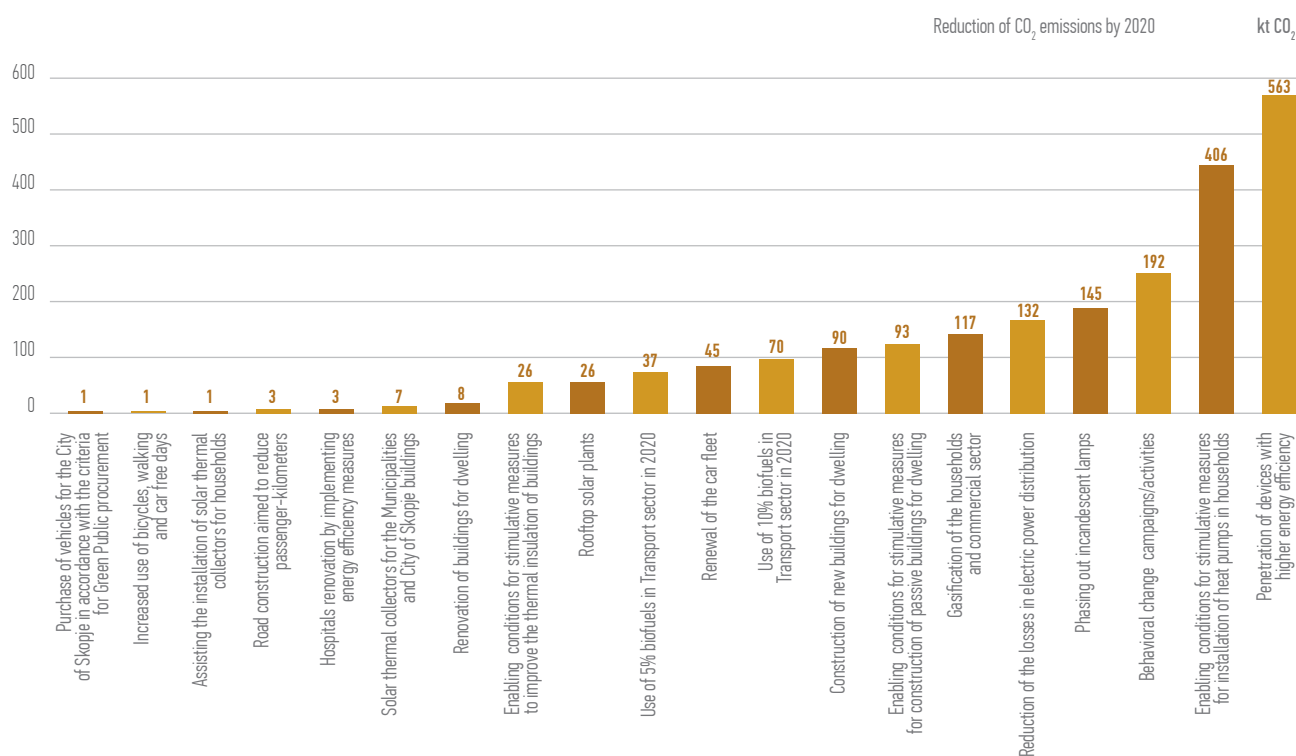
This means that there will be a 46% increase by 2025 compared to 2012, with an annual growth rate of 2.9%. The total costs of the energy system of the City of Skopje that refer to the entire planning period from 2012–2025, and which incorporate also the costs for investments in new technologies in the area of consumption and supply, fuel costs and their delivery and

maintenance costs, amount to 9,091 M€ (discounted with a 7.5% discount rate and expressed in 2012 €).

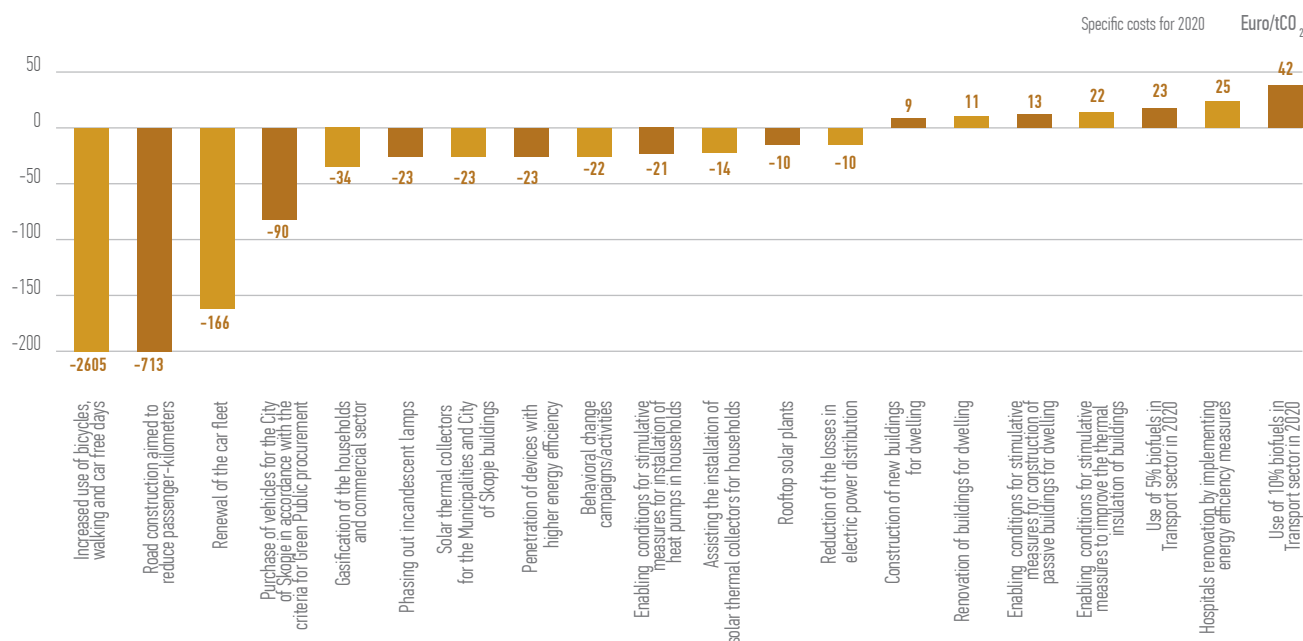
All climate change mitigation policies and measures are compared to the reference scenario in order to assess their environmental effectiveness, i.e. what emission reductions can be achieved with each policy/measure, and the economic effectiveness or specific costs, i.e. how much money will be needed to reduce 1 ton of emissions with that policy/measure. With regard to reducing CO<sub>2</sub> emissions, the best measures are: the penetration of devices with a higher class of efficiency and the creation of stimulation

measures for the greater penetration of heat pumps in households and in the commercial and service sectors. These measures will contribute to a reduction in emissions of 563 ktCO<sub>2</sub> and 406 ktCO<sub>2</sub>.

Measures that could reduce CO<sub>2</sub> emissions include: the procurement of vehicles for the City of Skopje in accordance with the criteria for "green" public procurements, increased use of bikes, walking and days without cars, and facilitating the instalment of solar thermal collectors for households, leading to reduction of about 1 ktCO<sub>2</sub>.



With regard to economic effectiveness, the most favourable measures are: increased use of bicycles, walking and days without cars, and the construction of roads for cutting down the number of kilometres travelled. About 2/3 of the examined measures have negative specific costs (win-win), which means they will generate profit and should be realised even without the goal of reducing emissions.



### STEP 3 | PRIORITY CLIMATE MITIGATION POLICIES AND MEASURES

By implementing all the measures, a total of about 2,000 ktCO<sub>2</sub> could be reduced. With the help of the win-win measures, about 1,600 ktCO<sub>2</sub> could be reduced, which is equivalent to about 80% of the potential of all the measures together. The first priority would be the implementation of the measures that have negative costs and great reduction potential (for example, implementing the measures for the penetration of devices of higher efficiency class and creating conditions for stimulating measures for greater penetration of heat pumps in households and the commercial and service sectors).

### STEP 4 | MITIGATION SCENARIOS

13 measures with CO<sub>2</sub> reduction potential of 1,351 kt, or 22% compared to the reference scenario.

#### SOLAR THERMAL COLLECTORS ON THE BUILDINGS OF THE CITY OF SKOPJE AND THE MUNICIPALITIES.

Indicative CO<sub>2</sub> emissions reduction (kt) **7**

#### FACILITATING THE INSTALMENT OF SOLAR THERMAL COLLECTORS FOR THE HOUSEHOLDS

Indicative CO<sub>2</sub> emissions reduction (kt) **1**

#### SOLAR POWER PLANTS (INSTALLED ON CITY, MUNICIPAL AND PRIVATE BUILDINGS).

Indicative CO<sub>2</sub> emissions reduction (kt) **26**

#### 5% SHARE OF BIO-FUELS IN TRANSPORTATION IN 2020

Indicative CO<sub>2</sub> emissions reduction (kt) **37**

#### RENOVATING HOSPITALS AND APPLYING ENERGY EFFICIENCY MEASURES.

Indicative CO<sub>2</sub> emissions reduction (kt) **3**

#### CREATING CONDITIONS FOR STIMULATING MEASURES FOR IMPROVING THE HEAT INSULATION OF THE COMMERCIAL AND SERVICE SECTORS BUILDINGS OF THE CITY OF SKOPJE AND THE MUNICIPALITIES.

Indicative CO<sub>2</sub> emissions reduction (kt) **26**

#### REPLACING INCANDESCENT LIGHT BULBS (MODERNISATION OF THE LIGHTING IN THE EDUCATIONAL INSTITUTIONS, BUILDINGS OWNED BY THE CITY OF SKOPJE AND THE MUNICIPALITIES, HOUSEHOLDS AND COMMERCIAL AND SERVICE SECTORS' BUILDINGS).

Indicative CO<sub>2</sub> emissions reduction (kt) **145**

#### CREATING CONDITIONS FOR STIMULATING MEASURES FOR THE GREATER PENETRATION OF HEAT PUMPS IN HOUSEHOLDS AND IN THE COMMERCIAL AND SERVICE SECTORS.

Indicative CO<sub>2</sub> emissions reduction (kt) **406**

#### PENETRATION OF DEVICES WITH HIGHER CLASS OF EFFICIENCY.

Indicative CO<sub>2</sub> emissions reduction (kt) **563**

#### RENOVATING RESIDENTIAL BUILDINGS (IN COMPLIANCE WITH THE ENERGY EFFICIENCY RULEBOOK FOR BUILDINGS AND THE 2010/31/EU DIRECTIVE)

Indicative CO<sub>2</sub> emissions reduction (kt) **8**

#### PROCUREMENT OF VEHICLES FOR THE CITY OF SKOPJE IN ACCORDANCE WITH GREEN PUBLIC PROCUREMENT CRITERIA

Indicative CO<sub>2</sub> emissions reduction (kt) **1**

#### RENEWAL OF FLEET VEHICLES

Indicative CO<sub>2</sub> emissions reduction (kt) **45**

#### TOTAL

Indicative CO<sub>2</sub> emissions reduction (kt) **1.351**

#### CONSTRUCTION OF RESIDENTIAL BUILDINGS (IN COMPLIANCE WITH THE ENERGY EFFICIENCY RULEBOOK FOR BUILDINGS AND THE 2010/31/EU DIRECTIVE)

Indicative CO<sub>2</sub> emissions reduction (kt) **90**

More ambitious mitigation scenario: This scenario contains all the measures from the mitigation scenario. This means that bio-fuels will have a 10% share in transportation by 2020 instead of 5%, and the following additional measures are added:

- Reducing losses in electric power distribution
- Measures for changing habits (Awareness-Raising Campaign and Energy Efficiency Information Centres)
- Creating conditions for stimulating measures for the construction of passive residential buildings
- Gasification of households and of the commercial sector
- Construction of roads for reducing the amount of kilometres travelled
- Increased use of bicycles, walking and days without cars

According to this scenario, the total CO<sub>2</sub> reduction potential is 1,929 kt, or 32% compared to the reference scenario.

#### STEP 5 | ESTABLISHING AN ADEQUATE GOAL FOR EMISSION REDUCTIONS

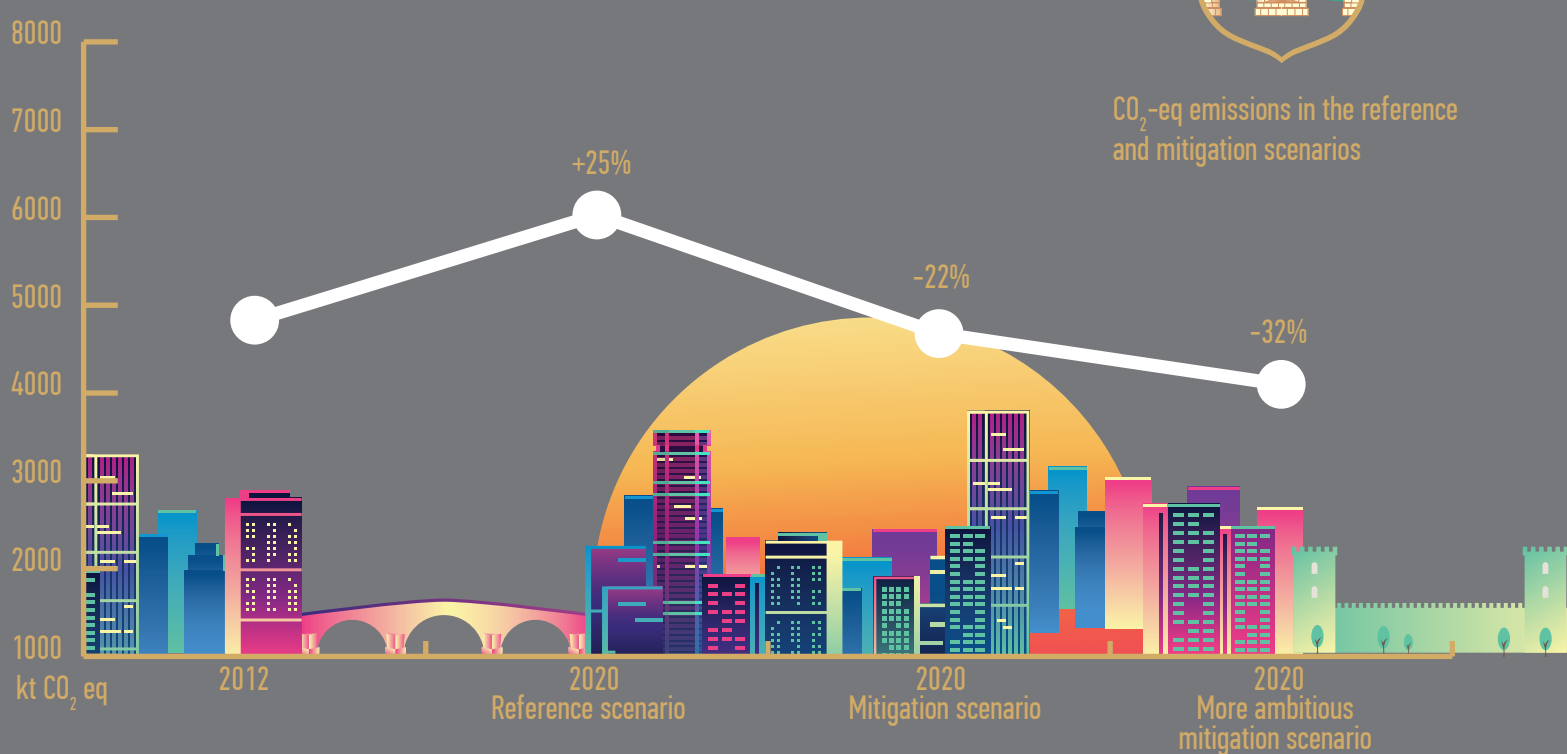
To achieve a 22% reduction in emissions by 2020, or a 32% reduction in case of a more ambitious plan concerning the reference scenario. The reduction refers to CO<sub>2</sub> emissions from the combustion of fossil fuels with dominating share of the energy supply, buildings and transportation sectors that participate with more than 80% share in the total greenhouse gas emissions. If in a more ambitious mitigation scenario only the measures with negative costs are implemented, the emissions will be reduced for 26.5% compared to the reference scenario in 2020.

