



# **SOFIA MUNICIPALITY SUSTAINABLE ENERGY AND CLIMATE ACTION PLAN 2021-2030**

**Including:**

**Energy Efficiency Programme  
of Sofia Municipality, 2021-2030**

**Long-term programme of Sofia Municipality to  
promote the use of renewable energy and bio-fuels,  
2021-2030**

**August 2021**

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## Abbreviations

Abbreviation	Meaning
AAPA	Ambient Air Purity Act
ACC	Adaptation to Climate Change
AD	Joint-stock Company
AQ	Air Quality
AQP	Air Quality Program
BA	Built-up Area
BAS	Bulgarian Academy of Sciences
BDA	Biodiversity Act
BEI	Baseline emissions inventory
BFB	Bulgarian Food Bank
BRC	Bulgarian Red Cross
CCAP	Climate Change Adaptation Plan
CCMA	Climate Change Mitigation Act
CF	Cohesion Fund
CIPE	Competitiveness and Innovation Program in Enterprises
CM	Council of Ministers
CMA	Condominium Management Act
CMCE	Covenant of Mayors on Climate and Energy
CULOC	Company under the Law on Obligations and Contracts
DSP	Detailed Spatial plan
DWTP	Drinking Water Treatment Plant
e.r.	equivalent residents
EAD	Sole Proprietorship
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EEA	Energy Efficiency Act
EERSF	Energy Efficiency and Renewable Sources Fund
EL	East latitude
ENPA	Environmental Noise Protection Act
EP	European Parliament
EP	Environmental program
EPBD	Energy Performance of Buildings Directive
ESCO	Energy Services Company
EU	European Union
DPA	Disaster Protection Act
EUKI	European Climate Initiative
EURDF	European Regional Development Fund
FMEEA	Financial Mechanism of European Economic Area

Abbreviation	Meaning
FRMP	Flood Risk Management Plans
GCAP	Green City Action Plan
GCMCE	Global Covenant of Mayors on Climate and Energy
GHG	Greenhouse gases
GIS	Geographic Information System
GSP	General Spatial Plan
HA	Health Act
HRS	Hydroelectric Power Station
HH	Household
IBT	Installation for Biological Treatment
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Center
LEERS	Law on Energy from Renewable Sources
LLSGLA	Law on Local Self-Government and Local Administration
LLTF	Law on Local Taxes and Fees
LOUAL	Law on the Ownership and Use of Agricultural Lands
LSDSM	Law on the Structure and Development of Sofia Municipality
LWSRSS	Law on Water Supply Regulation and Sewerage Services
MBT	Mechanical-biological Treatment
ME	Municipal enterprise
MES	Ministry of Education and Science
MEW	Ministry of the Environment and Waters
ME	Ministry of Energy
MoI	Ministry of the Interior
MRDPW	Ministry of Regional Development and Public Works
MRS	Mechanism for Recovery and Sustainability
MS	Metro Station
MV	Motor Vehicle
NA	National Assembly
NAMRB	National Association of Municipalities in the Republic of Bulgaria
NC	National Contributions
NCPHA	National Center for Public Health and Analysis
NDF	National Decarbonization Fund
NGO	Non-governmental organization
NIGGG at BAS	National Institute of Geophysics, Geodesy and Geography at the Bulgarian Academy of Sciences
NIMH	National Institute of Meteorology and Hydrology
NL	North Latitude
NPEEMRB	National Program for Energy Efficiency of Multifamily Residential Buildings
NSI	National Statistical Institute



<b>Abbreviation</b>	<b>Meaning</b>
OSMCDMPGSSM	Ordinance of the Sofia Municipal Council for Development, Maintenance and Protection of the Green System of Sofia Municipality
PM	Fine Dust Particles
PPUREBF	Program to Promote the Use of Renewable Energy and Bio-fuels
PSS	Pumping Stations
PWRO	Packaging Waste Recycling Organization
RDF	Refuse-derived fuel
REA	Renewable Energy Act
RES	Renewable Energy Sources
RP	Regulated plots
RRP	Recovery and Resilience Plan
RS	Renewable Sources
SaS	Surface-active Substances
SE	State Enterprise
SECAP	Sustainable Energy and Climate Action Plan
SEDA	Sustainable Energy Development Agency
SEDAP	Sustainable Energy Development Action Plan
SM	Sofia Municipality
SMEs	Small and medium enterprises
SPA	Spatial Planning Act
SU	Sofia University
SUMP	Sustainable Urban Mobility Plan
SWOT analyses	Analyses of the Strengths, Weaknesses, Opportunities, and Threats
SWP	Spatial Work Plan
SWSFE	Southwestern State Forest Enterprise
TA	Tourism Act
TPP	Thermal Power Plant
TVA	Risk and Vulnerability Assessment
UACEUP	University of Architecture, Civil Engineering and Urban Planning
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
WA	Water Act
WM	Waste Management
WMA	Waste Management Act
WWTP	Wastewater Treatment Plant

## 1. Introduction

Climate change and environmental degradation threaten not only the economic and social development, but also the very existence of Europe and the world. This threat is particularly perceptible in large urban centers, which are highly vulnerable to the negative effects of climate change; on the other hand, it is in them that the most significant potential for reduction of the negative effects of human activities on the climate and the environment is concentrated. The need to coordinate the climate and energy policies at the European, national and local levels is one of the main challenges that the EU and the Member States are facing, and this need is clearly reflected in the *European Green Deal* - the new European growth strategy aimed at the transformation of the Union into a modern, resource efficient and competitive economy with zero net greenhouse gas emissions. This strategy sets the roadmap for the achievement of economic sustainability by transforming the climate and environmental challenges into new opportunities in all areas of social development. This is also the leading topic at the national level, stated in the *Plan for Recovery and Resilience of the Republic of Bulgaria*, which provides significant resources for the implementation of the "green" transformation and brings to the fore the role of the cities in this process.

### Reasons to develop the plan

- Decision No 755/08.11.2018 of the Sofia Municipal Council for the accession of Sofia Municipality to the *Global Covenant of Mayors for Climate and Energy* for the period 2021–2030
- Obligation under Art. 12 of the Energy Efficiency Act
- Obligation under Art. 10, paragraphs 1 and 2 of the Renewable Energy Act
- Letter No SOA18-DI05-3266 (1) dated 19.11.2018 from the Executive Director of the Sustainable Energy Development Agency for the acceptance of the proposal of Sofia Municipality for development of an integrated plan.

In its role of an undisputed leader in the urban environment development at the national and regional level, Sofia Municipality takes a clear commitment to continue its long tradition in the field of sustainable energy development. In accordance with this commitment, with Decision No 755 / 08.11.2018 of the Sofia Municipal Council, Sofia Municipality joins the *Global Covenant of Mayors for Climate and Energy* for the period 2021-2030 undertaking the ambitious task **to reduce the GHG emissions by 40% compared to 2007 levels and to plan and implement activities for the adaptation to climate change.**

This *Sustainable Energy and Climate Action Plan 2021-2030* has been developed in accordance with the obligations of Sofia Municipality under the *Global Covenant of Mayors for Climate and Energy* and is a leading strategic document in the field of energy and climate, consistent with the strategy for the development of the municipality, presented in the *Vision for Sofia*. It proposes an entirely new **integrated approach to the planning and reporting on the energy and climate activities**, combining the municipal policies on climate change mitigation and adaptation, energy efficiency and renewable energy use, and in line with letter No SOA18-DI05-3266 (1) from 19.11.2018 of the *Sustainable Energy Development Agency*, fulfilling at the same time the commitments of Sofia Municipality according to Art. 10, para. 1 and para. 2 of the Renewable Energy Act, Art. 12 of the Energy Efficiency Act, along with those of the *Global Covenant of Mayors for Climate and Energy*. This allows the development of a comprehensive and consistent logical framework through which the proper balancing and prioritization of the specific activities and projects in these main areas, the identification of the complementary effects, the environmentally friendly solutions and avoidance of the negative influence between the individual planned measures is achievable. This lays the foundation for the realization of the ambitious goal for GHG emissions reduction by at least 40% by 2030 following the EU guiding principle "Energy efficiency comes first", the optimal integration of RES as a tool increasingly

replacing the conventional energy sources, and compliance with the requirements for financial efficiency of the projects, taking into account the existing resource opportunities and restrictions.

During the elaboration of the plan, the instructions of the *Sustainable Energy Development Agency* for the development of municipal plans and programs for the promotion of the renewable energy sources and bio-fuels and for energy efficiency, as well as the guidelines for developing an *Action Plan for Sustainable Energy and Climate of the Global Covenant of Mayors for Climate and Energy* are used.

### 1.1. Climate policies at the international, national and local levels

The main international framework agreement on fighting with climate change and acceleration and intensification of the activities and investments needed for the achievement of a sustainable, low-carbon future, is the so-called **Paris Agreement**. It was negotiated at the end of 2015 by the participating countries at the 21st Meeting of the Parties to the *United Nations Framework Convention on Climate Change* (UNFCCC) in Paris. The *Paris Agreement* brings together more than 190 countries that have ratified it in pursuit of the common goal - to strengthen the global response to the threat of climate change, leaving the global warming this century below 2°C above the pre-industrial levels and to continue the efforts for limiting the rise of temperatures to no more than 1.5°C.

To achieve these goals, an appropriate framework must be put in place to mobilize the financial resources to significantly reduce the GHG emissions, to use new technologies and intensify the capacity-building actions in support of the developing and the most vulnerable countries in meeting their national targets. In addition, the agreement aims to increase the ability of the states to cope with the effects of climate change. Full transparency of countries' actions and support for the developing countries is envisaged.

As a contribution to the objectives of the agreement, the countries have presented comprehensive *National Climate Action Plans* outlining their Nationally Determined Contributions (NDCs) for their GHG emissions reduction. Every 5 years, the collective progress towards the long-term goals will be assessed and the countries will be informed of the need to update and increase their NDCs.

Earlier in 2015, the UN adopted its 17 **Global Goals for Sustainable Development**<sup>1</sup> for the period 2015-2030. The document explicitly confirms the link between climate change and many of the goals set, such as: Goal 1 "No to Poverty"; Goal 2 "Zero famine"; Goal 6 "Clean water and sewerage"; Goal 7: "Affordable and Clean Energy"; Goal 11: "Sustainable Cities and Communities", etc.

The European Union is at the forefront of the global fight against climate change and has made it one of its top priorities. The EU formally ratified the *Paris Agreement* in 2016, but set its goals before the Paris summit, which are among the highest of the participating countries. The Union is committed to a common contribution under the Paris Agreement **to reduce the GHG emissions by at least 40% by 2030** compared to 1990, which should be achieved jointly by the Member States. This target was set in the broader framework for climate and energy for the period up to 2030, which also includes a target of a 27% increase in the share of energy from renewable sources (renewables) and a 27% improvement in energy efficiency. This framework was adopted in line with the *2050 Energy Roadmap*<sup>2</sup>, with which the EU has committed itself to reduce the GHG emissions by 80-95% against the 1990 levels by the end of the long term, ensuring competitiveness and decarbonization of the economy and to guarantee the energy supply security. The EU bases its energy policy on three main objectives: competitiveness, security of supply and sustainability. The creation and development of a stable and

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<sup>1</sup> UN (2015), *Global goals for sustainable development 2015-2030*  
<https://www.un.org/sustainabledevelopment/sustainable-development-goals/>

<sup>2</sup> European Commission (2011) *Roadmap for achieving competitive, low-carbon economy 2050*. Brussels, COM(2011) 112 final. <https://eur-lex.europa.eu/legal-content/BG/TXT/PDF/?uri=CELEX:52011DC0112&from=en>

long-term policy framework for energy efficiency, use of energy from renewable sources (RES) and reduction of GHG emissions provides security to local authorities and businesses.

All key EU legislation to meet the targets set in “the frame up to 2030”, which is the current legislation in place, was adopted by the end of 2018; and in the process of drafting the regulatory documents, the target for the average share of renewable energy for EU in the final energy consumption, has been increased to 32%, while the target for improvement of the energy efficiency by 2030 has been increased to 32.5%. This increase of the targets stems from the adopted by the EC in 2018 next **EU’s long-term vision by 2050** for a prosperous, modern, competitive and climate-neutral Europe, a “**Clean Planet for All**”. This update of the European Strategic Framework follows the EU’s commitment to the *Paris Agreement* to significantly reduce the GHG emissions and demonstrates a new and even greater ambition to **achieve a fully climate neutral economy by 2050**. The vision covers several strategic areas, including energy efficiency, renewable energy, mobility, competitive industry and circular economy. It is emphasized that energy efficiency must come first, as it is identified as the cost-effective way to achieve the EU’s long-term goals in terms of energy consumption, climate change and economic and energy security.

At the end of 2019, the European Commission (EC) adopted the current EU growth strategy presented as the **European Green Deal**<sup>3</sup> (also known as the *Green Deal*), setting the following goal:

*EU’s transformation into a fair and prosperous society with a modern resource-efficient and competitive economy, without net GHG emissions in 2050 and economic growth, independent of the resources used.*

The Commission puts **the sustainability and well-being of its citizens** at the heart of its economic policy, and the integration of all new EU policies and actions. The UN’s Global Sustainable Development Goals should be integrated in the basis of all new EU policies and actions development. In March 2020, the EC proposed a draft of the first European “Climate Act”, which **would make the goal of climate neutrality by 2050 legally binding for the EU institutions and Member State governments**. The adoption of the law will ensure that **all EU policies contribute to the goal of climate neutrality** and that **all sectors play their part**.

In addition to the achievement of full economy climate neutrality, the pact indicates an **increase in the climate ambitions by 2030 and 2050**. Based on an overall assessment of the impact of the policies pursued so far, in September 2020, the EC proposed to raise the target **for reduction of GHG emissions by 2030 to at least 55% compared to 1990**. This goal was endorsed by the European Parliament in November 2020. In this context, the necessary actions to achieve the goal will be reviewed, as the process of preparing detailed legislative proposals to implement and achieve the enhanced ambition are already under way and are expected to be published in June 2021. A significant increase in the targets for renewable energy and energy efficiency is also expected.

**The transformation of the economy** towards a sustainable future will follow several main directions, which, in addition to the achievement of zero GHG emissions, will also focus on the **health protection and well-being of the citizens from environment-related risks and impacts**. The main directions are:

- *Supply of clean, affordable and secure energy.*
- *Industry mobilization for clean and circular economy.*
- *Construction and renovation of buildings in an energy and resource efficient manner.*
- *Acceleration of the transition to sustainable and intelligent mobility.*

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<sup>3</sup> European Commission (2019) Communication from the Commission. European Green Deal. Brussels, COM/2019/640 final  
<https://eur-lex.europa.eu/legal-content/BG/TXT/?qid=1576150542719&uri=COM%3A2019%3A640%3AFIN>

- *Ambition to zero pollution to achieve a non-toxic environment.*
- *„From the farm to the table“: creation of a fair, healthy and environmentally friendly food system.*
- *Conservation and recovery of the ecosystems and biodiversity.*

The EC recognizes that the **participation and involvement of the public** and all stakeholders is crucial for the success of the *European Green Deal*. That's why, in 2020 the so-called *European Climate Pact*, which provides a platform for the joint development and implementation of climate solutions by people with various knowledge and occupations was adopted.

The realization of the economy transformation will be financed by large-scale public investments, through which however, private capital must also be directed to actions in the field of climate and environment. *The European Green Deal investment plan* envisages: mobilization of €1 trillion in investments by 2030; changes in the legislation to provide incentives for the acquisition and redirection of the public and private investments; and provision of practical assistance for the planning, preparation and implementation of sustainable projects.

Another key financial tool is the *Fair Transition Mechanism*. It must ensure the fair and inclusive way of the economy transformation, putting people first and paying attention to the regions, businesses and workers who will face the greatest challenges. The tool will provide targeted support for the mobilization of at least €100 billion for the period 2021-2027 and will have three main sources of funding: the *Fair Transition Fund*, which will also support the investments in the transition to clean energy, for example in the field of energy efficiency; a *Special Fair Transition Scheme* within *InvestEU* aimed at attracting private investments for a sustainable transition in these regions; and a *Public Sector Lending Facility* with the *European Investment Bank*, supported by the EU budget, which will provide loans to the public sector, for example for investments in the heating networks and buildings renovation.

The pandemic of COVID19 in early 2020 had a negative impact on the economies around the world. The EU has developed the *Mechanism for Recovery and Sustainability*<sup>4</sup> as a tool for support of the economy recovery and guarantee for the environmental and digital transition. Not less than 37% of the planned financial resources will be spent in support of the climate goals. Each of the member states will present for EC approval its national plan, which sets out the reforms and the public investment projects supported by the mechanism.

### 1.1.1. Climate change mitigation

The review of the European climate and energy policies so far shows that before the development of the *European Green Deal*, the leading place was occupied by those aimed at reducing the GHG emissions, or the so called policies to "mitigate" climate change.

The amended Energy Efficiency Directive<sup>5</sup> is the founding document for the Member States, setting the EU's overall target for energy efficiency up to 2030 by at least 32.5% and obliges the countries to determine their national indicative contribution. The document calls for strengthening the energy efficiency social aspects by taking **the energy poverty** into account when defining the schemes and alternative energy efficiency measures. The risk of energy poverty must be eliminated for households that cannot afford basic energy services in order to ensure a minimum standard of living. Important for the local authorities is the unchanged Art. 5 of the initial version of the Directive<sup>6</sup> concerning the role of

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<sup>4</sup> EC Press release of 10 February 2021. *The Commission welcomes the European Parliament's approval of the* [https://ec.europa.eu/commission/presscorner/detail/bg/ip\\_21\\_423](https://ec.europa.eu/commission/presscorner/detail/bg/ip_21_423)

<sup>5</sup> *Official Journal of the EU (2018) Directive (EU) 2018/2002 of the European Parliament and the Council from December 11, 2018. for amendment of Directive 2012/27/EU concerning energy efficiency.* <https://eur-lex.europa.eu/legal-content/BG/TXT/?uri=CELEX:32018L2002>

<sup>6</sup> *Official Journal of the EU (2012) Directive 2012/27/EU of the European Parliament and the Council from October 25, 2012 concerning energy efficiency , amending the Directives 2009/125/EO u 2010/30/EU and for*

a public authorities building model, according to which they must adopt an energy efficiency plan, independent or as part of a broader climate or environmental plan, setting out specific objectives and actions for energy savings and efficiency; introduce an energy management system, including energy audits, as part of the implementation of their plans; and use, where appropriate, energy service companies and energy performance contracts to finance the renovations. These provisions are included in the *Energy Efficiency Law (EEA)*.

A key measure to achieve the energy efficiency goal is to improve the energy performance of the buildings, as they are the largest independent energy consumer. That's why a separate **Directive on the Energy Performance of Buildings<sup>7</sup> (EPBD)** has been adopted for the buildings which obliges all countries to develop national plans and prepare a national definition for the buildings with nearly zero-energy consumption, as of 2019 it is mandatory for all new public buildings, and from 2021 - for all new buildings. The requirement for a building with nearly zero-energy consumption is that it should have a very **high level of energy efficiency and a significant share of energy consumption from renewable sources**. At buildings renovations, the implementation of the most cost-effective solutions that lead to the achievement of the highest possible class of energy consumption of the building is required. Instruments, such as the building passports and the labeling of the buildings, as well as the energy performance certificates, aim to provide a market-oriented signal for energy-efficient buildings and to serve as an incentive for the implementation of energy efficiency measures.

The National Definition of Buildings with Nearly zero-energy Consumption is presented in the Additional Provisions of the Energy Efficiency Law and the *National Plan for Buildings with Nearly zero-energy Consumption<sup>8</sup>*. According to the plan as of 01.01.2019, all newly built public property buildings must meet the national definition of buildings with nearly zero-energy consumption, and after 31.12.2020 all other buildings, including private ones, must meet this condition. To date, the mandatory practical application of the national definition in the construction of new buildings has not begun yet.

The amendment of the *EPBD from 2018 r.<sup>9</sup>* aims to promote the cost-effective deep renovations of buildings, the introduction of Smart Readiness Indicator, the simplification of the heating and air-conditioning systems inspections and the promotion of electromobility by creation of parking spaces for electric vehicles. This change in the Directive requires also each Member State to develop and present a Long-Term Building Renovation Strategy with a view to decarbonization by 2050 and a roadmap with intermediate targets by 2030 and 2040.

The **Bulgarian Long-Term National Strategy for Supporting the Renovation of the National Building Stock of Residential and Non-Residential Buildings by 2050<sup>10</sup>** sets a roadmap with targets for energy savings, renovated built-up area and reduction of CO<sub>2</sub> emissions for residential and non-residential buildings over ten years, based on a vision that sets the strategic goal for decarbonization by 2050 and the enhanced involvement of the property owners and private investors in the projects implementation. Along with this, the **cost-optimal levels of renovations are analyzed, which are mostly on the borders between A and B energy classes for the different types of buildings**. An important component is the clearly identified goal of attracting market funding through optimal use of the available

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repeal of Directives 2004/8/EO and 2006/32/EO.

<https://eur-lex.europa.eu/legal-content/BG/TXT/?uri=celex%3A32012L0027>

<sup>7</sup> Official Journal of the EU (2010) Directive 2010/31/EU of the European Parliament and the Council from May 19, 2010 z. concerning the energy performance of buildings.