#### COMPARISON WITH OTHER CITIES

- According to the tCO<sub>2</sub>/resident (9 tCO<sub>2</sub>/resident) indicator, the City of Skopje in 2012 belonged in the same group as Dubai and Prague i.e. the cities with the highest values in regard to this indicator.
- According to the reference scenario, in 2020 this indicator will rise to about 11 tCO<sub>2</sub>/resident.
- If the mitigation scenario is implemented, there will be a reduction of about 8.5 tCO<sub>2</sub>/resident by 2020. If the more ambitious scenario were implemented, this reduction would be 7.4 tCO<sub>2</sub>/resident, which is at the level of the 2020 values for Amsterdam, Berlin, Tallinn, Lisbon and Zagreb.



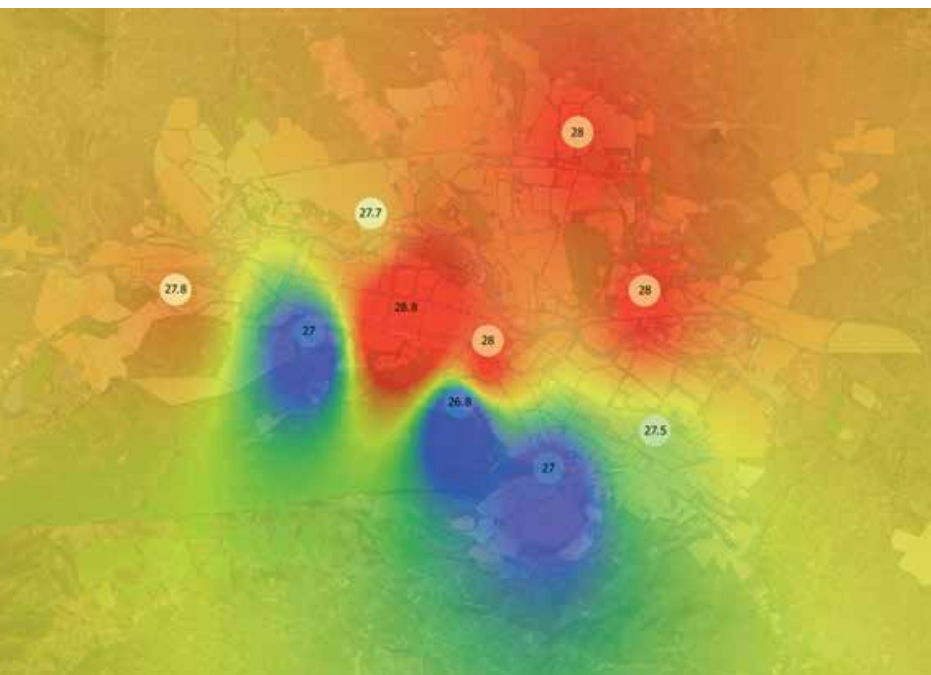
#### CO<sub>2</sub>-eq emissions in the reference and mitigation scenarios





## WE LEAD BY EXAMPLE | URBAN HEAT ISLANDS

An urban heat island is a part of a city or urban area or rural areas that is significantly warmer as a result of human activities than its surrounding. Temperature differences are usually greater at night than during the day and they especially appear in places with weak winds. Urban heat islands are most evident during the summer and winter periods. This Strategy includes the first ever attempt to determine the urban heat islands in Skopje. Two types of data were used in this task. Visualisation of the city sections with higher temperatures compared with the surrounding area was performed with meteorological measuring at 13 micro locations in the Skopje Valley (2013-2015) and with thermal imagery from a camera placed on a paraglider flying from Vodno Mountain to the City Park (2016). The objective is to register the urban heat islands in Skopje (the city's hotspots) and to undertake appropriate measures for building the city's resilience to the negative impacts of climate change by reducing the temperature of the heat islands, thus improving living conditions for local residents and reducing their energy consumption for cooling and heating.



2015-06-01 T 14:00 Temperature interpolation

Usually one expects a close link between the heat radiation from the Earth's surface and the atmosphere temperature near the air surface. In practice, however, if atmosphere and surface heat islands are in some way related, they can show different spatial and time patterns and significant variations. Technological developments have brought about new ways of researching this area, from thermal imaging cameras to satellite imagery.

Thermal imaging cameras (Regional Social Innovation Centre). The temperature difference between the city's outskirts and the central area of the city is about 7 degrees, while the difference in comparison to Vodno is 12 degrees. The River Vardar has a positive influence on temperature reduction to a few degrees lower than in areas at a greater distance from the river. The central core of the city, the area of Gradski Zid, has the highest temperature, which is 1.5 to 2 degrees higher than the temperature in Kisela Voda. It is notable that Makedonija Square is significantly cooler than its surroundings due to its white colour. For example, the asphalt temperature on Maksim Gorki Street is more than 6 degrees higher than the temperature of the tiles of the square. In general, due to the tradition of having dark red roofs, most of the buildings in the city have high temperatures on the roof surfaces due to their constant exposure to sun.

Buildings with lighter coloured roofs have a positive impact by reducing the temperature in their surroundings; however, unfortunately these are rare in Skopje.

More concrete and asphalt leads to higher temperatures. More green spaces are needed, as well as green roofs and green facades. There are existing and elaborated ideas on this topic, e.g. "50 shades of green" for placement of green roof on the Children Hospital, as part of the Climate Change Challenge

#ItDependsOnYou from 2015.

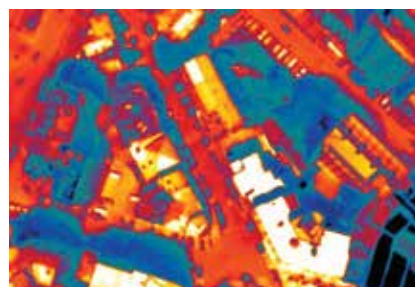
### RESULTS

Meteorological measuring  
(Hydro meteorological Service)

— The temperature differences in the Skopje Valley are within the limits of 1.2°C to 5.7°C. The greatest differences are mainly during afternoon and evening hours.

The highest average daily air temperatures are registered in the centre (Centar), the industrial zones (Butel and Avtokomanda) and Taftalidze, while the lowest air temperatures are registered in the outskirts of the Skopje Valley and in the urban areas at higher altitudes. The main characteristic is that the central part of the city is the warmest place.

By interpolation, temperature maps have been made for the City of Skopje based on the meteorological measuring, as shown below, with the coldest areas marked in blue, the hottest in red.









# 2.1 PREDICTING THE FUTURE

## CHAPTER 2

### VULNERABILITY AND ADAPTATION / CLIMATE RESILIENCE

It is notable that most of the participants believe that changing the habits of city residents is one of the most important actions that need to be undertaken.

“

THE BEST WAY TO PREDICT THE FUTURE  
IS TO BE INVENTED

Alan Kay



## IDENTIFYING THE MOST VULNERABLE SECTORS TO CLIMATE CHANGE IN SKOPJE IN A “DIFFERENT WAY”

In its efforts to stimulate the active participation of all stakeholders in the process of drafting this Strategy, UNDP recently adopted Foresight eXplorer, an innovative software tool based on contemporary methodology for “predicting” the future. Predicting is an innate human capacity, which means that all the affected parties in an organisation – i.e. not only the experts, civil society organisations and administrative workers – are capable of strategic devising.

This tool is used for generating new perceptions among the broader spectre of actors on the territory of the City of Skopje, from the municipal administration to the civil society sector and students from all city secondary schools.

The purpose is to identify the sectors most vulnerable to climate change and in this way to establish priorities and identify possible measures for adaptation and for increasing urban resilience. This democratisation and decentralisation of the planning efforts has ensured that the Strategy reflects not only the views of experts but also the perceptions of the city’s residents in relation to climate change.

The methodology is based on a highly interactive game that stimulates and motivates people to participate by using predefined hexagonal cards. New discussions and new learning opportunities are generated through simple rules for resolving complex challenges related to climate change today (2015) and in the future (2025).

FIVE TYPES OF CARDS WERE IN PLAY:

### RESOURCES

(i.e. wood, wells, agricultural products, complex materials, such as sewage and irrigation systems)

### STAKEHOLDERS

(i.e. those whose actions have an impact on the City of Skopje and on the municipalities, the activities of the Ministry of Environment and Physical Planning, public enterprises and citizens)

### ACTIONS

(activities and operations performed by various actors)

### CHALLENGES

(activities that could have a negative impact and are related to the impact of climate change, such as floods, illegal logging, and corruption)

### WILDCARDS

(events that seem of minor significance but which could have a significant impact)

According to the participants, the most important challenges in Skopje both now and in the future are as follows:

AIR POLLUTION

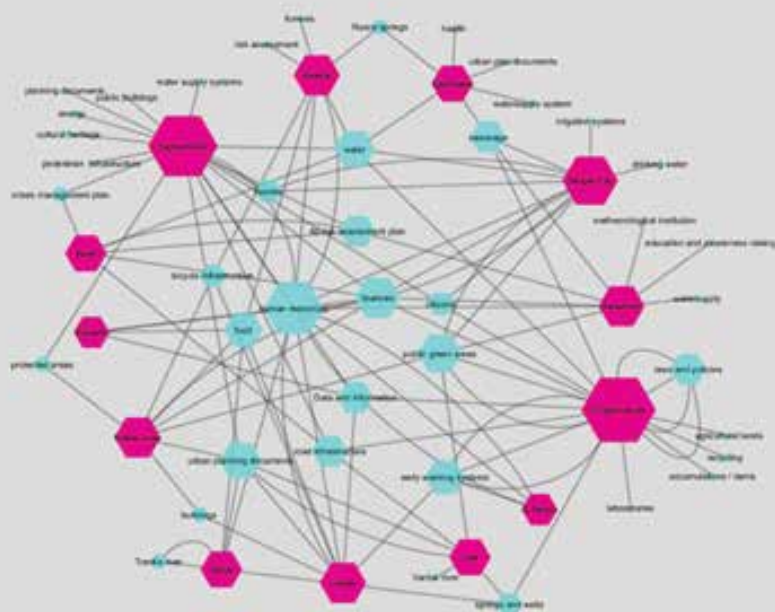
THE INCREASED NUMBER OF VEHICLES

CORRUPTION

MIGRATION

UNPLANNED URBANISATION

WASTE WATERS



PREDICTING  
THE FUTURE

Currently, the three most important activities identified are increasing the green areas, changing the behaviour/habits of the citizens, education and awareness-raising. Other important actions are: the need to develop higher standards of construction, a development plan for traffic regulation, and good urban planning.

The most important tasks to be taken by 2025 were identified by the participants as follows: water treatment, changing the behaviour/habits of the citizens, education and awareness-raising, and the development of a crisis management plan. In addition, institutional capacity building, permits for Integrated Prevention and Pollution Control, the development of a plan for protecting vulnerable groups, and the participation of the public in the process of decision-making, were all ranked very highly in comparison with the other activities.

The participants identified the most important resources for 2015 as follows: finances, human resources, public green spaces and urban planning documentation. In 2025, on the other hand, the most important resources were identified as human resources, water and water supply systems, springs and wells, food and citizens. Apart from human resources, which are very highly ranked in both cases, the other resources are very different, showing the participants' awareness of the various effects of climate change we will face in the future.

Comparison of the current and future scenarios shows that the two most important parties in resolving the climate change challenges are the City of Skopje and the Government of the Republic of Macedonia. There are differences in the level of importance of other stakeholders, but mainly the same groups are incorporated in both scenarios, i.e. ministries, local self-governments, public enterprises, crisis management centres and citizens.

Only the Municipality of Gjorce Petrov recognises civil society organisations as a stakeholder. Concerning resources, only Kisela Voda recognises the business sector as a resource, while only Saraj recognizes the Ministry of Interior as a resource, and only the secondary schools recognised the Hydro meteorological Service as a resource.



In regard to the wildcards (i.e. unexpected incidents that could happen in 2025 as a consequence of climate change), the citizens in general played with four wildcards: air pollution, floods, heat waves and droughts. In addition, the municipalities of Centar, Kiselja Voda and the City of Skopje believe that the erosion of Vodno will be a serious problem by 2025.

Experts believe that floods and heat waves will be the main problem, while the Municipality of Butel and the secondary schools believe there might be acid rains.

According to the Municipality of Gazi Baba and the secondary schools, there will be a shortage of drinking water by 2025. The use of the Foresight eXplorer tool with about 300 citizens of Skopje served to identify three sectors that are currently most vulnerable to climate change. This Strategy provides a detailed analysis of the climate change vulnerability and disaster risks in these three sectors:

## WATER RESOURCES | HEALTH | DISASTER RISK REDUCTION

There is a need to initiate research and activities for changing the habits of citizens to improve urban resilience to climate change.

Waste and transport are two other sectors that need to be analysed in detail in the near future to establish their vulnerability to climate change and to propose adequate measures for adaptation.







## 2.2 WATER



## HYDROGEOLOGY / UNDERGROUND WATERS

The River Vardar is the longest river in the Republic of Macedonia, with a catchment area of 22,290 km<sup>2</sup> that covers almost 80% of the country's total area. The River Vardar flows for 301 km in the Republic of Macedonia and for 80 km in Greece. One tenth of the total length of the Vardar River – is located in the Skopje Valley in its upper and middle part. The main tributaries of the River Vardar in its upper and middle part are the River Treska (138 km), Markova Reka (29 km) and Moranska Reka (10.5 km) on the right side, and Lepenec (75 km) and Serava (21 km) on the left side.

The linear trends of the annual values of the average annual flows of the Treska and Vardar rivers are decreasing. The monthly distribution of the flows is very similar to the precipitation distribution, increasing in May and December and dropping in August.

The Rasce springs located in the rocky mountains of Zeden are of vital significance for the water supply of the city of Skopje, with a capacity of between 2.9 m<sup>3</sup>/s and 7.74 m<sup>3</sup>/s. The springs have very favourable features and satisfy the water supply needs of the population with good quality water. Due to its huge importance, three protection zones have been established by national legislation (1999). The protection zone of Rasce has already been identified as a priority investment for broader national security, with zones in the Spatial Protection Plan (2003).

According to the 2011 Local Environmental Action Plan (LEAP), there are a total of 130 wells in the valley. In the industrial zone there are a certain number of boreholes for supplying the industry with water. Their capacity varies significantly from 60 l/s in the urban part to 225 l/s in the lower, rural part of the valley, depending on the location, diameter and depth of each borehole. At certain locations the drop in the level of underground waters reaches -10 m from the surface. The total capacity of the underground waters is believed to be 54.49 million m<sup>3</sup>, of which 16.4 million m<sup>3</sup> are used annually (LEAP, 2011). Wells have been dug at the Nerezi location and in the vicinity of the location where the River Lepenec empties into the Vardar water supply, (locally, city of Skopje). The total capacity of the wells near Nerezi is 790 l/s, while the wells near Lepenec have a total capacity of 690 l/s.

## SEWERAGE SYSTEM

The construction of the sewerage system in Skopje started as a separate system consisting of a faecal sewerage and storm sewers. The sewerage system covers about 80% of the population. The wastewaters from households and industry in Skopje are discharged without adequate treatment into the River Vardar and other recipients such as small canals and tributaries.

Storm water is collected in the City of Skopje by the storm sewer system and discharged into the River Vardar through drainage channels. The existing storm water network is located in the urban area, while the drainage channels are mainly located in the foot of the hills. The storm sewers currently cover 25% of the City of Skopje, or more than 50% of the residential area.

For a number of years, even during low intensity rainfalls, Skopje has experienced flooded underpasses not only in the outskirts, but also especially at several critical points in the city centre. These problems have been attributed to the fact that there are no storm sewers in certain parts of the city and that those sewers, which do exist, have insufficient capacity to evacuate the storm water.



## FLOODS

After the major floods in 1962 and the damage they caused, the city authorities started engineered planning and regulation of the Vardar riverbed to reduce the risk from floods in the central city area. The main regulation project for the Vardar was carried out between 1968 and 1974, in parallel with the construction works. With this project the riverbed was projected for a maximum water flow of 1,150 m<sup>3</sup>/s.

The Vardar's riverbed in the central area of Skopje has been subjected in the past few years to anthropogenic changes that have decreased the maximum projected flow capability of the regulated riverbed by about 25–30%. The construction activities related to the placing of three static ships in the riverbed, as well as two pedestrian bridges, and one more bridge that should hold a Ferris Wheel currently under construction, have not only reduced the flow capacity of the riverbed but have caused large quantities of sediment in the riverbed.