<https://eur-lex.europa.eu/legal-content/BG/TXT/HTML/?uri=CELEX:02010L0031-20210101&from=EN>

<sup>8</sup> National Plan for Buildings with nearly Zero-energy Consumption.

[https://www.seea.government.bg/documents/BG\\_National\\_nZEB\\_Plan\\_BG.pdf](https://www.seea.government.bg/documents/BG_National_nZEB_Plan_BG.pdf)

<sup>9</sup> Official Journal of the EU (2018) Directive (EC) 2018/844 of the European Parliament and the Council from May 30, 2018 for amendment of Directive 2010/31/EU concerning the energy performance of buildings.

<https://eur-lex.europa.eu/legal-content/bg/TXT/?uri=CELEX%3A32018L0844>

<sup>10</sup> Ministry of Energy, Long-term National Strategy to Support the Renovation of the National Residential and Non-residential Building Stock by 2050. Ministry of energy. [https://www.me.government.bg/files/useruploads/files/ltrs\\_bg\\_1.pdf](https://www.me.government.bg/files/useruploads/files/ltrs_bg_1.pdf)



public resources. This approach is fully justified in view of the necessary investments, which are set at over BGN4.6 billion for the period up to 2030. For the realization of such volume of investments, along with the existing financial mechanisms, the establishment of a *National Decarbonization Fund* is envisaged with three separate components – for the public sector, for the residential buildings and for the tertiary sector. In addition, the strategy addresses various instruments, such as guarantee funds at the national and local level, green bonds and green mortgages. Awareness-raising and training measures, for various professional and non-professional target groups, have also been proposed.

The building sector continues to be the center of attention, which was confirmed by the EC Communication of 14.10.2020 on the "**Renovation Wave for Europe**"<sup>11</sup>, part of the actions under the *European Green Deal*, which aims to at least double the annual rate of energy renovation of residential and non-residential buildings by 2030 and to promote the "**deep**" **energy renovation projects**. The resources mobilization at all levels will lead to the renovation of 35 million buildings by 2030. The increased speed and depth of renovations will have to be maintained beyond 2030 in order to achieve the climate neutrality across the EU by 2050.

In June 2021, the next change of *EPBD* is expected, which will include mandatory renovation of the most inefficient segments of the building stock and mandatory increase of the minimum energy performance requirements for buildings renovation with maximum approximation to the national definitions of nearly zero-energy buildings.

The leading legal instrument in the field of renewable energy use is the *EU Directive 2018/2011 on the Promotion of the Use of Energy from Renewable Sources*<sup>12</sup>. The EC, the Council of the EU and the EP have agreed on the *binding target* of achieving RES share of at least 32% of the gross final energy consumption by 2030 at the European level. The Member States will alone determine their own national contributions to the common goal, with a mechanism in place to ensure that the sum of national targets achieves the pan-European goal. The directive sets out the different ways in which the citizens could participate in the production of energy from renewable sources. One of the most promising opportunities are the so-called **renewable energy communities**<sup>13</sup>, through which people, local authorities and SMEs can become legal entities to produce, consume, accumulate and sell energy from renewable sources. Through the energy community, the citizens will now be able to generate revenue to provide services or meet their own needs. Companies are given the opportunity to install renewable energy systems in private homes. Another important requirement of the directive is that the states should provide the most simplified procedures about the connection of the small RES installations for own use, of up to 10.8 kW installed capacity, by a simple notification. The directive requires the Member States to put in place favorable frameworks to support the citizens and the communities to invest in energy from renewable sources, with a deadline June 30, 2021 for its transposition.

According to the Bulgarian *Law on Energy from Renewable Sources* (LERS) during the construction of new buildings or the rehabilitation, deep renovation, major repairs or reconstruction of existing buildings - installations for renewable energy production, when technically possible and economically feasible, must be put into operation. In these cases, at least 15% of the total heating and cooling energy required for the building should be produced from renewables. LERS allows a simplified

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<sup>11</sup> [https://ec.europa.eu/commission/presscorner/detail/bg/IP\\_20\\_1835](https://ec.europa.eu/commission/presscorner/detail/bg/IP_20_1835)

<sup>12</sup> *Official Journal of the EU (2018) Directive (EU) 2018/2011 of the European Parliament and of the Council of 11 December 2018 on the Promotion of the use of energy from renewable sources.* <https://eur-lex.europa.eu/legal-content/BG/TXT/?uri=CELEX:32018L2001>

<sup>13</sup> *According to the RES Directive a "renewable energy community" is a legal entity: (a) which, in accordance with the applicable national law, is based on open and voluntary participation; is autonomous and effectively controlled by the shareholders or the members located near the renewable energy projects that are owned and developed by a legal entity; (b) whose shareholders or members are natural persons, SMEs or local authorities, including municipalities; (c) whose principal purpose is to provide environmental, economic or social benefits to its shareholders or members, or to the local areas in which it operates, and not for financial gains.*

procedure for the connection of the photovoltaic installations with an installed capacity of up to 30 kWp to the electricity distribution network, but different from the definition for "simple notification" provided for in the directive.

The **Spatial Planning Act (SPA)** (Art. 147, para. 1, item 14) encourages the production of energy from renewable sources in urban areas without requiring approval of the investment projects for the issuance of a construction permit for the installation of electricity, heating and/or cooling systems from renewable energy sources with a total installed capacity of up to 1 MW, in existing buildings in urban areas also, incl. their roofs and facade structures and in the adjacent land properties.

Another important EC regulatory document aimed at climate change "*mitigation*" is Directive 2003/87/EC *establishing a scheme for greenhouse gas emission allowance trading*, which however, is not directly related to the activities of the local authorities and the SECAP of Sofia Municipality.

Within the long-term vision of a ***Clean Planet for All***, a new approach was introduced to plan and report on the related policies of the EU member states by replacing the existing separate plans in the fields of climate, energy efficiency and renewable energy with the integrated national plans in the field of energy and climate according to *Regulation (EU) 2018/1999 on the governance of the Energy Union*<sup>14</sup>. Bulgaria has developed its **2021-2030<sup>15</sup> Integrated Plan in the Field of Energy and Climate of the Republic of Bulgaria**. The main goals set in the plan are: stimulation of the low-carbon economy development; competitive and secure energy; reduction of the dependence on fuel and energy imports; energy supply guarantees for all consumers at affordable prices. The defined national contribution for the share of energy from renewable sources in the gross final energy consumption by 2030 is 27.09% and for the final energy consumption reduction - 31.67%. Meeting these two national targets will guarantee the reduction of the greenhouse gas emissions for sure, but the state has restrained from providing specific value for this national contribution.

In July 2021, the Council of Ministers published an updated draft of the Bulgarian ***Resilience and Recovery Plan***<sup>16</sup>. It envisages significant investments, which are related to the reduction of the greenhouse gas emissions and influence the current SECAP of Sofia Municipality. The planned investments of particular importance are: the energy efficiency of the building stock; the program for financing single renewable energy measures in single-family and multi-family buildings that are not connected to the heating and gas networks; the energy efficient municipal systems for outdoor artificial lighting; the program for public support of the industrial zones development, the parks and similar territories and attraction of investments; the economy transformation program; the construction of several sections of Sofia metro line 3; pilot scheme to support the sustainable urban mobility – "Green Mobility". The announced reforms related to the establishment of a national decarbonization fund will also be of great importance; the creation of a mechanism for energy efficiency and RES projects financing together with the energy bills and one-stop shop services.

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<sup>14</sup> *Regulation (EU) 2018/1999 of the European Union and of the Council of 11 December 2018 on the governance of the Energy Union and actions on climate change, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EC and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council* <https://eur-lex.europa.eu/legal-content/BG/TXT/?uri=CELEX:32018R1999>

<sup>15</sup> *Regulation (EU) 2018/1999 of the European Union and of the Council of 11 December 2018 on the governance of the Energy Union and actions on climate change, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EC and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council* <https://eur-lex.europa.eu/legal-content/BG/TXT/?uri=CELEX:32018R1999>

<sup>16</sup> *Council of Ministers of the Republic of Bulgaria. Recovery and sustainability plan.* <https://nextgeneration.bg/14>



In order to achieve efficient implementation of the sustainable energy and climate policies, Sofia Municipality is also implementing a **new integrated approach to planning and reporting on energy and climate activities**. This will create an opportunity to properly balance and prioritize the specific activities and projects in the two main areas, by which the ambitious goal for 40% reduction in greenhouse gas emissions by 2030 compared to 2007 can be achieved, resulting from the participation of the municipality in the Global Covenant of Mayors for Climate and Energy (GCMCE) - energy efficiency and increased use of renewable energy. It will also be possible to highlight energy efficiency as the top priority in the efforts to achieve this goal (by reducing overall energy demand) and RES as an additional tool that is increasingly replacing the conventional (especially fossil) energy sources.

In addition, the adoption of the revised standards for ecosystem statistical accounts allow the establishment of experimental environmental carbon accounts<sup>17</sup> in which the climate change mitigation in the ecosystems is reported at the expense of the carbon sequestration. This will give opportunity to monitor the contribution of the ecosystem restoration to climate change mitigation. This process has started for the forest ecosystems in Bulgaria.

In accordance with the commitments and the requirements of the GCMCE, Sofia Municipality has developed the **2021-2030 Sustainable Energy and Climate Action Plan (SECAP)**. This plan will be the leading long-term document of the municipality in the field of energy and climate. In accordance with the obligations of the municipality under the national legislation the **Long-term Program for the Use of Renewable Energy and Bio-fuels**, which will have the same time horizon and will be integrated in this plan. All future **short-term energy and climate programs will be in line with these long-term strategic documents**.

### 1.1.2. Adaptation to climate change

Adaptation means anticipation of the adverse effects of climate change and taking appropriate actions to prevent or minimize the damages that they may cause or use the opportunities that may arise.

The countries participating in the *Paris Agreement* agreed to strengthen the capacity of the communities to cope with the effects of climate change and to provide continuous and greater international support for the developing countries adaptation. The agreement recognizes the importance of preventing, minimizing and overcoming the losses and damages associated with the adverse effects of climate change and the need for cooperation and strengthening the understanding, actions and support in various areas, such as early warning systems, preparedness for emergencies and risk insurance. **The important role of the cities, regions and local authorities** is particularly emphasized, and they are invited to step up their efforts in support of the actions for emissions reduction, to build sustainability and reduce the vulnerability to the adverse effects of climate change, and promote regional and international cooperation.

In February 2021, the EC adopted the new EU Strategy for Adaptation to Climate Change<sup>18</sup>. This document upgrades the previous strategy of 2013, emphasizing on the integrated approach to smarter and faster, data-based adaptation, and ensures:

- Integration of the fiscal policy adaptation at the macroeconomic level.
- Environmentally friendly adaptation solutions.
- Local adaptation actions.

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<sup>17</sup> System for Environmental Economic Accounting – Experimental Ecosystem Accounting (SEEA-EEA), <https://seea.un.org/content/seea-experimental-ecosystem-accounting-revision>

<sup>18</sup> European Commission (2020). Communication from the Commission. Building a climate-resilient Europe - the EU's new strategy for adaptation to climate change. Brussels, COM (2021) 82 final. <https://eur-lex.europa.eu/legal-content/BG/TXT/HTML/?uri=CELEX:52021DC0082&from=EN>

In 2019, the World Bank developed the first Bulgarian *National Strategy for Adaptation to Climate Change and Action Plan*<sup>19</sup>. The document presents the performed vulnerability assessment and risk analysis of climate change in nine different sectors and sets out a common framework for the actions for climate change adaptation and the priority areas by 2030.

The first adaptation-oriented document of Sofia Municipality is the *Strategy for Adaptation to Climate Change of Sofia*<sup>20</sup>, adopted in 2017. In 2019, the municipality adopted also a *Plan for Adaptation to Climate Change of Sofia Municipality, 2019-2025*. The plan contains a number of activities aimed at improving the adaptation capacity of the municipality. During the development of the current SECAP of Sofia Municipality the first specialized analysis (Appendix 6) was performed at the municipal level on the vulnerability to climate hazards caused by climate change in several economic sectors; the impact of these hazards was described and the highest climate risks for the municipality were assessed and determined. In addition, the sectoral indicators for vulnerabilities monitoring and the impact of the climate hazards were identified. In accordance with this analysis, appropriate measures were developed to increase the adaptation capacity of the municipality, taking into account the provisions of the plan from 2019, which will be replaced by this document.

At the European level, the adoption of the European Green Deal prioritizes the areas of economic development that will provide a number of benefits beyond the reduction of the greenhouse gases - less waste, less use of materials and less pollution. The new *Circular Economy Action Plan* has already been presented in 2020<sup>21</sup>, the *Biodiversity Strategy*<sup>22</sup> and the strategy "*Farm-to-Table*"<sup>23</sup>. In the first of the listed documents, the EC focuses on the sectors in which most resources are used and where the potential for a circular economy is great, among which are: packaging; plastics, food, construction and buildings, etc. The *Biodiversity Strategy* proposes binding targets for damaged ecosystems and rivers recovery, improvement of the state of the protected habitats and species in the EU, return of the pollinators to the agricultural lands, reduction of the pollution, greening of cities, strengthening of the organic farming and other agricultural practices contributing to the biodiversity and improvement of the Europe's forests state. *The Farm-to-Table Strategy* aims to make the transition to a sustainable food system in the EU that protects food security and ensures access to healthy food.

The draft of the *Resilience and Reconstruction Plan* published by the Council of Ministers envisages the implementation of a number of investments that are important for the current SECAP of Sofia Municipality in the part for climate change adaptation: digitization for integrated management; control and efficient use of waters; program for construction/reconstruction of the water supply and sewerage systems, incl. WWTP for agglomerations between 2 and 10 thousand inhabitants; ongoing support for the de-institutionalization of the elderly people cares and people with disabilities; personal mobility and accessibility of the people with permanent disabilities; development of the regional administrative capacity of the enterprises of the social and solidarity economy and introduction of individual decisions; integration of the ecosystems approach and implementation of nature-based

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<sup>19</sup> World Bank 2019. *National Climate Change Adaptation Strategy and Action Plan*  
<https://www.moew.government.bg/bg/adaptaciya-kum-izmenenieto-na-klimata-9299/>

<sup>20</sup>[https://www.sofia.bg/search?p\\_p\\_id=101&p\\_p\\_lifecycle=0&p\\_p\\_state=maximized&p\\_p\\_mode=view&\\_101\\_struts\\_action=%2Fasset\\_publisher%2Fview\\_content&\\_101\\_returnToFullPageURL=%2Fsearch&\\_101\\_assetEntryId=1395518&\\_101\\_type=document](https://www.sofia.bg/search?p_p_id=101&p_p_lifecycle=0&p_p_state=maximized&p_p_mode=view&_101_struts_action=%2Fasset_publisher%2Fview_content&_101_returnToFullPageURL=%2Fsearch&_101_assetEntryId=1395518&_101_type=document)

<sup>21</sup> Press release of the European Commission dated 11.03.2021. *Change in the way we produce and consume: The new action plan for the circular economy outlines the path to a climate-neutral competitive economy of able-bodied consumers.* [https://ec.europa.eu/commission/presscorner/detail/bg/ip\\_20\\_420](https://ec.europa.eu/commission/presscorner/detail/bg/ip_20_420)

<sup>22</sup> European Commission (2020) *Communication from the Commission. The EU's 2030 Biodiversity Strategy to ensure that nature has its rightful place in our lives.* Brussels, COM (2020) 380 final.  
<https://eur-lex.europa.eu/legal-content/BG/TXT/HTML/?uri=CELEX:52020DC0380&from=EN>

<sup>23</sup> European Commission (2020) *Communication from the Commission. A Farm-to-table strategy for a fair, healthy and environmentally friendly food system.* Brussels, COM (2020) 381 final  
<https://eur-lex.europa.eu/legal-content/BG/TXT/?qid=1590404602495&uri=CELEX%3A52020DC0381>

solutions in the conservation of the Natura 2000 protected areas; restoration of key for the climate ecosystems for the implementation of the EU's 2030 Bio-diversity Strategy and the objectives of the European Green Deal.

## 1.2. The Global Covenant of Mayors on Climate and Energy and the commitments of Sofia Municipality

### 1.2.1. Information on the covenant – goals, requirements, rules

The *Global Covenant of Mayors for Climate and Energy* (GCMCE) is the largest international initiative involving on a voluntary basis the local authorities in the development and implementation of sustainable energy and climate policies. The GCMCE was established in 2017 by merging the EU's *Covenant of Mayors for Climate and Energy* (CMCE) and the *Covenant of Mayors for Climate and Energy (CMCE) of EC and the "Covenant of Mayors"*<sup>24</sup> (CoM). Besides the municipalities from European countries, it also includes local authorities from North America, Latin America and the Caribbeans, China and Southeast Asia, India and Japan, East and South Africa and sub-Saharan Africa. At present, more than 10,000 municipalities from 138 countries, with a total population of over 800 million people, have joined the *Global Covenant of Mayors for Climate and Energy*. The general goal of the local authorities united in the initiative is formulated as follows:

*to increase the access to secure, affordable and sustainable energy, to ensure that communities live in a healthy environment and to raise awareness to speed up the response to climate change.*

The *Covenant of Mayors on Climate and Energy* is the European Union's 2015 initiative, in which, for the first time, **both mitigation and adaptation measures** are being taken at local level. The rules of this initiative have been transferred to GCMCE. The goals set in the GCMCE are **to reduce CO<sub>2</sub> emissions by 40% up to 2030<sup>25</sup>** and develop a **comprehensive strategy for local adaptation or integration of the climate change adaptation into the relevant existing plans.**<sup>26</sup> The participating local authorities are committed to:

- Set their own ambitious mitigation and adaptation targets, not less than the overall goal of the emission reduction agreement.
- Measure the level of greenhouse gas emissions in the base year, in accordance with the general methodological approach presented in the Guidelines for the Development of SECAPs and the preparation of a baseline inventory of emissions (BIE).
- Carry out risk and vulnerability assessments (RVA) within their cities.
- Draw up an Energy and Climate Action Plan (SECAP), which contains a comprehensive set of measures and actions to achieve the set goals for mitigating and adapting to the effects of climate change. The plan should be based on the results of the previous evaluations (BIE and RVA).
- Approve and present publicly their action plan.

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<sup>24</sup> Founded in 2014 by the UN Secretary-General Ban Ki-moon and former New York Mayor Michael Bloomberg (former UN Special Envoy for Cities and Climate Change), the *Covenant of Mayors* is a global coalition of change-oriented urban leaders to climate change, who have declared themselves to reduce greenhouse gas emissions and prepare for the future effects of climate change. The *Covenant of Mayors* creates a common platform for pooling the efforts of cities through standardized assessment of the emissions and climate risks, and consistent, public reporting to stakeholders.

<sup>25</sup> In accordance with the EU 2030 Climate and Energy Package adopted in 2014.  
[https://ec.europa.eu/clima/policies/strategies/2030\\_bg](https://ec.europa.eu/clima/policies/strategies/2030_bg)

<sup>26</sup> In line with the EU's 2013 Adaptation Strategy.  
[https://ec.europa.eu/clima/policies/adaptation/what\\_bg](https://ec.europa.eu/clima/policies/adaptation/what_bg)

- Regularly report to the EC on the implementation of the action plan.
- Share their visions, results, experience and knowledge with other local authorities.

The *Covenant of Mayors on Climate and Energy*, for its part, brings together two earlier initiatives – the *Covenant of Mayors* (CoM) and the *Mayors adapt* (MA). The *Covenant of Mayors* initiative was launched in 2008 following the adoption of the 2007 EU climate and energy package by the European Commission. Its aim was to voluntarily involve the local and regional authorities in committing themselves to the implementation of sustainability policies on their territories and to provide them with a harmonized collection, methodological and reporting framework to turn their ambition for GHG emissions reduction into reality. By participating in it, the local authorities have committed themselves to achieving or exceeding the European target of a 20% reduction of the emissions by 2020 compared to the emissions level set in the base year, which is the closest to 1990 year, for which the respective municipality has reliable data.