In recent years, the protection of the City of Skopje from floods has been increased with the construction of the Kozjak Dam. In addition to producing electric power from renewable sources, one of the main purposes of the Dam, as defined in the accumulation utilisation regime, is to provide protection against flooding.

The forestation of the northern slopes of Mount Vodno after the First World War has contributed greatly to the protection of the city from potential erosive processes and torrents, additionally helped by the channels, barriers and clearer thresholds that take the water of the torrents to the River Vardar. The most recent expert analysis of the channels for regulating the natural torrents was carried out in 2010 and showed deterioration over the past few years.

The Nerezi channel (near the village of Nerezi), the central group of torrents (consisting of collecting a canal and a drainage channel that passes next to the state hospital) and the eastern group of torrents (near Kisela Voda that are only partially regulated), have not been maintained in recent years.

The current situation regarding protection from floods from the torrents in Skopska Crna Gora is even more critical. Protection from floods in this area is limited to a drainage system that mainly consists of open channels used primarily for lowering high level of underground water from arable land. Up to a certain level this system is also used for protecting rural settlements from floods.





## SUPPLYING DRINKING WATER FOR THE NEEDS OF INDUSTRY

The water supply system in the Skopje region covers 96% of the total population. The drinking water needs of the population of the City of Skopje and its suburbs are satisfied by various water supply systems that provide water to the settlements depending on the type and location of settlements:

THE CITY SYSTEM FOR WATER SUPPLY IN THE URBAN AREA IS MANAGED BY THE PUBLIC ENTERPRISE WATER SUPPLY AND SEWERAGE ("JP VODOVOD I KANALIZACIJA" – SKOPJE)

LOCAL WATER SUPPLY TO RURAL AREAS

The average age of the water supply network of the City of Skopje, including the pipeline and the hydro technical facilities built in the period between 1940 and 2009 is 30.5 years.

The time of its construction points at the need for the reconstruction of the water supply infrastructure. In average, the City of Skopje should replace or reconstruct about 2.7% of the total length of the network annually, with a total length of 27 km of pipes of various materials (LEAP, 2011).

According to data from JP "Vodovod i kanalizacija", the water supply to households, businesses and public enterprises in Skopje is about 85,000 m<sup>3</sup> per day. This public enterprise has incurred a significant percentage of water losses, resulting in an increased quantity of uncharged-for water. These losses of water are due primarily to the company's own activities for flushing the canals and water supply network, flushing the reservoirs, public water supply (for the public greenery and streets, fountains and public taps), losses of water within the network (clients paying lump sum, differences in the main-control water meter, written-off bills), technical losses (leakages due to defects, etc.), as well as illegal connections, which make up about 25%.

The water quality in the water supply system of the City of Skopje is regularly monitored and controlled by the Public Health Institute of the Republic of Macedonia – Skopje and by the laboratory of JP "Vodovod i kanalizacija" – Skopje. The results show that the drinking water supplied to the population of the City of Skopje and the surrounding villages is absolutely safe. The safety of the drinking water has been established by constant and regular analyses of its bacteriological safety, physical-chemical analysis, pesticide-residues analysis, radiological and parasite analysis, as well as contaminant analysis (ancillary products for the water disinfection).

These analyses are carried at the measuring-points and at all water springs: Rasce 1 and 2 springs and the Nerezi-Lepenec system of wells.

The population that is not connected to the water supply system of JP "Vodovod i kanalizacija" uses wells and/or springs as water resources. On the territory of the City of Skopje there are also local water supply systems, including the water supply systems of Ljubanci and Ljuboten in the Municipality of Butel, the systems of Rastak and Bulacani in the Municipality of Gazi Baba and of Kuckovo in the Municipality of Gjorce Petrov.

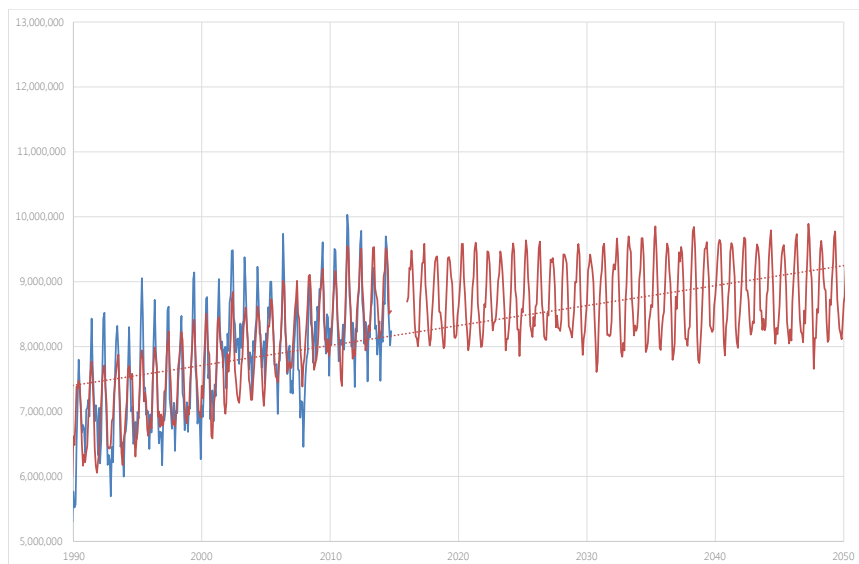
The local water supply in general is not in compliance with water quality or quantity standards.

Industry is a major water consumer in the Skopje Valley. Part of the industry sector is supplied with water from the city's water supply system, while the other part use underground waters from the local wells. According to the current data (annual reports by the JP "Vodovod i kanalizacija"), about 20% of the total water production of the city water supply system is distributed for the industry. In addition, many industries, especially in the industrial part of the city, use underground waters. The total number of wells and their capacity are not known.

Vardar in  
the central  
city area

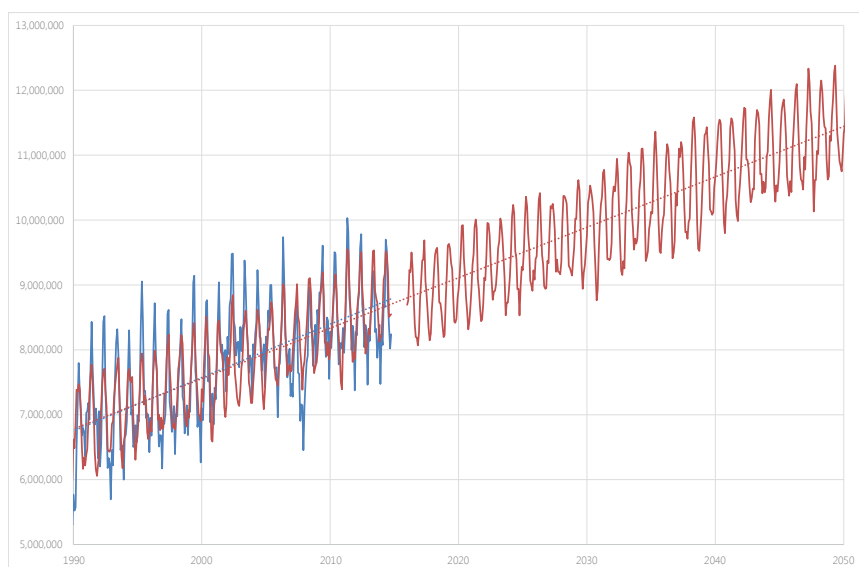
## CLIMATE CHANGE IMPACT

In order to assess the impact of climate change on water resources in regard to [water quantity and quality and the needs of drinking water, industrial water and irrigation water](#), the quantities of water produced is linked to the meteorological values (temperatures and precipitation). \*



Scenario I: Constant population size, temperatures increase and precipitation decrease in accordance with the official scenario for climate change in Macedonia.

Scenario I: Predicted water production – increase in the period 2016-2050 for ~12% compared to the historical period 1990-2015. This increase is due to climate change.



Scenario II: Average 0.58% annual increase of the population, temperature increase and precipitation decrease in accordance with the official scenario of climate change in Macedonia.

Scenario II: Predicted water production – increase in the (2016-2050) period for ~12% compared to the historical period (1990-2015). This increase is due primarily to the increase in population.

Taking into consideration the average capacity of the Rasce springs and the capacity of the wells at the Nerezi and Lepenec sites, the predicted water quantities for both scenarios, using the historical distribution of water supply to the consumers / produced water, were linked to the available resources of water to the water supply system of the City of Skopje. The results show that in the first scenario (i.e. with climate change when there is no change in the population), the current distribution of water per consumer could be satisfied with the help of the available resources of water. However, even a 0.58% increase in the population will require the maximum capacity of the Rasce springs and Nerezi-Lepenec wells to satisfy the maximum water production. Under such circumstances, there might be a shortage of water.

## IRRIGATION WATER

In the Skopje Region there are approximately 21,287 ha gross value (19,554 ha net-value) areas available for farming (source: the 2005-2020 Spatial Plan of the Skopje Region (draft), 2009). According to the Preliminary Design of the Skopsko Pole Irrigation System, it is designed to incorporate two separate irrigation systems: a system located on the left bank of the Vardar River, providing water from the Kozjak Reservoir to irrigate 17,774 ha of net-agricultural land, and an irrigation system located on the right bank of the Vardar River that provides water for the planned Kadina Reka hydro-system to irrigate 1,810 ha of agricultural land.

The recent construction of the Kozjak Dam has created a useful reservoir that should satisfy the irrigation needs of 18,500 ha of agricultural land (12.03 m<sup>3</sup>/son average) and the water requirements of industry with an average flow of 5.0 m<sup>3</sup>/s. However, although one of the envisaged uses of the Kozjak reservoir is to provide water for irrigation, the infrastructure and supply network for irrigation have not yet been constructed. The supply network for industry has also not yet been constructed.

\* Assessment of temperatures and precipitation changes until 2100 as a result of climate change, Third National Climate Change Plan (2013)

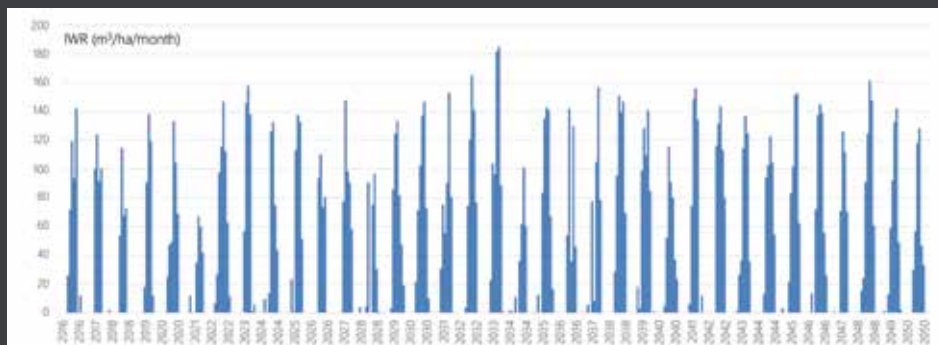


### CLIMATE CHANGE IMPACT

The evaluation of the water requirements for irrigation in a situation of climate change is carried out for a period of 45 years and it is presented as discrete daily values. All that is in compliance with the historical data about the water requirements for irrigation and the structure of the cultures, established with the constant taking of inventory in agriculture, surveys and the current agricultural practices in the region.

Under the presumption that based on the structure of cultures presented in the (2014) Statistical Yearbook on Agriculture, Orchards and Vineyards, the entire land, with the exception of the plots with corn, is irrigated, the total needs of water for irrigation are estimated at about 77 million m<sup>3</sup> water.

The climate change resulting in reduced precipitation and changes in their time distribution and increase in temperature could cause increase in the needs of water for irrigation of about 8%.



Projected water requirements for irrigation for 2016–2050

## WE LEAD BY EXAMPLE: MODELLING POTENTIAL FLOODS IN THE SKOPJE REGION

There had been floods in the past and there will be floods in the future in the Skopje Region, both along the natural routes of the river and when the protection facilities' capacity is exceeded or they fail. Upstream of the city there are three river basins: Upper Vardar, Treska and Lepenec that have such a form that under certain meteorological circumstances they could cause coincidence of flood waves, a "Damocles sword", that poses significant threat for the Skopje Valley.

The Matka, Sveta Petka and Kozjak reservoirs (on Treska River), that are downstream of the City of Skopje, even though they were constructed with the highest engineering standards and with a retention space sufficient to minimise the risk of floods, such as facilities for big urban areas, it still poses a risk from floods.

#### Types of possible floods in the Skopje Region:

- The main rivers: Upper Vardar, Treska, Lepenec
- Torrential rains
- Mountain torrents
- Storm water drain system (storm water)
- Underground waters
- Spills from the Treska River reservoirs upstream from Skopje (Matka, Sveta Petka, Kozjak)

Flooding from the reservoirs is possible after a dam failure, because of which the entire accumulated volume of water would spill in a very short period. This is an extreme case, with extremely low probability of occurrence.

#### TYPES OF POSSIBLE FLOODS IN THE SKOPJE REGION:

THE MAIN RIVERS: UPPER VARDAR, TRESKA, LEPENEC • TORRENTIAL RAINS • MOUNTAIN TORRENTS • STORM WATER DRAIN SYSTEM (STORM WATER)  
• UNDERGROUND WATERS • SPILLS FROM THE TRESKA RIVER RESERVOIRS UPSTREAM FROM SKOPJE (MATKA, SVETA PETKA, KOZJAK)

In order to identify the areas at potentially significant risk from floods and potentially negative consequences from future floods, hydrological and hydraulic modelling of the relevant water flows has been undertaken in combination with a detailed analysis of the hydro-geomorphology of the River Vardar (UNDP and the City of Skopje, 2016). The main objectives of the modelling are:

- DEVELOPING VARIOUS MATHEMATICAL MODELS FOR SIMULATING FLOODS
- FLOOD RISKS AND HAZARDS MAPPING
- ESTABLISHING THE OBJECTIVES FOR FLOODS RISK MANAGEMENT
- IDENTIFYING ACTIVITIES AND MEASURES FOR FLOODS RISK REDUCTION (NON-STRUCTURAL AND STRUCTURAL)
- ECONOMIC ANALYSIS OF IDENTIFIED MEASURES FOR FLOODS RISK REDUCTION
- DEVELOPING A MONITORING AND FORECAST SYSTEM FOR FLOODS RISKS BASED ON THE ENTIRE BASIN
- ESTABLISHING AN EARLY WARNING AND ALARM SYSTEM

# URBAN

## ZONE OF THE CITY OF SKOPJE

due to its economic importance and population density it needs a significantly high level of protection from floods. A flood waves with a Q100 occurrence probability that corresponds to the current flow of 900 m<sup>3</sup>/s could be caused by a full coincidence of the maximum flow of flood waves in the Upper Vardar and Lepenec, a phenomenon that was registered in 1979. The results from modelling have established that the current level of protection from floods of the Skopje urban zones is still reasonable.

However, it should be pointed out that the city has missed the opportunity of having a high level of protection, as well as the fact that there is no justification for any possible future reduction of the river flow in the urban zone.



# RURAL

## ZONE OF THE CITY OF SKOPJE

for the protection of the industrial, residential (semi-urban) and agricultural areas located downstream from the central/urban zone of the city. The analysis has shown that overtime this part of the city has been significantly urbanised and medium-level protection measures need to be implemented, i.e. protection from a flood wave with an occurrence probability of 100 years (Q100).

Higher level of protection, due to the relatively big investment costs, reduce the net current value of the benefits.



50 YEAR OLD WATER | 29 MIL € | 0.9% GDP FOR SKOPJE



100 YEAR OLD WATER | 48 MIL € | 1.5% GDP FOR SKOPJE



500 YEAR OLD WATER | 90 MIL € | 2.8% GDP FOR SKOPJE

# TORRENTS

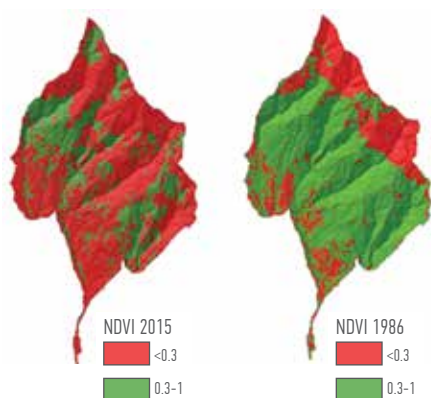
## TORRENTS IN SKOPJE – VODNO AND SKOPSKA CRNA GORA

Several torrent routes that are east of the city centre (Martino Brdo, Murtinec, Kisela Voda and Pripor) are either not regulated at all or only partially regulated. Apart from this, the transitional section of these torrent routes, which as a result of inappropriate planning is dominantly "urbanised" i.e. occupied mainly by residential buildings, represents a critical zone with significant flood risk.