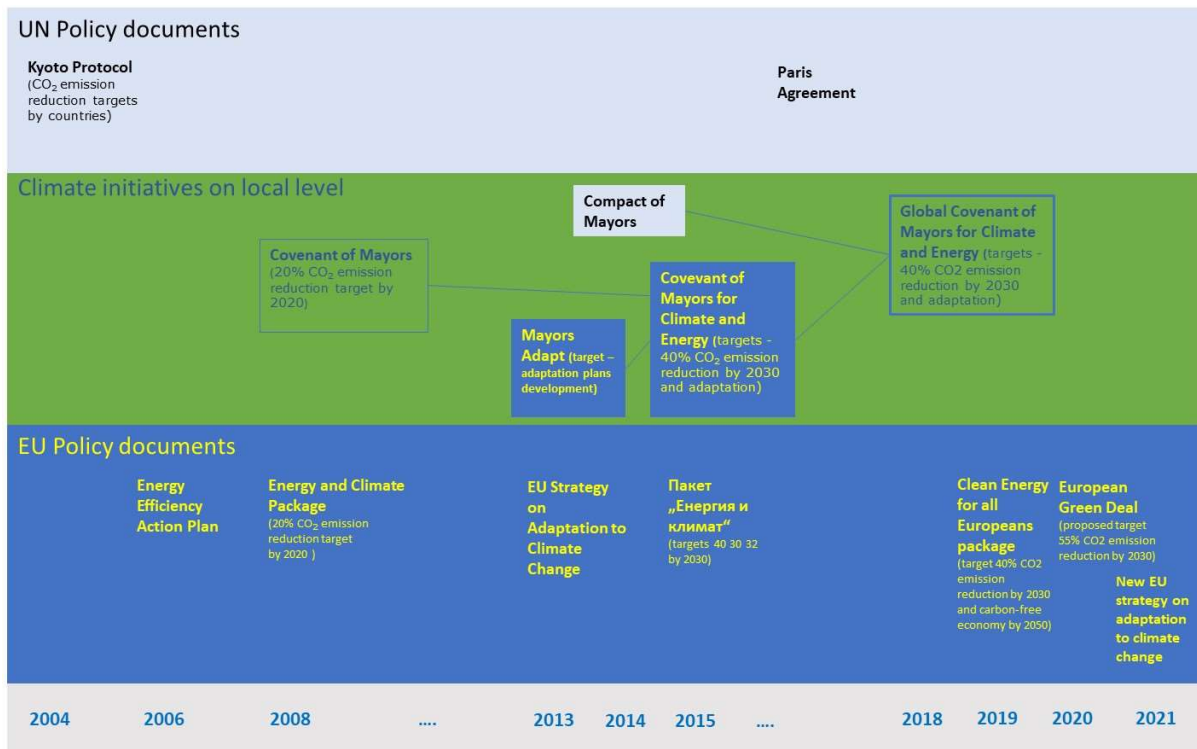


Figure 1. Diagram of the development of the main international climate policies and initiatives

The Mayors Adapt initiative was launched in 2013 by the EC in the context of the European Strategy for Adaptation to Climate Change. With it, the Commission encouraged the local authorities to commit to contributing to the overall goal of the EU's adaptation strategy by developing a comprehensive adaptation strategy at the local level or the adaptation integration with the climate change in the relevant action plans.

The sequence of the international climate initiatives creation at the local level compared to the adoption of the main international policy documents in the field of energy and climate is presented in Figure 1.

### 1.2.2. Participation and achievements of Sofia Municipality

Sofia Municipality pursues a long-term consistent policy of commitment and empathy with the global efforts against climate change, actively participating in the major international initiatives for climate and sustainable development oriented to the local authorities.

In 2011 the municipality joined the European *Covenant of Mayors* initiative, and according to the requirements of the initiative, developed its 2012-2020 Sustainable Energy Action Plan (SEAP). The plan is both a strategic and operational document, which defines the climate goals of Sofia Municipality until 2020 and presents the specific measures for emissions reduction, time frames and responsibilities assigned to achieve the set goals. Sofia Municipality chooses to adopt a higher target for emissions reduction than the minimum required by the participants in the initiative and is committed **to achieve a reduction of 22% of the total GHG emissions in the sectors, covered by the plan by 2020, compared to the set 2007 base year.**

In the performance of the SEAP, the municipality conducted three inventories of greenhouse gas emissions – in 2011, 2015 and 2018. Since 2015, Sofia Municipality has joined the UN *Covenant of Mayors* initiative, with which is committed to conduct inventories of greenhouse gas emissions in accordance with the requirements of the *Global Protocol for Community Greenhouse Gas Emissions Inventories* (GPCGGEI). This requires the expansions of the scope of the sectors included in the inventory compared to the baseline inventory under the SEAP. Therefore, the last two GHG inventories have been conducted in accordance with this scope.

According to the latest GHG emissions inventory of Sofia Municipality for 2018, conducted in connection with the implementation of the 2012-2020 SEAP, as of this year the municipality has achieved a reduction of the emissions by 18.2% compared to the 2007 base year. The result obtained by 2018 means that Sofia Municipality is very close to the achievement of the goal set in the SEAP to reduce the GHG emissions by 22% until 2020. In the period from 2007 to 2019 the population of Sofia Municipality has increased by 7.1% according to the NSI data. If the CMCE rule is applied to adjust the amount of emissions in the base year to the population increase, this will mean in practice that Sofia Municipality has already achieved its goal and **by 2018 may even report over 23% reduced GHG emissions compared to the 2007 base year.**

After the establishment in 2015 of the *Covenant of Mayors for Climate and Energy*, which combines the initiatives the *Covenant of Mayors* and the *Mayors Adapt* Sofia Municipality becomes a member of the new initiative, in which the local authorities focus their efforts on implementing policies and measures to adapt to climate change. As a result, in 2019 the municipality adopts a *Plan for Adaptation to Climate Change of Sofia Municipality, 2019-2025*.

With Decision No 755/08.11.2018 of the Sofia Municipal Council Sofia Municipality joins the *Global Covenant of Mayors for Climate and Energy* for the period 2021-2030, as a continuation of its participation in the *Covenant of Mayors* and the implementation of the 2012-2020 SEAP. By joining the agreement, Sofia Municipality sets itself the ambitious task **to reduce the GHG emissions by 40% compared to the 2007 levels within the scope of the plan and to plan and implement activities to the climate change adaptation.**

This *2021-2030 Sustainable Energy and Climate Action Plan*, has been developed in accordance with the participation of Sofia Municipality in GCMCE. The plan is the new strategic document in the field of energy and climate, which is in line with the municipality strategy for development, presented in the *Vision for Sofia*. In line with the imposed by EU trends in planning, Sofia Municipality is committed to **a new integrated approach to planning and reporting on the energy and climate activities.** The SECAP integrates the municipality's policies regarding climate change, energy efficiency and the use of energy from renewable sources. This will create an opportunity to properly balance and prioritize the specific activities and projects in the two main areas - energy efficiency and energy use from renewable sources, which can help for the achievement of the ambitious goal of the GHG emissions reduction by 40%. The energy efficiency will also be highlighted as the top priority in the efforts for the achievement of this goal (by reducing the overall energy demand) and of RES as an additional tool that is increasingly replacing the conventional (especially fossil) energy sources.

### 1.2.3. Relevant normative, planning documents and basic policies

The national legal framework and policies for adaptation and climate change follow Bulgaria's commitments related to the international conventions and the EU legislation. According to the team that developed the *National Strategy for Adaptation to Climate Change* and the Action Plan at the time of the document drafting (2019), in recent years the emphasis has been set on the mitigation and clear adaptation strategies, developed at national or sectoral level in Bulgaria, were not available. The institutional framework related to the adaptation and climate change is an element of the overall institutional framework for climate change enshrined in the Climate Change Mitigation Act (CCMA).

In the field of energy, the normative and planning documents reflect the EU's policy for the achievement of the objectives of the Agreement of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 21) in Paris, while ensuring clean energy throughout the Union. The strategic goals are related to the five indicators of the Energy Union, namely:

- Decarbonization – increase of the RES share.
- Energy efficiency – energy saving in the final energy consumption.
- Energy security – diversification of the sources and the routes.
- Internal energy market – competitive market of energy.
- Research, innovations and competitiveness – support for research and digitalization.

The European policies and objectives, in the field of climate change and energy, are reflected at the national level in the following key strategic and planning documents:

- *Integrated plan in the field of energy and climate of the Republic of Bulgaria for the period 2021-2030* – the plan sets goals until 2030, but is developed with a 2050 horizon.
- *National long-term strategy to support the renovation of the national building stock of residential and non-residential buildings until 2050.*
- *National Strategy for Adaptation to Climate Change and Action Plan* – covers the period up to 2030.

The national targets for EE and RES for 2030, determined by the adoption of the 2021-2030 *Integrated Plan in the field of energy and climate of the Republic of Bulgaria*, and significant part of the measures will be implemented at the local level, as until now. To this end, the Bulgarian municipalities are obliged to develop and publish long-term strategies and short-term RES programs and energy efficiency programs, as well as to submit annual reports on the savings and the implemented measures and RES to the Sustainable Energy Development Agency (SEDA). The requirements are defined in the *Energy Efficiency Act* and the *Renewable Energy Act*. A *Short-term program of Sofia Municipality for the promotion of use of renewable energy and bio-fuels 2020-2022* has been prepared and adopted. The current SECAP is considered a long-term program in the field of energy efficiency and renewable energy.

In connection with the accession of Sofia Municipality to the Covenant of Mayors initiative in 2012, the Sofia Municipality 2012-2020 *Sustainable Energy Action Plan* (SEAP) was developed. It lays the strategic foundations for the efforts of Sofia Municipality to achieve the European goals for reduction of the greenhouse gas emissions, energy efficiency improvement and the use of renewable energy at the municipal level by 2020.

At the local level, Sofia Municipality is also proactive in the field of adaptation and climate change, and in 2016 a Strategy for Adaptation to Climate Change of Sofia Municipality was developed in accordance with the requirements of the Covenant of Mayors initiative. In addition, in March 2019, the Plan for Adaptation to Climate Change of Sofia Municipality (2019-2025) was developed. The current SECAP covers most of the plan period and complements it by 2030.

By joint initiative of Sofia Municipality and the EBRD's "Green Cities" Framework Program, an Action Plan for a "Green City" (2020-2024) has been prepared – this is an investment plan and besides the concrete projects, a ten years vision for the sectors energy, residential buildings and communities,



urban planning, blue-green infrastructure and transport is expected to be drawn after its implementation.

Sofia Municipality and its structures and enterprises have also developed a number of general and sectoral strategies, programs and plans that are relevant to this plan:

- *Vision for Sofia* - a long-term strategy for the development of the capital and the suburban areas until 2050.
- *Air quality management program of Sofia Municipality for the period 2021–2026.*
- *Program for supplementing the 2015-2020 Air Quality Management Program on the territory of Sofia Municipality* - reduction of the emissions and achievement of the established norms for PM10, according to PM2.5 and the surfactant indicators.
- *Sustainable urban mobility plan of Sofia Municipality, 2019-2035.*
- *Operational action plan in case of established norms exceeding or alarm thresholds of air pollutants at unfavorable meteorological conditions and other factors on the territory of Sofia Municipality.*
- *Waste Management Program of Sofia Municipality, 2015-2020.*
- *Action plan for management, prevention and reduction of the noise in the environment of Sofia agglomeration.*
- *Program for development of the bicycle transport on the territory of Sofia Municipality.*
- General plan for the traffic organization on the territory of Sofia Municipality.
- *Strategy for development of the engineering infrastructure on the territory of Sofia Municipality for: water supply, sewerage and riverbed corrections.*
- *Strategy for Development of Sofia as a Tourist Destination (2017-2030).*

The list of the above mentioned strategies, plans and programs does not claim to be accurate and comprehensive, as many of the documents are being amended and updated, and new ones are being developed also.<sup>27</sup>

The Sofia Municipal Council has adopted about 40 municipal ordinances, which regulate the activities in the fields of buildings, transport, waste and other activities related to the use of buildings and energy or adaptation and climate change. The main regulations and the sector to which they refer are the following:

- ORDINANCE on the terms and conditions for travel by public transport on the territory of Sofia Municipality – transport.
- ORDINANCE for waste management and maintenance and protection of the cleanliness on the territory of Sofia Municipality – waste.
- ORDINANCE for determination of the local taxes amount of the Sofia Municipal Council – buildings.
- ORDINANCE on the procedure and manner of conducting public discussions in the field of spatial development and the territorial structure of Sofia Municipality - urban planning, environment and bio-diversity.
- ORDINANCE for the urban environment of Sofia Municipality - urban planning.
- ORDINANCE for construction, maintenance and protection of the green system of Sofia Municipality - urban planning.
- ORDINANCE for the traffic organization on the territory of Sofia Municipality – transport.
- ORDINANCE for the municipal property – buildings.