The analyses show that the optimum flood risk reduction measures in the regions struck by torrents should be somewhere in the high protection scenarios (protection from floods with rare probability of occurrence).

Critical and priority torrents are the torrent routes from Vodno to the north-eastern side towards very important public infrastructure and densely populated areas.

Regulating the torrent routes is a long-term process most directly linked to the improvement of hydrological conditions in the basin areas. The results have shown that even small improvements in the use of land and forests in the area of the Skopska Crna Gora Mountain could have a major impact on the flood risk reduction.



## ALONG THE RIVER

# LEPENEC

through the populated area of the broader region of the City of Skopje – in compliance with the hydraulic and economic models, a medium to high level of protection is proposed as the most adequate level of protection that also corresponds to the level of protection of the Vardar River in the urban area.

With this kind of protection, one gets the highest cost-benefit ratio, and the net current value of the proposed protection is maximised.

## UPPER VARDAR

# RASCE

The analysis has shown risk from potential flooding of the Rasce springs of the River Vardar. Bearing in mind that Rasce are springs that provide water for the entire City of Skopje, the potential threat and consequences are characterised as severe.

There is a need for full protection from the harmful effects of flooding from the Vardar and for preventing the hazard of having the river dragging large quantities of alluvium as a result of the rise and change in the course of the riverbed.

# EXTREME

## SCENARIOS

Even though the entities that manage the big dams are obliged to prepare flood risk analysis in case of dam failure, the major damage that could occur as a result of such extreme incidents emphasises the importance of proper management of the dams and reservoirs upstream from the City of Skopje.

## 2.3 HEALTH

The cities are very vulnerable to climate change. More than 70% of them are facing the effects of climate change.

**“IN A HEALTHY BODY,  
HEALTHY MIND**  
Keller

The Republic of Macedonia has adopted a Strategy for coping with climate change in the health sector, as well as action plans for coping with heat and cold waves. However, the reduction/mitigation of the consequences of such climate change on health is a task not only for the public health sector, but for the entire social system, including the City of Skopje.

By reviewing and analysing the publications, studies, public health and statistical reports and expert evaluation, the vulnerable groups of the population in the Skopje Region have been determined, and the direct effects from climate change on the health and the climate change impact and probable pressures in the Skopje Region have been registered.

#### VULNERABLE GROUPS

### ETHNIC GROUPS

especially those who live in adverse living conditions and with low socio-economic standards and low education.

### ELDERLY

the percent of the elderly population in Skopje and in the country is growing and their living conditions are deteriorating, especially when they are living alone or in nursing homes. Their sensitivity to climate extremes is great and their resilience is reduced.

### PUBLIC UTILITY WORKERS

more than 2,500 workers in the public utility services in Skopje work intensively outdoors, including police officers, fire-fighters, farmers and construction workers.

### HOMELESS PEOPLE

there is only one shelter for about 70 homeless people, and the shelter is in a very bad condition. There are several Red Cross shelters for about 150 persons. Most of the homeless sleep in the open with absolutely no protection, especially not from climate change.

### OTHER

long-term bed-bound sick people and prisoners.

#### REGISTERED DIRECT EFFECTS OF CLIMATE CHANGE ON HUMAN HEALTH

### MORTALITY FROM TEMPERATURE EXTREMES

High temperatures are linked to increased mortality among the population, especially among the older population (older than 75). This is due, among other reasons, to increases in the concentration of ozone in the air.

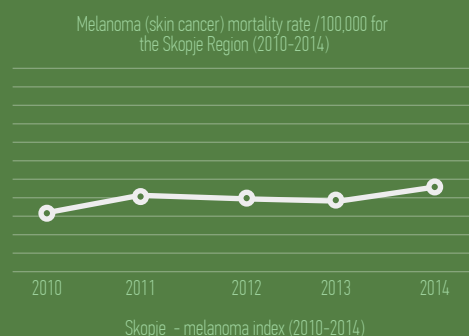
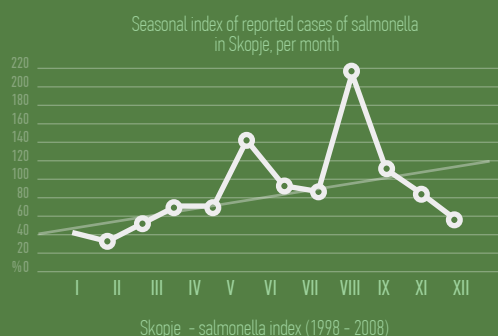
During periods of extremely low temperatures, the average daily number of deaths was 7% higher compared to the rest of the year, especially among those with cardiovascular conditions. In the 2006-2010 period an additional 316 cases of cardiovascular and 344 cases of respiratory diseases were recorded, as well as an additional 14 deaths, as a result of temperature extremes.

### FOOD POISONING

Incidents of food poisoning in Skopje have risen by 2.8% with every increase of one degree Celsius (above the limit of 17.9°C). The projections to 2030 show that there will be an average of two extreme peaks in the summer and one in the winter period.

### SKIN MELANOMA

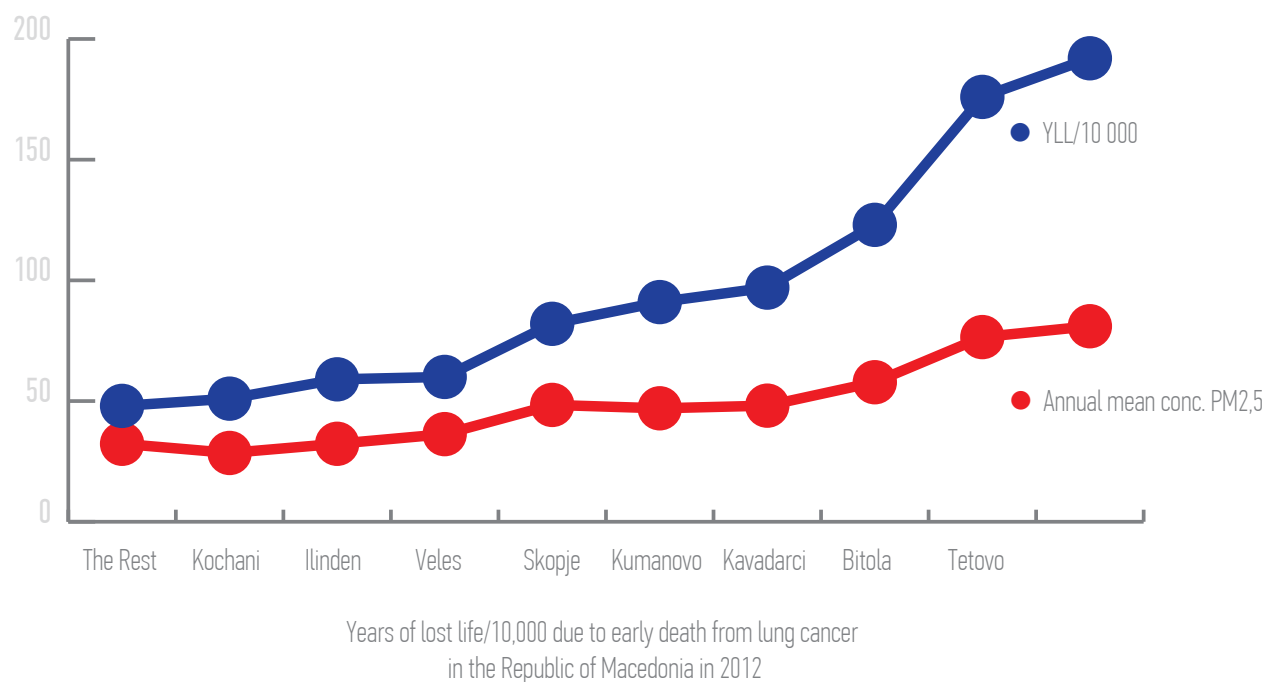
Even though at a low rate, there is still an increase in the registered mortality rate from skin melanoma.





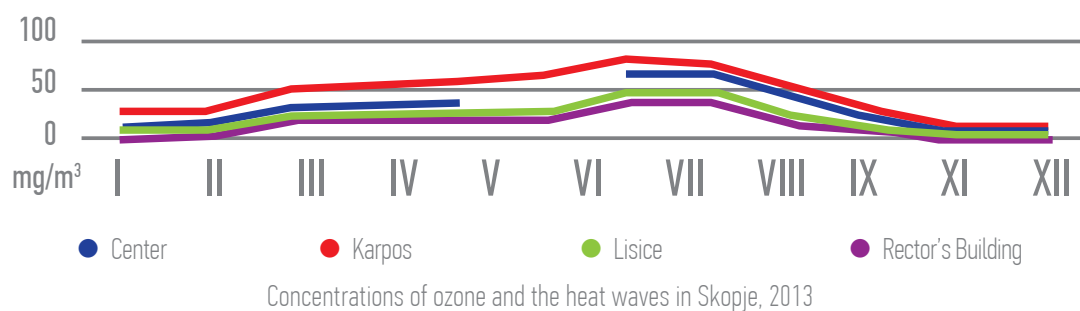
## AIR POLLUTION

The greatest environmental stressor/hazard in Skopje is air pollution. Even though there are seasonal variations, air pollution is exacerbated by climate change. When assessing the prevalence of diseases caused by high concentrations of PM 2.5, according to the calculations of the Public Health Institute (PHI), in a situation of annual average concentrations of 48.4 µg/m<sup>3</sup> PM2.5 in 2012, 4,174 years of life of the citizens of Skopje (82/10,000 residents) have been lost as a result of death from lung cancer.



## HEAT WAVES

Heat waves are a common phenomenon in Skopje. They contribute to summer air pollution with an increased concentration of ozone. This has a serious impact on the increase in diseases and mortality during the summer, primarily of cardiovascular and lung diseases.



## INDIRECT THREAT

Water, food, waste disposal, hygienic conditions and hygiene habits are also under threat from climate extremes. Under such conditions, the "enterocolitis" diagnosis, which is linked to frequent diarrhoea, as well as infectious jaundice, are the most frequent diagnoses, primarily in suburban settlements.



Waters and alimentary diseases (food-borne diseases) in the Skopje region in 2015

## PREDICTING THE IMPACT AND PRESSURES OF CLIMATE CHANGE

- The number of deaths caused by cold weather will probably decrease significantly.
- The number of deaths caused by heat waves (high temperatures) will probably increase significantly.
- Cases of food poisoning will most probably increase significantly.
- Vector-borne diseases could represent a local problem, but the increase of their total impact will be small.
- Water-borne diseases could increase in certain parts, but again the total impact will be small.
- In principle the effects of air pollution on human health will increase, including the possible effects of ozone during summer: several thousand deaths and a similar number of hospitalisations could happen every year.
- Cases of skin cancer will most probably increase.

## WE LEAD BY EXAMPLE: #SKOPJEAIR – USING DATA TO REDUCE AIR POLLUTION IN SKOPJE

One of the first challenges of the City of Skopje Innovation Centre is to reduce air pollution #SkopjeAir. This pilot innovation will be carried out in several phases:

1. Establishing a test-system for collecting and analysing air pollution in Skopje at a micro-level of data, based on a number of data sources and big data in real time. By identifying the obscure and concealed reasons for increased pollution in the city, fast and cheap actions will be tested that would result in a significant reduction of air pollution.
2. Data analysis and visualisation for the purpose of changing public behaviour and motivating citizens to participate actively in resolving the problem.

"The will to act is a renewable source."  
Al Gore

3. Testing concrete activities - (for example preparing a programme for motivating poor households to use heating practices that are less polluting; better protection and isolation of construction sites; working from home one day in the week during days with the highest levels of pollution - testing the employees of some governmental institutions and volunteering by some bigger companies; redesigning the bike hiring system).



# 2.4 RISK MANAGEMENT AND INCREASING URBAN RESILIENCE



The City of Skopje is the capital of the Republic and the area with the greatest concentration of population as well as critical infrastructure and systems necessary for the functioning of the city and the state as a whole, because all state authorities are concentrated here, including the Government and its executive institutions and foreign diplomatic and other missions. For this reason it is necessary to undertake comprehensive measures and activities for disaster and climate risk management.

The City of Skopje has its own recognisable profile of risks that is based on the number, frequency and features of accidents and disasters that happened in the past, as well as the existing profile of hazards determined by the particularities of nature and of the environment, and even more by the effects related to the dispersion and the particular construction of the space, the exposure and vulnerability of the population and other risk elements.

Earthquakes are the leading threat according to the expected scale of impact and consequences that can be expressed in human losses and injured people, direct damages and long-term consequences to the natural, material and cultural resources, as well as in their negative effect on gross national product having in mind the historical facts and the vulnerability of the broader city area. On the other hand, fires and floods are ranked second and third respectively according to their frequency and intensity in recent years and the damage they have caused. In Skopje there are also some other hazards linked to climate and meteorological changes, and they are expressed in the extremely high levels of air pollution, extreme weather phenomena, like heat and cold waves, landslides, torrential rains accompanied by lightning and thunders, strong winds and long-lasting fog.

In the Republic of Macedonia, disaster risk management is organised at national and local level. In the case of the City of Skopje, it is unique bearing in mind that the city is a separate local self-government unit. Regarding legislation in the field of risk management there are numerous laws among which the laws on crisis management, protection and rescue, fire protection, local self-government and other laws and bylaws.

The Law on Crisis Management regulates the crisis management system, including organisation and operation, decision-making and use of resources, communication, coordination and cooperation, security threat assessment of the Republic, planning and financing, as well as other issues. The crisis management system is implemented for the purpose of prevention, early warning and coping with crises that result from natural disasters and epidemics and pose a threat to the property, health and lives of people and animals, and of other risks and hazards that directly threaten the constitutional order and security of the Republic of Macedonia or part of it, and for which there are no conditions for declaring martial law or a state of emergency.

The Law on Protection and Rescue regulates the area of protection and rescue with general provisions about the area, protection and rescue planning, the obligations of the entities in the system, including the citizens, protection and rescue measures and the organisation of protection and rescue forces, etc.

Pursuant to the Law on Local Self-Government and the principle of subsidiarity, the local self-government units have a right to perform activities of public interest and local significance in their areas, including activities for crisis management and protection and rescue, primarily related to the lives and health of the citizens and the material goods on the territory of the municipality, space arrangement, utilities and other services.

The institutional framework is led by the Crisis Management Centre and the Protection and Rescue Directorate, as well as local self-government units and public enterprises, institutions and services and other entities.

The Crisis Management Centre is responsible for early warning, monitoring of the situation and identification of the risks and hazards that could result in a crisis, while informing all the entities in the Crisis Management System and the citizens of the state. Within the CMC framework there is a 24/7 operational centre for receiving, processing and exchanging information about potentially risky situations, using the emergency number 195, as well as other protocols established with bylaws and internal procedures. The CMC territorial organisation consists of 35 Regional Crisis Management Centres, and 8 of them (including the Centre in Skopje) operate nonstop (24/7).

The Protection and Rescue Directorate organises the Protection and Rescue System in the country and ensures the functionality of the protection and rescue measures in compliance with the law. Protection and rescue forces are organised at national level (republic forces), and at territorial level (territorial forces), and there are also rapid reaction forces. The Directorate has 35 regional directorates, plus its headquarters in Skopje.

Local self-government units have an obligation and responsibility to be the first to respond to disaster risks on their territory. If they do not have sufficient capacity or forces to respond, they may ask for assistance from neighbouring municipalities, the City of Skopje and the Protection and Rescue Directorate or the CMC to coordinate the involvement of other resources and forces (the Army and others).

The Territorial Fire Brigade is part of the capabilities of the local self-government units. In Skopje they are organised at the level of the city of Skopje and mostly participate in protection and rescue activities in cases of fires, floods and other accidents and incidents. Public enterprises, institutions and services, as well as companies of a particular character, are also part of the disaster risk management system and have their own obligations and responsibilities.

From the operational aspect, at the level of the City of Skopje there is a City Protection and Rescue Headquarters, while municipal headquarters are organised at the level of local self-government units. The City of Skopje coordinates activities in the area of protection and rescue on its territory, and the municipalities in the City of Skopje are obliged to cooperate and to follow the instructions of the City of Skopje. From the aspects of adopted assessments, the Council of the City of Skopje in 2015 adopted the Assessment of threats from all risks and hazards for the territory of the City of Skopje\* (including all 17 municipalities in its wider region).