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<sup>27</sup> The report for the Assessment of the Vulnerability and Climate Change Risk for Sofia Municipality, which preceded the SECAP, provides a detailed tabular list of national legislation and the regulated by it planning documents at the regional and municipal level.

- ORDINANCE for the municipal sports facilities management and disposal and for the financial support of the sport activities on the territory of Sofia Municipality – buildings.
- ORDINANCE for the markets on the territory of Sofia Municipality – buildings.
- ORDINANCE for the construction of the technical infrastructure elements and the green systems, and guarantees for their construction on the territory of Sofia Municipality (Title supplemented - Decision No 660 under Protocol No 41 of 12.10.2017) - environment and bio-diversity.
- ORDINANCE for the municipal medical establishments – buildings.
- ORDINANCE for attraction and encouragement of investments with municipal importance in Sofia Municipality and the procedure for issuing a class B investment certificate – buildings.
- ORDINANCE for offering public transport to passengers on additional route lines of the municipal transport scheme on the territory of Sofia Municipality – transport.

When updating the ordinances, the review should be made in the light of the legal analysis of the relevant regulations potential impact in the context of energy and climate.

### 1.3. Methodology for the current plan development

The rules for the SECAP development are presented in a special guidelines in three volumes<sup>28</sup> prepared by the *Center for Joint Research (JRC)*. The *Sustainable Energy Development Agency (SEDA)* has issued instructions on the development of **municipal programs for the use of renewable energy and bio-fuels** and for the preparation of **municipal energy efficiency programs**.<sup>29,30</sup> The three documents present sample proposals **for the document structures that are not mandatory**, but adhering to them would help to unify the documents from the different municipalities. Therefore, the structure of the current plan is fully aligned with these three recommended structures, trying to combine, as much as possible, all three recommendations. The leading document taken into account, is the SECAP, but all components of the sample structure contents for the RES and energy efficiency programs have also found place in this document.

Book Two of the SECAP Development Guide describes the rules for selection of a base year and selection of the sectors scope in which an inventory of greenhouse gas emissions should be conducted. The choices made in this plan are in full compliance with these rules and are described in Section 4. In the same book of the guidelines the obligatory methodology for carrying out inventory of greenhouse gas emissions is presented. How this methodology was applied in the preparation of the baseline inventory of emissions is described in section 4.4.4 of this document, as well as in the separate document, presenting the baseline inventory added in *Annex 1*.

Despite the growing interest in the climate change mitigation through carbon sequestration from ecosystems – this mechanism is best studied for forests and wetlands, Sofia Municipality does not currently have a mechanism for these greenhouse gases accounting. In this regard, in the SECAP (measure A.3.1) we propose the creation of experimental carbon accounts, which could be included in the inventory at a later stage.

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<sup>28</sup> JRC, *Guidebook "How to develop Sustainable Energy and Climate Action Plan (SECAP)"*, 2018  
<https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/guidebook-how-develop-sustainable-energy-and-climate-action-plan-secap>

<sup>29</sup> SEDA, *Guidelines for the preparation of municipal programs to promote the use of renewable energy from and bio-fuels* [https://www.seea.government.bg/documents/Ukazania\\_Programi\\_ZEVI.pdf](https://www.seea.government.bg/documents/Ukazania_Programi_ZEVI.pdf)

<sup>30</sup> SEDA, *Guidelines for the preparation of municipal energy efficacy programs*  
[https://www.seea.government.bg/documents/Programi\\_EE\\_Ukazania\\_2020.pdf](https://www.seea.government.bg/documents/Programi_EE_Ukazania_2020.pdf)



With regard to the development of the “adaptation” part of the SECAP, there are requirements for the adaptation capacity assessment, assessment of the degree of vulnerability and climate impact on the individual sectors, and identification and assessment of the climate risks. It is also required to define the monitoring vulnerability and impact indicators, as well as for the monitoring results from the recommended adaptation measures/actions. The SECAP development guide does not indicate a specific methodology for carrying out these assessments, but various examples of individual assessments carried out in other documents are presented. In line with these examples and a study of other literary sources, the team advising the plan elaboration developed a methodology for carrying out the required assessments, which is summarized in Chapter 5.2, and the entire document is presented as *Annex 6*.

The requirements regarding the plan implementation, monitoring and control and its reporting are described in the first book of the guidelines for the development of SECAP. Their application in this document is described in Section 7.

## 2. Vision, strategic goals and organization for the development and implementation of SECAP of Sofia Municipality

### 2.1. Long-term vision, priorities and goals for the development of Sofia Municipality

In 2020, the Sofia Municipal Council adopted the current leading, long-term strategic document for the development of Sofia Municipality - "Vision for Sofia". The document outlines the long-term vision, priorities and main directions for the municipality development until 2050 and sets the long-term development goals. **The Vision for development** of the municipality is formulated as follows:

*Sofia 2050 is a compact, diverse and adaptable city, skillfully managing its resources and involving citizens in the decisions for the future in order to create and maintain a variety of opportunities for development and high quality of life*

The vision outlines the five adopted **priorities for development**, which are:

- *Compact city*
- *Diverse city*
- *Adaptive city*
- *Skilfully managing its resources city*
- *A city involving citizens in the decisions for the future.*

In accordance with the identified priorities for development, the strategic document identifies seven **main areas of development**, for each of which **long-term development goals** have been formulated. They are presented schematically in a synthesized form in *Figure 2*.

Main areas of development:	Urban Environment	Economy	People	Environment	Identity and Culture	Transport	Management
Дългосрочни цели за развитие:	Multifunctional city	Sustainable and innovative tourism	Cohesion and community	Sustainable resources and energy balance	Development as a culture center	Active movement	Decentralized and democratized governance
	Quality urban environment	High-productive economy	Education, directed to the future	Clean environment	Positive image	Global and regional connectivity	The municipality is a strategist
	Compact and clustered city	Center fo innovations	Healthy living and healthy people	Adaptive city	Authentic and multi-layered city	Popular public transport	Automated administrative process
		Circular economy		Live environment		Mobility as a service	

Figure 2. Scheme of the organizational structure of Sofia Municipality.

For the implementation of each of the set long-term development goals in the *Vision for Sofia*, specific **intermediate steps** and deadlines for their implementation have been determined and the respective measures have been developed. Each of the intermediate steps is presented with a short explanatory text. In accordance with these descriptions, in all major areas of development, a large number of **emphases, directly or indirectly, related to the implementation of solutions with a positive impact on the climate change issues** in the parts for "mitigation" or "adaptation" can be identified. The following lines highlight some of the most important accents, which are planned for the period until 2030.

#### Direction "Urban environment":

- 2023** *Information system with a complete and up-to-date database of each type of technical infrastructure. Construction control has been drastically improved.*
- 2024** *Increased capacity for the improvement and maintenance of the urban environment. Improved coordination of the units, distribution of responsibilities, monitoring. Program budgeting.*
- 2025** *Identified priority abandoned areas for renewal.*
- 2027** *All cultural, sports and administrative municipal buildings are used as intended and are renovated. Expanded system of pedestrian spaces. Created streets for shared traffic. Priority of pedestrians.*
- 2028** *Dedicated areas in which experimental neighborhoods are developed with innovative buildings architecture, new materials and construction methods and processes. The concept of a smart city is tested.*
- 2029** *The market offering of unoccupied housing encouraged. The municipality interacts for the optimal use of the housing.*
- 2030** *Provided quick, walking access to parks, gardens or green public spaces.*

#### Direction "Economics":

- 2025** *Effective access control of cars/restored lifts, ski lifts and chalets.*
- 2027** *Functioning clusters in the priority economic sectors.*

**2028** *Developed entrepreneurial ecosystem, with secured funding in all segments, wide opportunities for exchange of experience and mentoring, reduced administrative burden and simplified regulatory regimes, access to a lot of open data, research and exchange of ideas, interaction with business, scientists and career centers.*

**2029** *The pedestrian is with priority. Restored mineral baths/developed spa hotels. Sofia is the entrepreneurial hub in the region.*

#### **Direction “People”:**

**2023** *Efficient participation of the citizens in the decision-making and monitoring of their implementation. Renovation of the schools by applying resource efficient and green construction solutions and materials.*

**2027** *Expanded system of pedestrian spaces. Streets for shared traffic are created. Priority of the pedestrians.*

**2029** *The architecture of the urban spaces is designed to minimize the risk of injury, heat, radiation, noise and similar factors.*

**2030** *Good readiness for disasters. Development of the heat and gas transmission networks.*

#### **Direction “Environment”:**

**2023** *Separate waste collection and recycling. The landfill is almost zero. Detailed digital inventory of the green system is performed. Active communication with the citizens to explain and emphasize on the use of ecosystem services.*

**2024** *Reformed waste charging system in accordance with the volume of their generation.*

**2025** *Qualitative assessment of the soil resources in the municipality. Created soil quality planning map. Adopted horizontal policies for adaptation to climate change, successfully integrated into the rest of the specific strategic documents. Regular assessment of the adaptation and update of the measures, taking into account the attitudes of the residents and businesses.*

**2026** *Awareness of the citizens and businesses about the appropriate approaches to minimize the impact on climate.*

**2027** *Recultivated deserted terrains actively included in the urban ecosystem. Reconstruction of the existing and construction of new infrastructure for utilization of the mineral waters. Built mineral spas and urban mineral beaches for recreation and sports.*

**2028** *Solid and liquid fuels are not used for heating. The municipal fleet consists of low-emission cars. Reconstructed streets are planted with perennial vegetation and flower and grass areas.*

**2030** *Reduced amount of waste generated. Reuse of waste as a resource. Heating of households is carried out by non-polluting energy sources. Stopped heating on solid and liquid fuels and illegally burned waste. Annual monitoring of the energy balance of each neighborhood. Preserved green areas and with increased tree vegetation coverage in the inter-block spaces maintained in good condition. The replacement of the tree species follows the general strategy of the green system.*

#### **Direction “Identity and Culture”:**

**2025** *Established effective information channels on the planned actions, the interventions in the urban environment, the allocation of funds, the development directions and the provision of services in the city for the citizens.*

**2027** *Easy access to information for the citizens, business and other target groups and opportunities for participation in the communication with the administration on important topics for the city.*

#### **Direction “Transport”:**

**2022** *Improved and secured connectivity between the bus stops. Regional trains are connected to the metro and the key transport locations for easy and fast access to suburban areas with sustainable transport.*

- 2023** *Improved environment in the neighborhoods that are designated as pedestrian. Integration between the active mode of movement and the mass transport. New, well maintained, comfortable and safe zero-emission public transport vehicles.*
- 2024** *The load of the routes varies depending on the time range and the associated locations.*
- 2025** *High capacity and accessibility of the renewed regional railway network. High integration between the trains, the metro and the rest of the public transport. Introduced intelligent transport management system.*
- 2027** *Expanded paid parking area throughout the city. Dedicated parking spaces for shared cars or those for charging or short stay mainly. Sufficient car parks in the neighborhoods.*
- 2028** *Increased number of shared cars at the expense of the personal ones. Sufficient number of charging stations throughout the city. At least 80% of the trips are made by sustainable forms of transport - active and mass. Availability of autonomous shared cars and ability for redirection of vehicles to locations with increased demand. Transition to autonomy of public transport. Built bicycle network that connects all parts of the city and the suburban areas with the possibility of continuous movement throughout the city.*
- 2029** *Significantly increased use of shared vehicles. Bicycles, scooters and other means of active mobility are imposed as the preferred vehicle for short and medium distances.*

**Direction "Management:**

- 2023** *Regulated legal basis and efficiently used legal mechanisms for public-private partnership, which allow the achievement of more efficient use of the resources and higher quality of the environment and the processes in it. Clarified and categorized resources used rationally and sustainably, subordinated to the coordinated implementation of the strategic goals.*
- 2024** *Program budgeting is applied in the administration in accordance with the set goals, tasks and deadlines of the units. Synchronized municipal strategies by coordination of the goals, measures, projects, responsibilities and indicators.*
- 2025** *All data that the municipality works with are easily accessible and traceable, including the primary data generated and collected by the administration, the monitoring data, costs, processes and tasks in the municipality.*
- 2026** *High capacity and accessibility of the renewed regional railway network. Efficient integration between the trains, the metro and rest of the public transport. Introduced intelligent transport management system. Implemented unified municipal IT system for data exchange between the municipal structures with controlled and traceable access.*
- 2027** *Introduced simulation models for data analysis, which are used for the impact assessment and analysis of the test scenarios for the development of policies and strategies.*
- 2030** *Linked implementation of the strategies and plans. All strategic documents and plans are based on data analysis, using the established common data storage and the simulation models and impact assessments.*

After 2030, the *Vision for Sofia* envisages other steps for the achievement of the set specific goals. Several important accents of the "Environment" direction can be derived, whose results can be achieved in the specified terms only if the appropriate measures can be undertaken in the period before 2030.

- 2034** *Built infrastructure for sustainable use of rainwater.*
- 2036** *Implemented action plan for increase of the energy efficiency in production, including pilot areas and methods.*
- 2030** *Use of the mineral waters for heating and cooling in certain areas.*
- 2040** *Energy efficiency measures are implemented in all existing buildings.*
- 2040** *The energy from renewable sources is with the major share in the energy mix.*

## 2.2. Strategic goals in the field of energy and climate

The long-term strategic goals in the field of energy and climate are set in compliance with the following principles:

- Compliance with the international, European and national strategic documents and the goals set in the leading long-term strategic document of Sofia Municipality – “Vision for Sofia”.
- Compliance with the policy framework in the field of energy and climate at the European and national levels.
- Compliance with the objectives of the Global Covenant of Mayors for Climate and Energy and the commitments of Sofia Municipality with its accession to the covenant.

With the act of joining the GCMCE Sofia Municipality has clearly stated its position in support of the objectives of the initiative and the implementation of the planned activities for the achievement of these objectives. Given that this initiative is based mainly on the rules of the Covenant of Mayors on Climate and Energy, which in turn is designed to support the implementation of the EU climate and energy goals and policies, and taking into account the Union's main long-term goal of climate and energy, Sofia Municipality has reason to declare its own goals:

*Strategic goals 1:*

### ***Sofia Municipality –climate-neutral***

*Transforming Sofia Municipality into a carbon-neutral city until 2050 by applying the highest standards in terms of energy efficiency and transforming the energy mix for use of renewable energy with focus on the shared production and consumption at the local level.*

In its strategic framework for development, presented in the *Vision for Sofia*, Sofia Municipality unequivocally demonstrates, through the adopted goals and intermediate steps towards their implementation, that it attaches great significance to the efficient use and management of resources, which is pointed out as one of the five main areas of development. The next goal follows from this one:

*Strategic goals 2:*

### ***Sofia Municipality – resource efficient***

*Development of Sofia Municipality according to the circular economy principles with an emphasis on on the environment and bio-diversity protection and the creation of comfortable and healthy living conditions and professional realization of the citizens.*

The increasingly occurring climate phenomena, caused by climate change and leading to significant negative impacts on the environment and bio-diversity, and in particular on the urban environment and the people, are the reasons why the international actions for adaptation to climate change have become an integral part of the related with the climate and energy policies. Although, due to its geographical location, Sofia Municipality is not facing the world's biggest challenges related to climate change, it also needs to make the necessary efforts to reduce the potential negative impacts of dangerous climate events in the future. From this follows the next goal:

*Strategic goals 3:*

### ***Sofia Municipality - adaptive***

*Increasing the adaptation capacity of Sofia Municipality to deal with the caused by climate change negative impacts through the development of regulatory framework and institutional capacity, attracting the public and*

*business attention, implementing environmentally friendly adaptation solutions and increasing the prevention opportunities and improving the preparedness and reaction to the occurrence of extreme weather events.*

### **2.3. Organizational structure and staff of Sofia Municipality in relation to SECAP**

With regard to the implementation of the commitments connected with SECAP, Sofia Municipality has distributed its functions and responsibilities among the various departments and directorates of the municipal administration. For the more successful and efficient implementation of SECAP and in accordance with Article 2, item 18 of Regulation 2018/1999 in connection with the governance of the EU, namely "energy efficiency in the first place" a Coordination Unit to the Mayor of Sofia will be established in order to concentrate the responsibility for initiating, implementation and effectiveness of the projects in Sofia Municipality. The Coordination unit to the Mayor of Sofia will initiate, coordinate and control all relevant to Article 2, item 18 of Regulation 2018/1999 projects in Sofia Municipality, refracting them through the prism of energy planning and the reduction of greenhouse gas emissions.

The "Climate, Energy and Air" Directorate will monitor the implementation of the measures and the activities set in the current plan. With regard to the communication with the stakeholders, it is responsible for the organization of the public information on the content of the programs that promote the use of renewable energy and bio-fuels in the appropriate way. The participation of the directorate in the budgeting process for the implementation of the plans, programs and strategies, related to energy and climate, is of great importance also.

The general administration creates the working conditions for all employees and organizational structures and their involvement in the implementation of the set climate and energy goals which is of key importance for the implementation of the specific activities. Apart from the process of digitalization and ensuring efficient and transparent work of the municipal administration, which is in line with the good governance principles and the rule of law, the preparation of the budget and the funding of the specific activities are essential for the implementation of the activities and the measures set.

The "Finance and Healthcare" Division organizes, coordinates and controls the activities of the municipality in the field of finance, healthcare, and municipal property management. The division controls the financing and the activities of the municipal companies and enterprises and has specific obligations related to the sites that provide activities in the field of healthcare. At the same time, the division horizontally impacts all structures, programs, activities and processes in the municipality, for the financial management mainly. The department also includes the "Municipal Property" Directorate, which is responsible for the management of the municipal property and the housing stock.

The "Digitalization, Innovation and Economic Development" Division plays an important role in the development of the intelligent city, organizing, coordinating and controlling the municipality's activities related to the information and communication technologies, the e-government, the economic development and the digitalization of Sofia Municipality. The division is responsible for the preparation of the strategies and programs and the organization of their implementation, as well as for the network and information security.

One of the main functions of the Deputy Mayor of the "Public Construction" Division is to coordinate and control the implementation of the programs related to the energy efficiency in buildings, including the obligations under Art. 63 of the Energy Efficiency Act for the municipal property energy efficiency management. The division also decides on the projects for construction and repairs of the municipal buildings and roads, the water supply and sewage and the river repairs corrections. The construction of bicycle infrastructure, parking lots and other sites of importance for the transport and mobility policy are also in the responsibilities of this division.

The “European Policies, International Affairs and Tourism” Division supports and coordinates the preparation of the projects funded by the operational programs, the EU territorial cooperation programs, and other European, national and international programs and projects. The division is also responsible for the coordination of Sofia Municipality policy in the field of tourism, the strategic documents in this field and the work of the Advisory Council on Tourism. The role of the division is also essential for the implementation of the communication strategy in the part of the organization, conducting and protocol provision of conferences, symposia, seminars, discussions and round tables, official and working meetings related to the activities of Sofia Municipality for climate and energy.

The Deputy Mayor of Sofia Municipality, responsible for the “Transport and Urban Mobility” Division supports the exercise of the Mayor of Sofia Municipality’s powers by controlling and coordinating the activities and services in the field of transport and urban mobility. The “Transport” and “Traffic Management and Analysis” Directorates are responsible for a number of activities, including the traffic and safety analysis, the development of intermodal connections between the different types of urban transport and its coordination with the interregional transport, the promotion of public transport use, etc.

The directorates of the “Green System, Ecology and Land Use” Division – “Green System”, “Environment” and “Waste Management and Control Activities” have an essential role to play in the implementation of the measures in the waste and land use sectors. The preparation of legal, strategic and program documents, as well as their control and implementation, the management of water bodies, lands and forests, waste management, etc. are in their functions. According to the organization chart – structure of Sofia Municipality, approved by Decision No 246 under Protocol No 16 of 25.06.2020 of Sofia Municipality, the number of employees in the division is 71, and practically all of them have relationship with the energy and climate activities.

The “Social Activities and Integration of People with Disabilities” Division has a key role in the integration of the people with disabilities and the social services for children and adults. In addition to the management of the social sites municipal property, the division supports the activities for the energy poverty reduction of the target groups with which it works.

The “Culture, Education, Sports and Youth Activities” Division organizes, controls and coordinates the activities in the field of culture, education, sports and youth activities. In addition to the control of the budget funds spending in the cultural, educational and sports infrastructure, the division has the opportunity to initiate and control the implementation of activities for improvement of the material and technical base, including energy efficiency.