When implementing activities for risk reduction and strengthening resilience, the following challenges need to be taken into consideration:

INSUFFICIENT INCLUSION OF DISASTER RISK REDUCTION IN SECTOR STRATEGIES AND PROGRAMMES, AS WELL AS PRIORITIES FOR ACTION OF THE INVOLVED INSTITUTIONS AT NATIONAL AND LOCAL LEVELS.

INSUFFICIENT COORDINATION AND COMMUNICATION AMONG THE INVOLVED INSTITUTIONS AT NATIONAL AND LOCAL LEVELS.

ACCELERATED URBANISATION AND BUILT ENVIRONMENT.

INSUFFICIENT FINANCIAL SUPPORT FOR THE IMPLEMENTATION OF ACTIVITIES AND MEASURES.

LOW LEVEL OF APPLICATION OF GENDER PRACTICES IN RISK REDUCTION MANAGEMENT.

INSUFFICIENTLY DEVELOPED CULTURE OF PREVENTION AND COOPERATION WITH THE BUSINESS SECTOR.

\* The Assessment of threats from all risks and hazards for the territory of the City of Skopje was prepared by the Regional Office of the Crisis Management Centre in the City of Skopje.

# SOCIO-ECONOMIC VULNERABILITY AND CLIMATE RISKS

## EVALUATION OF THE CITY OF SKOPJE'S MUNICIPALITIES

The municipalities are ranked according to their socio-economic vulnerability. This is based on the calculated Social Vulnerability Index (SoVI) of the City of Skopje and the ten municipalities using the following indicators:

1. RAPID GROWTH OF THE POPULATION, AVERAGE ANNUAL POPULATION GROWTH RATE IN THE MUNICIPALITY
2. YOUNG POPULATION
3. OLDER POPULATION
4. ETHNIC BACKGROUND
5. POPULATION WITH SPECIAL NEEDS
6. EMPLOYMENT
7. HOUSING CONDITIONS, WATER SUPPLY SYSTEM
8. HOUSING CONDITIONS, WASTE WATER DRAINAGE SYSTEM
9. ENVIRONMENT, ACCESS TO HEALTH SERVICES

In addition, all the indicators have the same effect on social vulnerability. The greater value of the indicators from 1 to 6 contribute to increasing social vulnerability, while the indicators from 7 to 9 contribute to its reduction. It is important to mention that the social vulnerability index is not a unit of measurement but a relative indicator that is used for comparing the geographical units for which it is calculated, while its absolute value is of no significance. The interval within which the calculated values of the Social Vulnerability Index are arranged (from the lowest to the highest) is divided into five equal parts and each is marked with a certain rank, as illustrated below:



### CITY OF SKOPJE

Karpos	-6,7	H	<div></div>
Aerodrom	-5,2	H	<div></div>
Gjorce Petrov	-2,4	C-H	<div></div>
Kisela Voda	-2,3	C-H	<div></div>
Cair	-1,4	C-H	<div></div>
Gazi Baba	-1,2	C-H	<div></div>
Butel	0,6	C	<div></div>
Centar	3,2	C-B	<div></div>
Saraj	6,7	B	<div></div>
Suto Orizari	8,8	B	<div></div>

Table 1. Social Vulnerability Index (SoVI) of the population in the municipalities of the City of Skopje

According to the evaluation within the City of Skopje, social vulnerability is greatest in the municipalities of Suto Orizari and Saraj. The high level of vulnerability of the population of Suto Orizari in comparison to other municipalities in the city of Skopje is primarily due to the high concentration in this municipality of the population of Roma ethnic background, with a higher than average annual population growth rate, a higher percentage of the population younger than 6 in the total population of the municipality, a higher number of registered unemployed persons in every 100 individuals capable to work, and a smaller number of GPs with practices per 10,000 residents.

The high level of vulnerability of the population of the municipality of Saraj in comparison to the other municipalities in the City of Skopje is primarily due to the higher annual population growth rate, the higher percentage of the population younger than 6 in the total population of the municipality, the housing conditions related to the water supply system and their connection to the public sewerage network, as well as the smaller number of GPs with practices per 10,000 residents.

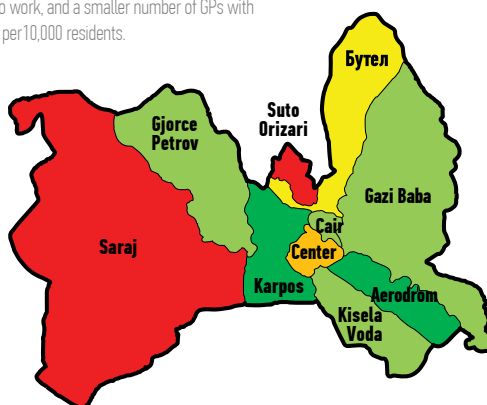


Figure 1. Map of the City of Skopje: municipalities according to the level of social vulnerability

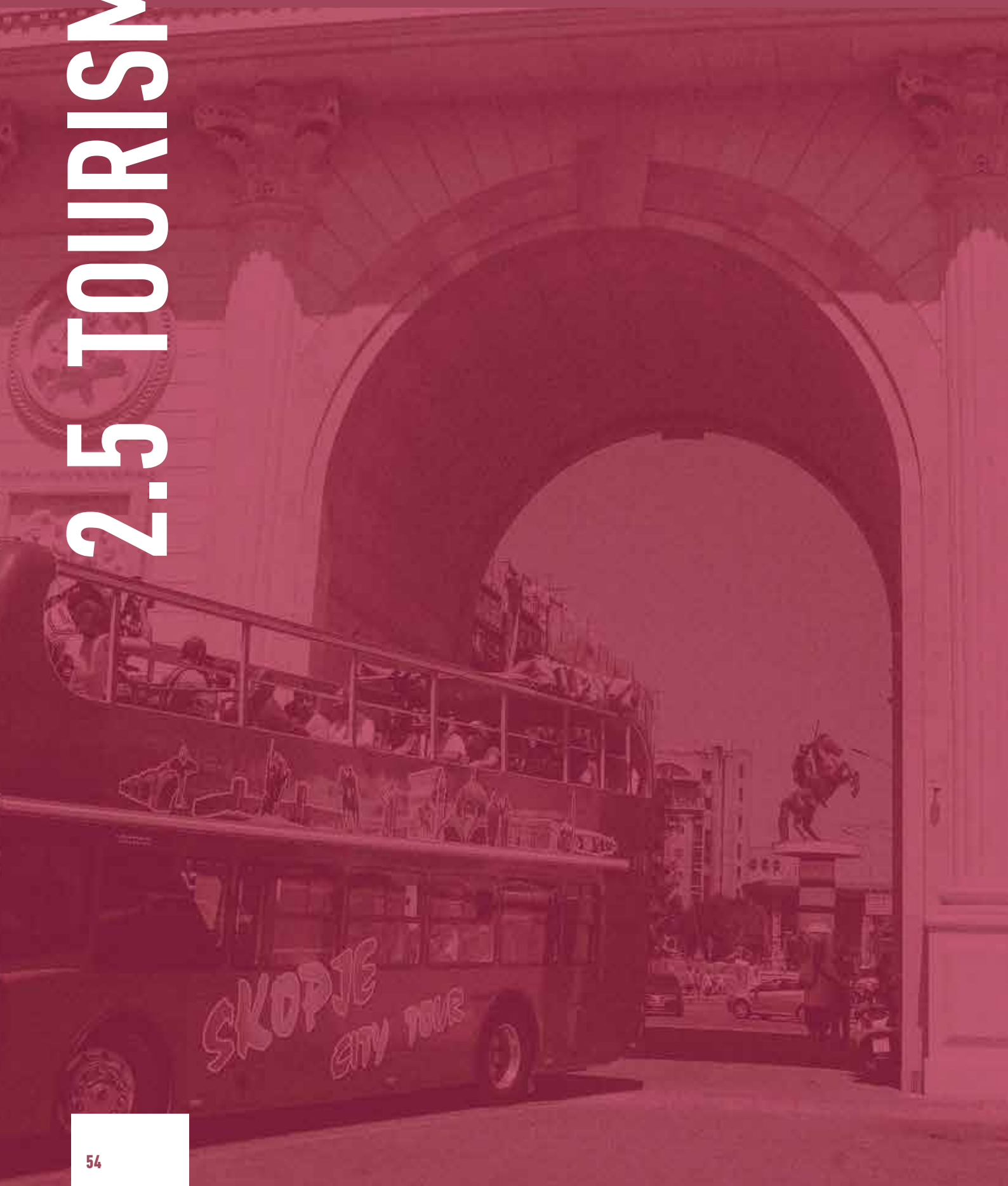


Vulnerability to climate change is the degree to which the system is vulnerable to the adverse effects of climate change and can not handle it. Social vulnerability describes those characteristics of the population, affecting the ability of a community to prepare for danger or disaster respond to it and to recover from it.

Social vulnerability helps explain why some communities perceive danger differently, although they perceive the same level of flood or tidal waves in the same storm.



# 2.5 TOURISM



## TOURISM AND THE CHALLENGE OF CLIMATE CHANGE<sup>4</sup>

Tourism and travel for the purpose of rest and recreation in the City of Skopje contributes significantly to the national economy. In 2014, some 14% of the total number of nights spent by tourists in the country were in Skopje, while 90% of the tourists in Skopje in that year were foreigners. The impact of climate change on tourism has become a social topic of discussion. Preserving the country's rich cultural heritage, its complex identity and history, is crucial for the continued development of tourism as a vital and growing source of income. This heritage needs to be protected for the sake of Macedonia and for the sake of the world heritage.

The City of Skopje has shown a firm and growing dedication to developing tourism and protecting its cultural heritage within the framework of its competences, mobilising and coordinating numerous human and material resources to such development and protection.

Climate change has added new complexities to the challenge of preserving the cultural heritage and developing tourism. Climate is a decisive factor when tourists select their destinations. Tourism depends significantly on climate stability. Increased summer temperatures could place some outdoor destinations outside the comfort zone of most international tourists. The traditional tourist regions, including the well-known wine regions in their vicinity, could change significantly as a result of climate change. Any increase in the frequency of extreme weather events could damage the image and ultimately the structure of many of the country's cultural monuments – monuments that were built under very different climate conditions.

These mutual influences were analysed in detail for the first time for the Third National Report on Climate Change, which identified the significance of introducing city tourism as a new cluster in future National Tourism Strategies, as well as introducing a methodology for evaluating the impact of climate change on cultural heritage in the open air.

From the changed weather conditions that have been registered in Macedonia it can be concluded that tourism in the City of Skopje will be exposed to risk in two ways:

- SUMMERS MAY BECOME TOO HOT, CAUSING DISCOMFORT FOR TOURISTS AND REDUCING THE LENGTH OF THE TOURIST SEASON.
- EXTREME WEATHER, ESPECIALLY ICE AND RAIN, COULD CAUSE SIGNIFICANT PHYSICAL DAMAGE TO HISTORICAL SITES, MAKING THEM LESS ATTRACTIVE FOR TOURISTS.

(It should be noted however, that warmer winters could prolong the tourist season of some areas, including Skopje.)

## WE LEAD BY EXAMPLE: HOW TO SPEND A "GREEN" DAY IN SKOPJE

To harness the innovative potential of the population to come up with ideas for smart urban development, the City of Skopje launched a competition, in cooperation with the Ministry of Environment and Physical Planning and UNDP, invited the public to propose ideas for the best way of spending a green day in Skopje, i.e. activities and journeys in the city involving the lowest emissions of greenhouse gases. Entitled "How to spend a different – "green" day in Skopje?", this inclusive challenge encourages citizens to take initiative and to participate actively in the development of better solutions for urban mobility that will make the city more resistant to climate change and will contribute for stronger local economy.

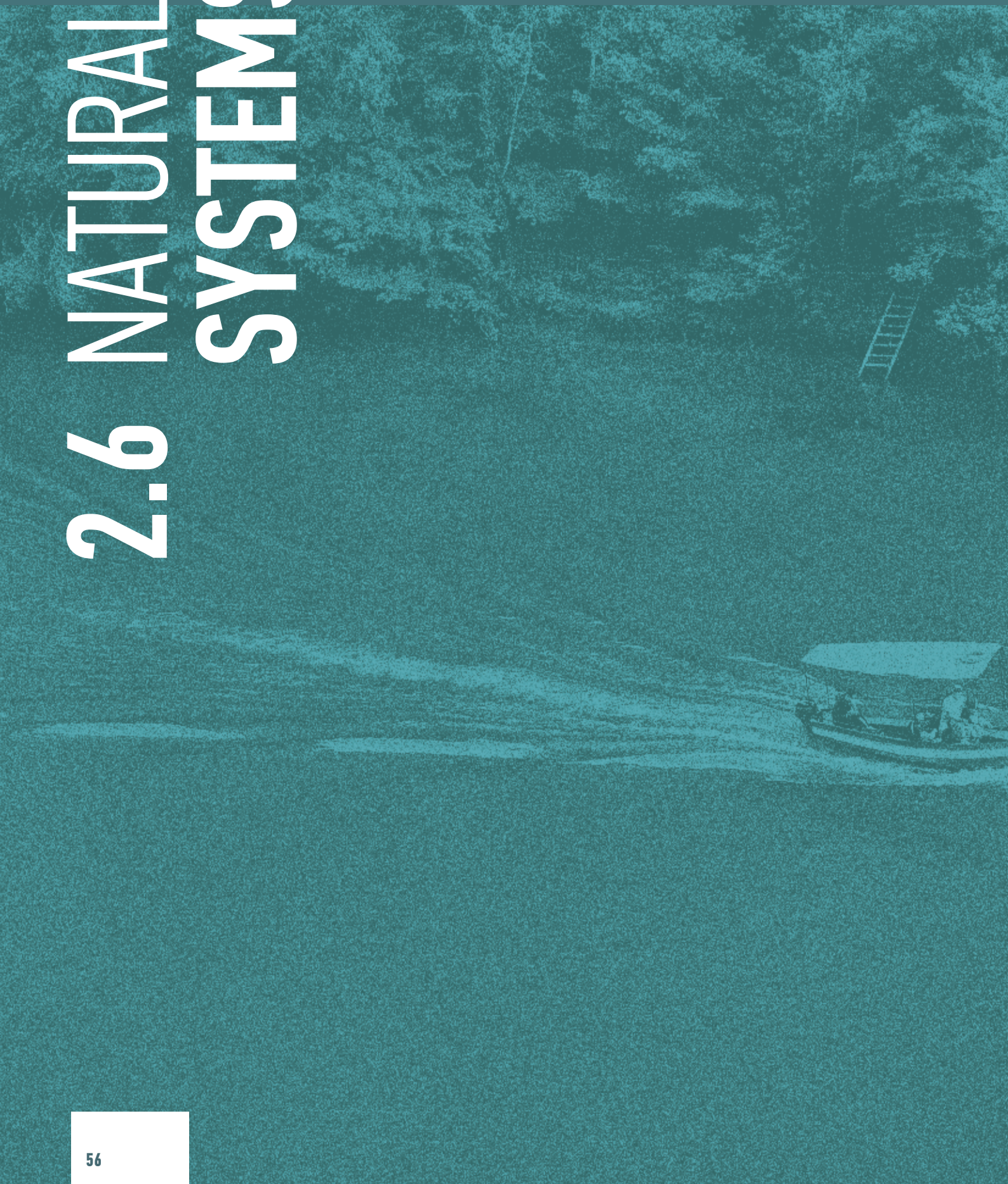
The private sector was also invited to participate by offering discounts for healthy meals and picnic hampers, as well as offering group transport with electric vehicles from the closest bus stop and "green" tours of their premises.

In addition, tour operators offered to incorporate the greenest routes in their regular tourist offers.

<sup>4</sup> Excerpt from the results of the assessment of the first country report evaluating the vulnerability of tourism and cultural heritage protection in the Republic of Macedonia to climate change, with possible adaptation measures and strategies. These assessments were conducted as part of the Third National Report on Climate Change to the UNFCCC, prepared by the Ministry of Environment and Physical Planning with the support of UNDP and GEF. The entire report is available at <http://unfccc.org.mk/Default.aspx?LCID=301>; [http://www.unfccc.org.mk/content/Documents/VULNERABILITY/EN\\_Tourism%20CC\\_Final%20Macedonia%20Report\\_Peter%20Burns.pdf](http://www.unfccc.org.mk/content/Documents/VULNERABILITY/EN_Tourism%20CC_Final%20Macedonia%20Report_Peter%20Burns.pdf); <http://www.unfccc.org.mk/Default.aspx?LCID=258>.



# 2.6 NATURAL SYSTEMS





Climate change has a significant impact on ecosystems and biodiversity. Although wildlife has been evolving for millions of years, adapting to naturally changing climate conditions, the current rate of climate change, exacerbated by human activities, is now faster and more intensive than the capacities of many species to adapt.

Naturally preserved ecosystems are more flexible and capable of adapting to changes. This is why protected areas are so significant. By applying special regimes of protection to preserve the adaptable potential of the ecosystem on as large an area as possible. In this way they help society cope with the impact of climate change by maintaining the fundamental services of the ecosystems on which people depend, including the effects of climate change on water reserves, diseases and agricultural production.

Many measures can be undertaken to mitigate the impact of climate change on biodiversity. The most important measures incorporate changes in the policies on the use of land adaptation of physical plans, etc. Specific measures include:

- EXPANDING THE PROTECTION AREA SYSTEM
- INCORPORATING CLIMATE CHANGE MEASURES IN PLANS FOR MANAGING PROTECTION AREAS
- CONNECTING PROTECTED AREAS WITH BIOLOGICAL CORRIDORS
- ENABLING THE FREE MOVEMENT OF SPECIES AND EXPANDING HABITATS ACROSS THE LINEAR INFRASTRUCTURE, I.E. ROADS, RAILWAYS, HYDRO-SYSTEMS, ETC.\*

The area of the Skopje Valley covers seven climate-vegetation-soil zones of significant bio-geographical diversity. The following four biomes have been identified: a biome of sub-Mediterranean, mainly deciduous forests and shrubberies; a biome of South European, mainly deciduous forests; a biome of European forests; and a biome of high mountainous rocky grounds, pastures and glaciers. This distribution of biomes reflects the historical development of the valley, including the ways in which humans have used the areas and adapted them to their needs.

The City of Skopje has legal obligations to take care of the following protected areas under its authority:

- THE GAZI BABA PARK: A PLATEAU WITH 110 HA OF FOREST WITHIN THE URBAN STRUCTURE OF THE CITY.
- THE PARK AND FOREST OF VODNO: A MOUNTAIN WHOSE FOOTHILLS IN THE SOUTH-WESTERN CITY LIMITS HAVE BEEN SUBJECT TO UNSCRUPULOUS URBAN DEVELOPMENT.
- THE MATKA CANYON: A CANYON OF THE RIVER TRESKA TO THE NORTHWEST OF SKOPJE. THE CANYON IS A RICH REFUGIAL CENTRE WITH BOTH ABOVEGROUND AND UNDERGROUND GEOMORPHOLOGIC FORMS.

In recent years, the City of Skopje has drafted a Study for the Valorisation of the Zeden Massif (where the Rasce springs of drinking water are located) and a Study for establishing an ecological protection corridor connecting Vodno-Saraj-Matka. Four additional studies are in their final stages at the time of writing: a Study for the Valorisation of Skopska Crna Gora; a study for the Revalorisation of Vodno; a Study for the Revalorisation of Gazi Baba; and a Study for the Revalorisation of Matka (drafted as part of an international project).

The negative impact of human activities on protected areas is evident. This is despite their established protected status, for which the City of Skopje has been continuously allocating funds for protection, landscaping and development, within its annual budgets, implementing numerous activities and undertaking measures, carrying out studies and writing academic papers.

The process of revalorisation and re-protection of protected sites, in accordance with the Law on the Protection of Nature is currently being implemented by the Ministry of Environment and Physical Planning. As part of this process, plans have been adopted for managing the protected areas – plans, which need to encompass all the interested parties, problems, solutions and measures for the protection and promotion of the sites.

The development and expansion of the network of protected nature areas is crucial for the survival of natural systems.

\* 'Third National Report to the UNFCCC': project report on climate change vulnerability in the biodiversity sector. (Authors: Melovski Ljupčo, Matevski Vlado, Hristovski Slavčo).

## 2.7 URBAN GREEN SPACES



Urban areas have very different features to the surrounding rural areas. In urban areas, non-porous built surfaces have replaced spaces for vegetation that produce natural shades, cooling, retention of storm water, depositing and infiltration. Urbanisation has altered natural regimes of energy explorer, creating urban heat islands and changing the hydrology of the urban area leading to increased surface runoff of rain water. Given that these negative effects of urbanisation will be greatly exacerbated by climate change and extreme weather phenomena, there is an urgent need for development and protection of the urban green infrastructure. In addition to providing conventional functions, the development of an urban green infrastructure will help provide a long-term solution to the mitigation of climate change.

Regardless of the developed understanding of green spaces, they are not adequately integrated in the planning and managing process. Hence, the creative utilisation of the green infrastructure needs to be accepted in the process of planning at all levels and in all sectors.

The development and the management of the urban green spaces is becoming a complex task that should be reviewed attentively, if the common goal is for the green urban areas to be accepted and appreciated by the citizens. The development of green spaces and their proper management require a comprehensive and interdisciplinary approach and knowledge of the complex relations between the factors that determine them.

In its search to find its adequate approach to developing the green infrastructure, the City of Skopje has drafted the 2015 Greenery Study.

The results from the study could be summarised in the following guidelines:

- RECOMMENDATIONS FOR CREATING AN INTERCONNECTED SYSTEM AND NETWORK OF URBAN GREEN AREAS AND GREEN CORRIDORS IN THE CITY AND ITS SURROUNDING;
- GUIDELINES FOR PROVIDING LAND FOR OPEN PUBLIC SPACES;
- DEFINING THE CRITERIA FOR APPLYING THE MOST ADEQUATE TYPES OF LANDSCAPING OF GREEN SPACES IN ACCORDANCE WITH THE DISRUPTED ENVIRONMENTAL QUALITY AND CLIMATE CHANGE EFFECTS.

Simultaneously, the City started with the implementation of the Study's recommendations, such as:

- PROVIDING REAL SPATIAL, QUANTIFIED AND QUALITY DATA ON THE PUBLIC GREENERY, BY MAKING A GREEN CADASTRE, AND
- CARRYING OUT A STUDY IN ORDER TO ESTABLISH THE POSSIBILITIES AND THE WAYS OF CREATING URBAN GREEN CORRIDORS ALONG THE LEPENEC AND SERAVA RIVERS AND THEIR BENEFITS.

## WE LEAD BY SETTING: GREEN CADASTRE OF THE CITY OF SKOPJE

The City of Skopje, in cooperation with UNDP, has implemented activities for establishing a Green Cadastre of the city's public green areas within the territory of the general urban plan. The fundamental objective is to improve public greenery management and environmental protection, as well as to strengthen urban resilience by collecting and analysing spatial data about the greenery. The beneficiaries are the City of Skopje, the Public Enterprise Parks and Greenery (JP Parkovi i zelenilo), the municipalities within the City of Skopje, and the citizens.

Due to their complexity, these cadastre-related activities are being implemented in phases. In the first phase (2015–2016), implemented activities included the geodetic recording of trees and shrubbery as well as of the park infrastructure on 650 ha, the making of a mobile application for taking an inventory of the greenery in the area, a GIS application for reviewing and managing public greenery on the territory of the City of Skopje, as well as for strengthening the internal capacities of the City of Skopje and the Public Enterprise Parks and Greenery "Parkovi i Zelenilo". In the second phase (2017) there will be a field inventory of trees and shrubbery, collecting data and attributes, as well as making a mobile application for crowdsourcing data from citizens.

While implementing the activities, the lessons learned and the best practices of the cities of Osijek (Republic of Croatia) and Belgrade (Republic of Serbia) were used, and experiences were explorer.



Green Cadastre  
of the City  
of Skopje

# 3.1 KEY RECOMMENDATIONS

## CHAPTER 3 WHAT'S NEXT?

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As a direct measure from the recommendations for climate change mitigation identified during the preparation of this Strategy, in 2016 the City of Skopje published a public call for subsidies of the citizens for buying pellets ovens.

For implementation of this measure, the City of Skopje allocated 96,000 EUR in its own budget e.g. the subsidies shall be given to 196 households, based on the fact that the subsidies are in the amount of 70% from the price of the oven, but not more than 500 EUR. Subsidies are only for citizens with the address in the parts of the city without central heating system. Due to the high interest, this measure shall continue also in following years through allocation from the City of Skopje's budget.

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General recommendation: the City will invest efforts through innovative solutions to involve the public in the design and implementation of all actions and measures to mitigate climate change. In addition, the gender aspect will also be adequately incorporated in efforts for mitigation and adaptation.

## RECOMMENDATIONS FOR IMPROVING THE QUALITY OF FUTURE INVENTORIES

### STATIONARY ENERGY

- To create and maintain a computer database on the energy consumption (fuels and electricity) of institutional buildings and facilities.
- The city administration should keep records of the energy consumption of residential and commercial buildings or the State Statistical Office to disaggregate it by cities

### TRANSPORTATION

- To collect statistics at city level about the fuel consumption of city traffic.
- To sign a Memorandum for continuous cooperation among the public enterprises, including the Macedonian Railways, to regulate access to and eXplorer of data.

### WASTE

- To establish a computer database in which the Ministry of Environment and Physical Planning (MEPP) or the city administration of Skopje can collect and register data on industrial activity, the characteristics of waste waters and emission factors (quantity of waste waters and chemical oxygen demand), in order to enable calculation of the emissions from the treatment and discharge of industrial waste waters.

### INDUSTRIAL PROCESSES

- To collect data for the next inventory or to update this inventory directly through the platform for Emission Monitoring in Industry (EMI) established by the MEPP in cooperation with UNDP.
- To collect data on the use of F-gases for air-conditioning of buildings or vehicles, in order to calculate emissions of F-gases and include this data in the Greenhouse Gas Inventory of the City of Skopje.

### AGRICULTURE, FORESTRY AND OTHER USES OF LAND

- To compile an inventory of the land to determine the area, type, density, annual growth, wood types as well as conversion of the land (by analysing data for remote recording provided from a satellite and using image-processing software).
- To establish a practice of taking input data from the Skopje Green Cadastre.

## RECOMMENDATIONS FOR IMPROVING FUTURE ANALYSIS AND IMPLEMENTATION ASPECTS OF MITIGATION

- **ESTABLISHING ADDITIONAL BENEFITS FROM THE PROPOSED MEASURES FOR CLIMATE CHANGE MITIGATION, SUCH AS:**
  - Creating (green) jobs
  - Reducing air pollution as well as pollution of other media, thereby improving the health of the citizens of the City of Skopje.
- **IMPROVING THE PROCESS OF DATA COLLECTION FOR COMPILING THE GREENHOUSE GAS INVENTORY, AND THUS MAKING BETTER PROJECTIONS FOR THE FUTURE CONSUMPTION OF ENERGY IN THE CITY OF SKOPJE.**
- **CARRYING OUT A DETAILED SURVEY ON THE TYPES OF HEATING THE CITIZENS USE (INCLUDING GENDER DISAGGREGATED DATA) IN ORDER TO ENSURE INFORMED DECISION-MAKING AND POLICY-MAKING.**
- **CONDUCTING AN ANALYSIS OF THE IMPACT OF GREEN ROOFS/FACADES/AREAS ON REDUCING ENERGY CONSUMPTION AND REDUCING THE TEMPERATURE AND HEAT ISLANDS OF THE CITY.**
- **ESTABLISHING AND IMPLEMENTING ACTIVITIES FOR CHANGING THE BEHAVIOUR OF THE CITIZENS AND INSTITUTIONS AS THE INSTIGATORS OF POSITIVE CHANGES, IN ORDER TO COOPERATE IN COPING WITH THE CHALLENGES OF CLIMATE CHANGE.**
- **USING DATA FROM THE GREEN CADASTRE FOR DESIGNING APPROPRIATE MITIGATION MEASURES.**
- **EXPLORING THE POTENTIAL OF GREATER PENETRATION OF HYBRID VEHICLES AND ELECTRIFICATION OF TRANSPORT AS POSSIBLE MITIGATION MEASURES, IN ACCORDANCE WITH GLOBAL AND EUROPEAN TRENDS.**



## RECOMMENDATIONS FOR IMPROVING FUTURE ANALYSIS AND IMPLEMENTATION ASPECTS OF MITIGATION

Establishing additional benefits from the proposed measures for climate change mitigation, such as:

### 1. URBAN HEAT ISLANDS

#### AREAS FOR FURTHER ACTIONS:

- Establishing a modern automated meteorological-climate monitoring system for the needs of the City of Skopje and Skopje Valley. In this way information will be provided about the climate system's "vulnerability" and the possibility of providing early warnings about extraordinary, dangerous and catastrophic meteorological conditions.
- Developing an Urban Heat Index and its gender monitoring.
- More detailed measuring of certain specific areas that are registered as urban heat islands.
- Gathering thermal Imagery from a plane/drone in order to cover a larger area of the city.
- Preparing a detailed analysis of the heat islands in Skopje and designing, prototyping and testing measures for mitigating the consequences from urban heat islands by (for example, introducing a practice of constructing white roof tops).
- Developing a web-platform and interactive database for all data related to the urban heat islands in Skopje.
- Gender analysis of the information, plans and recommendations for mitigation.
- Collecting gender-disaggregated data for informing mitigation analyses.

### 2. WATER RESOURCES

- Using the following criteria for assessing adaptation measures according to their significance (from the greatest to the smallest):
  - ▶ Maintaining the quality and quantity of water at the Rasce springs, since the Rasce springs could be vital for the survival of the population of the City of Skopje.
  - ▶ Maintaining the quality and quantity of water from the Nerezi-Lepenec wells system.
  - ▶ Improving the quality of surface waters.
  - ▶ Economic criteria (total investments, annual expenditures, cost-benefit analyses).
  - ▶ Time frame for application.
- Comparison and ranking of adaptation measures by using various criteria and preferences of decision-makers with a combination of multi-criteria methods and analytical hierarchical processes in order to establish the relative importance of the criteria.



### 3. FLOODS

The Skopje Region is extremely sensitive to climate change. Although the current level of flood protection in the Skopje urban zone is still reasonable, every further capacity reduction of the river in the urban zone is unacceptable. For this purpose, it is necessary to adopt the following recommendations:

- Continued upgrading of the weather stations network.
- Defining new criteria and standards as part of the spatial and urban planning documentation for establishing the dimensions of the draining systems in urban areas with high levels of urbanisation and economic significance.
- Minimum measures are proposed for the urban zone of the City of Skopje, including continued cleaning and maintenance of the entire infrastructure for flood protection i.e. restoration and long-term maintenance.
- Treating the torrents that affect Skopje from the Vodno side and from the southern slopes of Skopska Crna Gora, which are characterised as the most critical and of the greatest priority, and which have important public infrastructure and green spaces on their route, in combination with various measures that provide a high level of protection (protection from floods with rare probability of occurrence), accompanied by a series of non-structural measures linked to urban planning and land management.
- Proper management of dams and reservoirs upstream from the City of Skopje in order to avoid the damage that could result from their failure.
- Gender analysis of the exposure and vulnerability of the citizens of the City of Skopje and of the municipalities on the territory of the City of Skopje to various types of floods.

## 4. HEALTH

The following activities and research should be undertaken:

- Establishing the degree of climate change that could happen in Skopje in the coming period (especially with regard to extreme weather events)
- Establishing the connection of climate factors and their effects on human health:
  - ▶ The exposure of the most vulnerable groups to temperature changes, especially during extreme temperatures.
  - ▶ Identifying association mechanisms between temperatures and diseases.
  - ▶ Reporting and researching cases of food poisoning.
  - ▶ Reporting and investigating water-borne epidemics.
  - ▶ Reporting vector-borne diseases and using GP-based systems for reporting such diseases.
  - ▶ Identifying exposure-response relation of air pollutants, including ozone in summer.
  - ▶ Collecting and analysing gender-disaggregated data.
- Means and methods for mitigating the effects of climate change on health and for the purpose of adaptation:
  - ▶ Strengthening the capacity of the Hydro meteorological Service to undertake timely monitoring and reporting.
  - ▶ Development and implementing the plans for coping with climate disasters should be at an advanced stage.
  - ▶ Community awareness-raising campaigns on the consequences of extreme weather conditions and events.
  - ▶ Efficient methods for initiating changes in the citizens "behaviour during climate extremes.
  - ▶ Women and young people as agents of positive changes.

## 5. NATURAL SYSTEMS

The following activities in this area should be implemented in cooperation with the Ministry of Environment and Physical Planning:

- Continued undertaking of measures and activities for protecting and promoting protected natural rare species.
- Strengthening the process for increasing the number of protected sites.
- Monitoring the status of biodiversity, the impact of climate change and the protection of biodiversity.
- Registering erosion phenomena and undertaking activities for its reduction and prevention.

## 6. TOURISM

- Planning for 21st century urban tourism instead of mass 20th century tourism. Planners and decision-makers could give examples by providing stimulations and regulations that do not harm business and profitability (e.g. information and practical workshops for tourist sub-sectors with a focus on sharing experience among big and small companies, such as major international hotel brands sharing their experiences with smaller hoteliers).
- To ensure future tourist development along sustainable lines (for example by installing solar panels on buildings along with mechanisms for the eXplorer of heat and adequate insulation in order to reduce energy costs, including solid waste management as a very important field). The urgency of such measures is evident in view of the increases in temperatures envisaged in Skopje.
- To undertake a detailed assessment of the sensitivity and exposure of tourist sites in the City of Skopje to climate change.
- To undertake an assessment of all types of risks and hazards for tourist sites on the territory of the City of Skopje and the municipalities.
- Adaptation through diversification. Activities that are influenced by the climate, such as visits to cultural sites in the open, will suffer negative impacts from climate change; consequently, adaptation measures in the tourism sector must contain a diverse range of activities that are most suitable for the changed weather conditions.

## 7. URBAN GREEN SPACES

Green spaces have a positive impact on natural values such as air, water, soil, flora and fauna, and thus represent a "climate infrastructure" of the city, which requires:

- Preservation of the existing greenery in the city
- Creating new urban green spaces, including public urban gardens
- Continued maintenance, upgrading and development of the City of Skopje Green Cadastre
- Combining green areas with water bodies
- Creating shade for pedestrians

## 8. RISK MANAGEMENT AND INCREASING URBAN RESILIENCE

- Incorporating disaster and climate risk management in sector strategies, programmes and plans at local level.
- Strengthening local capacities, capabilities and resources for disaster risk reduction and strengthening resilience.
- Timely updating of evaluations of all types of risks and hazards and adopting plans and developing scenarios for prevention and response to risks, natural disasters and climate risks.
- Integrating data from climate models into existing threat assessments of all types of risks and hazards.
- Continued data collecting, monitoring, analysis and providing timely information about the exposure of citizens to risks.
- Making risk maps on the territory of the municipalities and the City of Skopje.
- Registration and analysis of direct and long-term consequences and losses from natural accidents and disasters for people, communities, infrastructure, critical facilities and development.
- EXplorer of spatial data within the framework of the national infrastructure of spatial data among the Crisis Management Centre, the City of Skopje and other competent institutions.
- Building a resilience culture by implementing targeted activities for strengthening the public awareness among the general population and especially among persons with disabilities.
- Developing innovative models for improving the readiness and capability of citizens to respond to disasters.
- Preparing an appropriate curriculum for strengthening the capacity of forces for preventing, coping and recovering from natural accidents and disasters.
- Including gender aspects in climate change and disaster risk reduction. Establishing public-private partnerships and innovative models for cooperation with the citizens in order to reduce disaster risks and strengthen resilience.

# 3.2 ACTION PLAN



## GENERAL MEASURES

The City of Skopje and the municipalities in the City of Skopje should continue working on maintaining the quality of the environment and improving services in various spheres of the city's life:

POLICY/MEASURE	BUDGET	DESCRIPTION/GOAL
<p>Incorporating the issue of climate change into urban planning</p> 		<ul style="list-style-type: none"> <li>When developing new urban structures, the fundamental goal should be establishing compact settlement structures with optimum functions for access (trade, services, reactions, entertainment, etc.)</li> <li>Planning the orientation of buildings and streets to ensure ventilation of public spaces.</li> <li>The planning process needs to focus on ensuring the penetration of fresh cool air in the city.</li> <li>When planning new or reconstructing existing parts of the city, a cooling effect should be ensured through the orientation of buildings, streets and open spaces, as well as by maintaining the ratio between buildings and the widths of streets.</li> <li>Harmonisation of economic development with spatial potential in order to reduce transport needs and thus reduce CO2 emissions.</li> <li>There should be planned transportation infrastructure wherever possible for public, pedestrian and bicycle traffic.</li> <li>The gender aspect needs to be incorporated when introducing the climate change issue in urban planning.</li> </ul>
Drafting the Third 2017-2022 Local Environment Action Plan of the City of Skopje and its implementation	€ € € €	<p>The City of Skopje has a legal obligation to draft the LEAP, a planning document with an action plan, which is the basis for management of the city environment and for the planning of all projects and activities linked to the environment and nature protection, with a special emphasis on the part related to climate change.</p>
Drafting a new Sustainable Energy Action Plan for the City of Skopje (SEAP) and its implementation.	€ € € € € €	<p>The SEAP is drafted for the purpose of implementing the following goals:</p> <ul style="list-style-type: none"> <li>Reducing CO2 emissions from all sectors by implementing energy-efficiency measures and using renewable energy</li> <li>Reducing energy consumption</li> <li>Ensuring sustainable energy development</li> </ul>
Implementation of the IPPC Directive		Continued implementation of the procedure for issuing integrated environmental licences and approving environment protection studies.
Implementing measures from action plans in documents for the protection of ambient air	€ € € €	<p>When planning actions in the City of Skopje activities, consideration needs to be taken of the recommendations, measures and specific activities that are part of:</p> <ul style="list-style-type: none"> <li>The plan for ambient air pollution reduction for the Skopje Region agglomeration</li> <li>The operational programme for reducing air pollution with PM10 and PM2.5</li> <li>The study on the level of noise and quality of the ambient air in the City of Skopje area during and after the heating season.</li> </ul>

POLICY/MEASURE	BUDGET	DESCRIPTION/GOAL
Carrying out indicative and strictly focused measuring at certain locations and for certain polluters.	€ € € €	<p>Continued amendment of the measuring of the State Air Quality Monitoring for the city area, for certain parts of the city or certain sites, or for certain sources of air pollution, such as:</p> <ul style="list-style-type: none"> <li>Carrying out indicative measuring and conducting a Study of the Ambient Air Pollution from the combustion processes in traffic</li> <li>Carrying out indicative measuring and conducting a Study of Ambient Air Pollution from the burning of firewood for heating, etc.</li> </ul>
Continued conduct of mezzo-meteorological measurements and observations in cooperation with National Hydro Meteorological Services (NHMS)	€ €	<p>Mezzo-meteorological measurements and observations are conducted for the purpose of:</p> <ul style="list-style-type: none"> <li>collecting data about the impact of urban structure on the weather</li> <li>collecting data in order to predict heat waves, temperature inversions, cold air lakes and cold waves.</li> </ul>
Making a Climate Atlas for the City of Skopje	€ € € €	<p>The climate atlas should show the distribution of temperature and cold air movement in relation to topographic features and land use. On the basis of this atlas, recommendations for urban planning need to be developed in accordance with climate change and taking into consideration the exposure and vulnerability of citizens, including gender aspects.</p>
Updating the Greenhouse Gas Inventory for the City of Skopje	€ €	<p>For the purpose of collecting data on greenhouse gas quantities in each sector, it is necessary to update the Greenhouse Gas Inventory consistently, or at least by 2020 as the reference year in accordance with the signed Covenant of Mayors.</p>
Improving services in the area of collecting communal solid waste	€ € € €	<p>The activities for improving the services in the area of collecting communal solid waste need to be implemented in accordance with the second 2016-2020 Waste Management Plan, with special emphasis on:</p> <ul style="list-style-type: none"> <li>further expanding the established policies for providing services in the rural parts of the municipalities of the City of Skopje</li> <li>increasing the number of installed systems of underground containers in the city for disposing of communal waste and thus reducing the possibility of outbreaks of infectious diseases, especially in a situation of high temperatures, etc.</li> <li>Increased washing of waste containers after they are emptied</li> <li>finalising activities for revitalising the former Vardariste landfill, etc.</li> <li>Improving the operation of the Drisla landfill, etc.</li> </ul>
Strengthening the city green fund	€ € € €	<p>This measure requires:</p> <ul style="list-style-type: none"> <li>planned and specific activities for expanding the public green spaces in the city, paying special attention to the type of plants appropriate to the location and use of the space as well as the role of greenery.</li> <li>continued and thought-through activities for preserving the public greenery</li> <li>introducing new initiatives such as public urban gardens, green roofs, green facades, etc.</li> </ul>
Awareness-raising	€ €	<p>Designing and implementing activities for raising awareness about the environment and climate change, animating the citizens to become active participants in undertaking specific measures, etc.</p>

# MITIGATION

## CONNECTION TO THE SUSTAINABLE DEVELOPMENT GOALS



## ENERGY SUPPLY

POLICY/MEASURE	BUDGET	CITIZENS AND INVESTOR(S)	CO <sub>2</sub> REDUCTION (kt)
Solar collectors for the buildings of the City of Skopje and the municipalities.	€ € € €	City of Skopje and the municipalities	7
Creating conditions for measures to stimulate the installation of solar collectors by households	€ € € €	MoE, MoF, City of Skopje and the municipalities* and the citizens	1
Creating conditions for measures to stimulate the installation of photovoltaic systems (installed on municipal and private buildings)	€ € € € € € € €	City of Skopje and the municipalities, citizens, the business sector, MoE, Energy Agency, EVN	26
5% share of bio-fuels in transportation by 2020.	€ € € € € € € €	MoE, manufacturers, importers and retailers in petroleum products, the citizens, Skopje and the municipalities*	37

## BUILDINGS

POLICY/MEASURE	BUDGET	CITIZENS AND INVESTOR(S)	CO <sub>2</sub> REDUCTION (kt) <sup>2</sup>
Renovating hospitals and applying energy-efficiency measures	€ € € €	MoH, MoF, City of Skopje and the municipalities*	3
Creating conditions for stimulating measures for improving the heat insulation of the commercial and service sectors* buildings of the City of Skopje and the municipalities.	€ € € € €	Commercial and service sectors, City of Skopje and the municipalities	26
Replacing incandescent light bulbs (modernisation of lighting in buildings owned by the city of Skopje and the municipalities, households and commercial and service sectors).	€ €	MoE, Energy Agency, retailers in household appliances, the citizens of the city of Skopje, City of Skopje and the municipalities	145
Creating conditions for stimulating measures for greater penetration of heat pumps in households and in the commercial and service sector.	€ €	MoE, Energy Agency, retailers in household appliances, the citizens, City of Skopje and the municipalities*	406
Penetration of devices with higher efficiency.	€ €	MoE, Energy Agency, merchants of household appliances, the citizens, City of Skopje and the municipalities*	563

\* The City of Skopje and the municipalities act as facilitators by identifying mechanisms for greater penetration of the measure



## BUILDINGS

POLICY/MEASURE	BUDGET	CITIZENS AND INVESTOR(S)	CO <sub>2</sub> REDUCTION (kt)
Application of the Energy Efficiency Rulebook for Buildings and the 2010/31/EU Directive when renovating residential buildings.	€ € € €	Citizens, private investors, City of Skopje and the municipalities	8
Application of the Energy Efficiency Rulebook for Buildings and the 2010/31/EU Directive when building new residential buildings.	€ € € €	Citizens, private investors, City of Skopje and the municipalities	90
To carry out a detailed survey about heating habits in Skopje in order to adopt informed policies, including collecting and analysing gender-disaggregated data	€ €	City of Skopje and the municipalities, BEK, EVN, municipalities	/

## TRANSPORTATION

POLICY/MEASURE	BUDGET	CITIZENS AND INVESTOR(S)	CO <sub>2</sub> REDUCTION (kt)
Procurement of vehicles for the City of Skopje in accordance with Green Public Procurement criteria	€ €	City of Skopje and the municipalities, public enterprises	1
Renewal of fleet vehicles	€ €	Citizens, City of Skopje and the municipalities*	45

\*The City of Skopje and the municipalities act as facilitators by identifying mechanisms for greater penetration of the measure

# ADAPTATION

## CONNECTION TO THE SUSTAINABLE DEVELOPMENT GOALS



## WATER RESOURCES

POLICY/MEASURE	BUDGET	DESCRIPTION/GOAL
Legal measures	€ € € €	<ul style="list-style-type: none"> <li>Updating expertise about the protection zones of the Rasce springs.</li> <li>Updating the Decision about the protection zones of the Rasce springs in order to preserve the water capacity and quality.</li> <li>Incorporating the legal requirements adopted for the protection of the Rasce springs in all the prescribed documents and urban plans.</li> <li>Updating the expertise about the protection zones of the Nerezi-Lepenec wells site.</li> <li>Updating the Decision about the protection zones of the Nerezi-Lepenec wells site.</li> <li>Incorporating climate change considerations in the general and detailed urban plans.</li> </ul>
Institutional measures	€ € € €	<ul style="list-style-type: none"> <li>Increasing the capacity of the City of Skopje and the municipal administrations to strengthen urban resilience to climate change by introducing innovative learning methodologies.</li> <li>Introducing and creating policies based on climate change and water-related evidence.</li> </ul>
Direct measures	€ € € € € € €	<ul style="list-style-type: none"> <li>Regulation of the riverbed in the upstream section of the River Vardar in order to protect the Rasce springs from floods.</li> <li>Implementing measures for maintaining the quantity and quality of the Rasce springs in accordance with the Decision on the protection zones of the springs (Official Gazette of RM 36/1990).</li> <li>Reconstruction and modernisation of the water supply system of the City of Skopje to improve efficiency. Implementing the measure according to the annual plans of the Public Enterprise "Vodovod i kanalizacija"</li> <li>Looking into the possibilities for finding alternative resources for water supply.</li> <li>Application of measures for using alternative sources of water for the irrigation of green spaces and for washing streets and public spaces.</li> <li>Improving the quality of local water supply systems within the Skopje Region.</li> <li>Increasing the scale of construction of storm sewers. Separating the storm sewers from the faecal sewerage in the areas where they are connected to faecal sewerage. Implementing the measure according to the annual plans of the JP "Vodovod i kanalizacija"</li> <li>Designing a project for obtaining the necessary permits for the construction of the waste water treatment station for the city of Skopje</li> <li>Reducing the risks of flooding and erosion through forestation of bare land and of land which the urban planning documentation has no plans to use for any other purpose.</li> <li>Construction of systems for reusing industrial water within industrial plants wherever possible.</li> <li>Creating a register of underground wells used by public enterprises and legal entities.</li> <li>Compiling an inventory of underground wells used by natural persons.</li> <li>Creating a cadastre (compiling an inventory, mapping wells) of the existing wells used for irrigation and supplying the industry with water in the Skopje Region.</li> <li>Making a study of the underground waters on the territory of the City of Skopje and the Skopje planning region.</li> <li>Carrying out a Study of Innovative Intensive Rainfall Intensity, Duration and Frequency Curves in the Skopje Region within the context of climate change.</li> <li>Reassessment of the drainage network capacity of the Skopsko Pole drainage system.</li> <li>Monitoring the quantity and quality of wastewater in the main faecal wastewater collectors and storm water collectors at a measuring point before their emptying into the recipient.</li> <li>Focused activities for increasing awareness about the impact of climate change on droughts and floods, as well as the possibilities for protection and reduction of the negative impact.</li> </ul>



## FLOODS

### POLICY/MEASURE

Meteorological and hydrological monitoring

Establishing a community early-warning system

Integrating floods risk management into the urban plans for flood-prone areas.

Flood management in the urban zone of the City of Skopje

Water resources management along the River Vardar

Lepenec

### DESCRIPTION/GOAL

- It is necessary to establish continuous monitoring of rain intensity at a number of particular locations in the torrential catchment areas in the urban parts
- Developing two new modern radar systems at the Hydro meteorological Service connected to the pan-European "Opera" Platform.

The main objective of an early warning system is to provide timely information to communities in those parts of the city exposed to greater flood risk, as well as to enable coordinated exploration of information about floods among all institutions. This system needs to be part of the national early warning and alarm system.

Making flood-risk maps.

Improving spatial and urban planning, making use of the maps made as part of this study showing the areas at significant risk of floods, especially in urban areas with high level of urbanisation and economic importance.

- As a minimum measure there should be regular cleaning (from deposited substances) and renovation of the entire existing infrastructure for flood protection, i.e. renewed and maintaining it in its initial projected state. The average annual expenses for these activities are estimated to be EUR 200,000.
- Due to rapid urbanisation and the existing and planned infrastructure, there is a plan to regulate ~16 km of the River Vardar downstream from the city centre (from the point where the current regulated section ends to the Gorge Taorska Klisura) by building earth mounds, cascades for levelling the slope and strengthening the bottom of the riverbed and of the embankments at certain locations by coating them with natural materials. The estimated investment is between EUR 20,000,000 for low-level protection and EUR 30,000,000 for medium- and high level protection.
- The City Council should review the possibility for taking over or equally sharing the responsibility for managing the three water reservoirs upstream from the city, due to the inestimable damage that could be caused by extreme incidents. This risk underlines and justifies the importance of proper dam and reservoir management downstream from the City of Skopje.
- The protection of the Rasce springs should be classified as a top priority in regard to flood risk management in the City of Skopje. The Rasce springs protection zones should be expanded in accordance with the adopted Spatial Plan, Rasce 2003, and the Decision for establishing protection zones and protection measures (Official Gazette of the RM No. 36/1999).
- Implementation of the project designed for regulating the River Vardar near the Village of Rasce in the Rasce springs protection zone in a total length of 5.76 km and with an estimated investment value of 5-6 million EUR (LEAP, 2011). (This has not yet been realised.)

Channelling the watercourse of the River Lepenec through the residential areas. Depending on the protection level (from minimum measures up to high protection), the estimated investment is between EUR 3,100,000 for minimum measures and EUR 6,150,000 for measures providing a high level of protection.

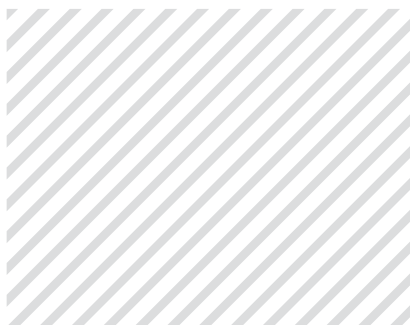




## FLOODS

### POLICY/MEASURE

Torrents on Skopska  
Crna Gora Mountain



### DESCRIPTION/GOAL

- Regulating the torrents of the rivers Smilkovska Reka, Stracinska Reka, Rastanski Poroj and of other smaller torrents in the initial and transitional zones, including designing and building barriers/small dams for reducing the gradient of the watercourse and covering the transported sediment. The estimated investment value is ~2.8 million Euros
- Regulating the riverbeds of the torrents through residential areas. This includes designing and building regulated riverbeds for safe evacuation of flood waves outside of residential areas. The steep longitude slopes require complete coating of the regulated riverbeds and their control with cascading structures. The estimated investment value is ~3.0 million Euros
- The reconstruction and cleaning of the riverbeds and torrents downstream from settlements for the purpose of increasing their flow capacity. The estimated investment value is ~1.1 million Euros.
- Constructing a retention pool above the Skopje Ring Road as a special measure aimed primarily at providing flood protection for the settlements south of the motorway. The retention pool is to be constructed with an earth mound sufficiently long and high to ensure retention of a flood wave with small probability of occurrence. The retention area is mainly on farmland. In the retention zone there is no limitation on the use of the farmland except in cases of a flood wave with a small probability of occurrence. The retention structure will be secured with complete infrastructure for evacuation/discharging after the end of the potential flood. For emptying the retention pool, a drain channel should be used that will be directly connected to the existing infrastructure of the HMS Skopsko Pole. The estimated investment value of both structures (the retention pool and the channel) is ~2 million Euros.
- Promoting good farming practices (limiting the arable land and introducing sustainable farming practices).
- Ensuring the sustainability of pastures.
- Renewing and expanding forests (forestation).
- The estimated value of the non-structural measures is ~1.6 million Euros

## HEALTH

POLICY/MEASURE	BUDGET	DESCRIPTION/GOAL
Establishing a Public Health Council	€ €	Determining the action priorities; cooperation with the PHI
Establishing an Inter-sectoral Committee on Climate Change and Public Health for the Skopje Region.	€ €	Monitoring the climate change adaptation process in the region and coping with the consequences
Improving preventative activities for reducing risks to public health	€ € € € € €	<ul style="list-style-type: none"> <li>Improving the quality of air and water</li> <li>Improving the waste management system</li> <li>Reducing the risks of natural and technological disasters</li> </ul>
Developing a system for data collection and research on the impact of climate change on health in the Skopje Region, especially in regard to vulnerable groups	€ € € €	In cooperation with the MoH and the PHI
Increasing activities for social protection, child care and education	€ € € €	Strengthening the activities of the City of Skopje in the field of social welfare, primarily the activities that concern vulnerable groups such as the elderly, the homeless, persons with physical and mental disabilities, etc.

## RISK MANAGEMENT AND INCREASING URBAN RESILIENCE

POLICY/MEASURE	BUDGET	DESCRIPTION/GOAL
Updating the Assessment of threats from all risks and hazards for the territory of the City of Skopje.	€ €	The City of Skopje in cooperation with the municipalities on the territory of the city of Skopje, the Crisis Management Centre, the Protection and Rescue Directorate.
Passing the Integrated Urban Resilience Action Plan	€ €	The City of Skopje in cooperation with the municipalities on the territory of the city The City of Skopje, in cooperation with the municipalities on the territory of the City of Skopje, the Crisis Management Centre, the Protection and Rescue Directorate and other competent ministries and institutions
Introducing climate change and disaster risk reduction practices in the General Urban Plan and other sectoral strategies, programmes and plans	€ €	The City of Skopje in cooperation with the municipalities on the territory of the city The City of Skopje, in cooperation with the municipalities on the territory of the City of Skopje, the Crisis Management Centre, the Protection and Rescue Directorate and other competent ministries and institutions
Drafting, adopting and updating plans and scenarios for preventing and responding to climate change and natural disaster risks at the level of the City of Skopje and the municipalities	€ €	The City of Skopje, in cooperation with the municipalities on the territory of the City of Skopje, the Crisis Management Centre, the Protection and Rescue Directorate and other competent ministries and institutions
Implementing targeted activities for raising public awareness among the general population and the persons with disabilities.	€ €	The City of Skopje, in cooperation with the municipalities on the territory of the city of Skopje, the Crisis Management Centre, the Protection and Rescue Directorate.

## RISK MANAGEMENT AND INCREASING URBAN RESILIENCE

POLICY/MEASURE	BUDGET	DESCRIPTION/GOAL
Implementing activities for strengthening local resilience through tactical exercises for preparing and responding to natural accidents and disasters in schools and other institutions under the competence of the City of Skopje and the municipalities	€ €	The City of Skopje, in cooperation with the municipalities on the territory of the City of Skopje, the Crisis Management Centre, the Protection and Rescue Directorate and other competent ministries and institutions
Mapping hazards and risks for the City of Skopje and the municipalities on its territory	€ €	The City of Skopje, in cooperation with the municipalities on the territory of the city of Skopje, the Crisis Management Centre, the Protection and Rescue Directorate.
Carrying out annual open calls for strengthening urban resilience, inviting the public and businesses to propose and develop innovative solutions	€ €	The City of Skopje, in cooperation with the municipalities on the territory of the City of Skopje, UNDP, the Crisis Management Centre, the Protection and Rescue Directorate and other competent ministries and institutions

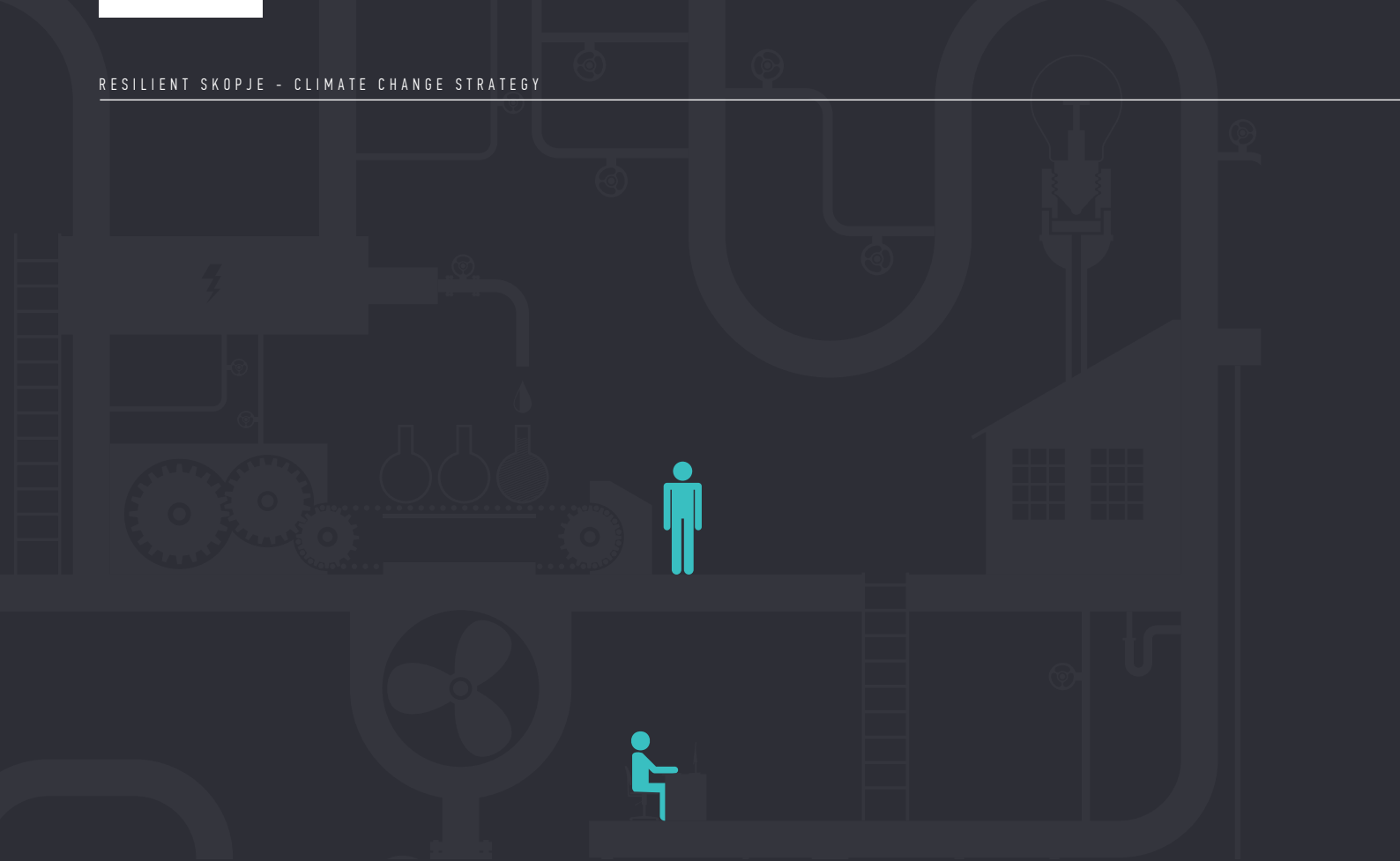
## TOURISM

POLICY/MEASURE	BUDGET	DESCRIPTION/GOAL
Incorporating the tourism sector into the Risk Management Plans of the city and the municipalities, especially for those sub-sectors that are obviously exposed to risk within a short period of time	€ €	In cooperation with CMC and PRD and the Agency for Promotion and Support of Tourism
Coordination with tourism planning in the other sectors	€ €	Tourism will be part of broader measures for environment preservation and the implementation of plans for revitalisation of the cultural heritage. Given the vulnerability of this sector, it should be integrated in urban planning

## NATURAL SYSTEMS

POLICY/MEASURE	BUDGET	DESCRIPTION/GOAL
Biodiversity protection	€ € € € € € € €	Monitoring the impact of climate change on the region's biodiversity and protecting this biodiversity: <ul style="list-style-type: none"> <li>City area, but also the protected natural sites: the park-forest Vodno, the nature park Gazi Baba, the nature monument Matka Canyon (in cooperation with MEPP and UKIM)</li> <li>Looking into the biodiversity representation and the state in the Skopje Valley</li> <li>Protection of water habitats (riparian habitats)</li> <li>Protection of endemic and endangered species</li> <li>Making a map of biotopes (Belgrade's experience could be useful)</li> </ul>
Protection from erosion	€ € € € € €	Drafting an Erosion Protection Programme for the City of Skopje with an Action Plan





## NATURAL SYSTEMS

POLICY/MEASURE	BUDGET	DESCRIPTION/GOAL
Improving conditions for the protection and management of protected natural rarities	SMALL	<ul style="list-style-type: none"> <li>Strengthening the process of re-protecting formerly protected natural sites</li> <li>Making plans for managing natural sites</li> </ul>
Increasing the number of areas with formal protection status	SMALL	<ul style="list-style-type: none"> <li>Reinforcing the processes for protecting the new sites by carrying out studies for their valorisation and implementing a protection procedure</li> <li>Making plans for managing new protected sites</li> </ul>

## URBAN GREEN SPACES

POLICY/MEASURE	BUDGET	DESCRIPTION/GOAL
Increasing and improving the green fund	MEDIUM	<ul style="list-style-type: none"> <li>Implementing the recommendations of the Strategy for Greener City of Skopje</li> <li>Regularly updating and upgrading the City of Skopje Green Cadastre, as an activity within the broader concept of urban resilience and as part of the city's strategic priorities</li> </ul>
Innovative measures for protecting and expanding public greenery	LARGE	<ul style="list-style-type: none"> <li>Creating urban green corridors (along certain axes of pedestrian movement) and blue-green corridors (along the rivers)</li> <li>Popularising the construction of green roofs and green facades on city buildings as a good example</li> <li>Creating public urban gardens</li> </ul>

# ANNEX 1

## LIST OF ADDITIONAL DATA NECESSARY FOR COMPILING THE GREENHOUSE GAS INVENTORY

### ENERGY | Stationary sources – primary energy (liquid, solid and gas fuels)

CONSUMPTION OF PRIMARY ENERGY (LIQUID, SOLID AND GAS FUELS)	TONS/YEAR	INSTITUTION	DATA STATUS
Residential sector		Fuel suppliers	Not provided
Commercial sector		Fuel suppliers	Not provided

### ENERGY | Mobile sources

CONSUMPTION OF PRIMARY ENERGY (LIQUID, SOLID AND GAS FUELS)	TONS/YEAR	INSTITUTION	DATA STATUS
Road traffic		Fuel suppliers	Not provided
Railway traffic – fuel consumption on the territory of the City of Skopje (annual number of trains transiting through Skopje and their average consumption per km)		Macedonian Railways	No data has been provided by the Macedonian Railways. Emissions were calculated using a specific methodology

### INDUSTRIAL PROCESSES AND USE OF PRODUCTS

CONSUMPTION OF PRIMARY ENERGY (LIQUID, SOLID AND GAS FUELS)	TONS/YEAR	INSTITUTION	DATA STATUS
Use of freon in households (fridges, air conditioning)		MEPP	Not provided

### AGRICULTURE

TYPE OF GOODS	NO. OF ANIMALS	INSTITUTION	DATA STATUS
Dairy cattle - cows		From B permits for farms / MAFWE or the Food and Veterinary Agency	Not provided
Non-dairy cattle		From B permits for farms / MAFWE or the Food and Veterinary Agency	Not provided
Sheep		From B permits for farms / MAFWE or the Food and Veterinary Agency	Not provided
Goats		From B permits for farms / MAFWE or the Food and Veterinary Agency	Not provided
Horses		From B permits for farms / MAFWE or the Food and Veterinary Agency	Not provided
Mules and donkeys		From B permits for farms / MAFWE or the Food and Veterinary Agency	Not provided
Pigs		From B permits for farms / MAFWE or the Food and Veterinary Agency	Not provided
Poultry		From B permits for farms / MAFWE or the Food and Veterinary Agency	Not provided

### WASTE

CONSUMPTION OF PRIMARY ENERGY (LIQUID, SOLID AND GAS FUELS)	TONS/YEAR	INSTITUTION	DATA STATUS
Quantity of wastewater generated in the city		MoEPP	Not provided. Calculated using a methodology