The Chief Architect of Sofia Municipality, as Head of the “Architecture and Urban Planning” Division exercises the management and control of the activities related to spatial planning, urban planning, architecture, construction, planning of public works and construction control. Part of his powers is delegated to the specialized district technical services and the districts’ chief architects, but the functions of methodological guidance and administrative control on their acts remain. The division is also responsible for the use of the underground resources and mineral waters on the territory of the municipality.

A summary (sample) organizational chart is presented in the following *Figure 3*:



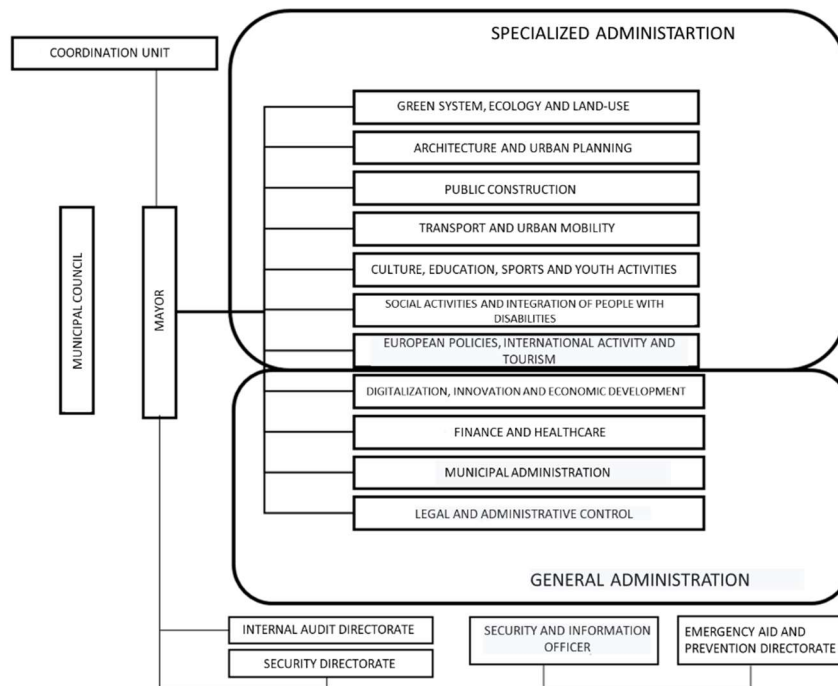


Figure 3. Scheme of the organizational structure of Sofia Municipality

The municipal administration works together with the “Sofiaplan” municipal enterprise also, which is responsible for the spatial and strategic planning of Sofia Municipality. Key projects of ME “Sofiaplan” are *Vision for Sofia* (long-term strategy for the development of Sofia Municipality until 2050), *The Plan of Sofia* (the current General Development Plan and its forthcoming amendment) and the *Program for Sofia* (the 2021-2027 Integrated Plan for Municipal Development). It also develops plans, strategies and policies for the sustainable development of Sofia Municipality. The enterprise has a multidisciplinary team of nearly 30 professionals who work in active dialogue with the various stakeholders, collects and analyzes data on various aspects of the urban environment and municipal development, and makes policy proposals to the Sofia Municipal Council, the mayor, the district mayors and the deputy mayors of Sofia Municipality.

As a specialized unit of Sofia Municipality, by decision of the Sofia Municipal Council in 2003 the ME “Tourist Services” was established. In 2014 it was renamed to ME “Tourism”, was organizationally restructured and its functions were optimized. It ensures the activity of the Mayor of Sofia Municipality in fulfilling the requirements assigned to him according to the Tourism Act.

The Sofia Municipal Council (SMC) is the local self-government body on the territory of Sofia Municipality. It is a collective body with common competence. According to the Law on Local Self-Government and Local Administration, the Municipal Council determines the policy for construction and development of the municipality and has a number of powers regarding the municipal budget approval, the management and disposal with municipal property; adopts strategies, forecasts, programs and development plans of Sofia Municipality. The municipal administration prepares strategic documents and reports on the progress of the energy and climate policy implementation, which are discussed and adopted by the SMC at regular meetings of the Council and its specialized commissions.

## 2.4. External experts

This plan has been developed by a team of “EnEffect Group” DZZD (Company Under the Law on Obligations and Contracts) under the terms of Contract No COA19-DG55-758/12.11.2019. The establishment of the team for the plan development is in line with the official SECAP development



guidelines, which identifies the specific sectors for climate change mitigation - "residential buildings", "tertiary sector buildings", "municipal buildings" and "transport". With regard to the climate change adaptation policies, SM identifies as most vulnerable the following sectors: "Buildings", "Transport", "Energy", "Waters", "Waste", "Land Use Planning", "Environment and Biodiversity", "Health", "Civil Protection and Emergency", "Tourism" and "Others". To comply as fully as possible with the set scope of the plan, the contractor's team includes experts with proven qualifications and experience in the following spheres:

1. "Strategic planning"
2. "Climate - Greenhouse Gas Reduction and Adaptation"
3. "Greenhouse gas emissions Inventories"
4. "Database"
5. "Energy, energy efficiency, renewable energy sources and bio-fuels"
6. "Transport"
7. "Publicity and communications"
8. "Urban planning"
9. "Economic analysis"
10. "Waters"
11. "Waste"
12. "Civil protection, disasters and accidents"
13. "Agriculture and forestry, landscaping and land use"
14. "Human health"
15. "Tourism"
16. "Environment and Biodiversity"

## 2.5. Stakeholders and citizens

A number of stakeholders are involved in the preparation and implementation of the SECAP, whose guidance concerning the identified policies and measures should be taken into account, ensuring the necessary balance between the different proposals based on the feasibility study. On the other hand, the final evaluation of the real impact of the plan and the overall impact on the development of the economy and the improvement of the urban environment will be given by the citizens of the capital. For this reason, the mobilization of professional and public support and the involvement of the population and the main participants in the process of developing and implementing the plan, become an issue of particular importance. For this purpose, by Order SOA19-RD92-266/31.07.2019, a "Climate and Energy" Expert Council was established, which, in addition to the representatives of all directorates of SM and its municipal enterprises related to the plan subject, includes experts from MoEW, ME, MRDPW, SEDA, the Sofia Regional Administration, UACEG, St. Kliment Ohridski Sofia University and the Technical University of Sofia. The process of the plan development includes regular presentations of the completed activities and the forthcoming steps to the Council members, and the comments and guidance received have been taken into account at each stage of the work. In order to coordinate with the developed in parallel strategic and planning instruments, serious attention in the development of the SECAP was paid to the cooperation and exchange of information with ME "Sofiaplan". After the completion of the work on the plan, it will be presented for public discussion and adjustments and improvements in the contents will be made after the relevant coordination procedure.

The citizens' participation is also extremely important for the process of the envisaged measures implementation. In the communication strategy of the Plan (see Chapter 8) mechanisms will be set both for informing the citizens and businesses about the undertaken commitments and planned activities and for receiving feedback and acceptance of the concrete proposals for the activities improvement. The district administrations, which have direct contact with the active representatives of the civil society and the opinion leaders of the neighboring communities, will be included in this process.

The planned public events, in support of the implementation of the SECAP, will include components that ensure the direct participation of the interested citizens in the form of open working sessions and discussion forums in various formats. The potential of the non-governmental sector will be used in the process also, and the results of the implemented initiatives will be monitored and used in the work on the implementation of the specific activities under the Plan. At the same time, and in order to provide internal capacity and resources for the active cooperation with the civil society representatives, Sofia Municipality will continue to use the opportunities for direct participation in national and international projects in support of the sustainable energy development policies including of a wide circle of stakeholders and partner organizations.

## **2.6. Financial framework of SECAP**

### **2.6.1. Maximum eligible budget for the measures, projects and activities implementation**

The financial framework of the plan represents the total sum of the available municipal own and attracted funds, which the municipality is capable to provide and commits itself to allocate for the implementation of the planned activities financing. In order to be able to implement the planned activities and projects, they must be provided with the appropriate funding. The financial framework determines the maximum amount of financial resources within which the activities and projects that can contribute to the maximum extent to the achievement of the plan set goals and priorities must be selected.

Theoretically, there are two approaches for financial framework definition – “top-down” and “bottom-up”. The first approach is better for the municipal energy planning, although the practice shows that the second one is almost always applied. In the “top-down” approach, the financial framework is determined by the following activities: forecasting the trends in the municipal budget for the period of the plan implementation; review and anticipation of the legal framework development for the period of plan validity; an overview of the expectations for changes in the national and local tax policy and their impact on the municipality revenues; study of the expectations for extra-budgetary revenues of the municipality.

For the needs of the current plan, Sofia Municipality prefers to apply the second, “bottom-up” approach in which the financial framework is determined by the sum of the value of the projects developed for implementation. As in the specific case, with the act of joining SECAP, the municipality has accepted a specific commitment to achieve a definite result, the plan must contain a sufficient number of activities and projects to ensure the implementation of this commitment. At the same time, the plan is comprehensive and interdisciplinary.

However, given the budgetary constraints and increased costs associated with the COVID-19 situation, Sofia Municipality will give priority to the measures that may apply for grants, and the number of measures that cannot receive such funding will be limited.

### **2.6.2. Funding sources and financial schemes**

In recent years, Sofia Municipality has successfully used all opportunities to finance energy efficiency measures, use of renewable energy sources and climate change mitigation and adaptation activities. Own funds from the budget of Sofia Municipality, attracted financing from financial institutions, grant financing from operational programs and other financial mechanisms were also used.

The main sources of funding in the next programming period 2021-2027 of the European Union will remain the programs of the European funds (in the previous programming period called operational programs), which provide the municipalities with high intensity grants, in most cases up to 100%. All operational programs to which the SM or the institutions, companies and organizations on its territory will have access, and which will affect the activities under the SECAP, are in a process of negotiation, and they are:

- Competitiveness and Innovations Program
- Education Program
- Environment Program
- Transport Connectivity Program
- Technical Assistance Program
- Regions in Growth Program
- Human Resource Development Program
- Food and/or Basic Material Support Program
- Research, Innovation and Digitization for Intelligent Transformation Program
- Maritime work, Fisheries and Aqua Cultures Program

Some of the more important programs are:

- **Regions in Growth Program 2021-2027**

By Priority 1 “Integrated Urban Development” – Sofia, together with the city of Blagoevgrad, will get 33.02% of the total priority budget, which amounts to €578,566 453 of which €459,280 are from grants and €22,964,040 – funds from financial instruments). (Version 3.0 of January, 2021). Indicative support measures:

- Infrastructural measures to promote the economic activities.
- Energy efficiency and renovation of residential and public buildings.
- Sustainable urban mobility.
- Road infrastructure, functional links and road safety.
- Green urban infrastructure and security in public spaces.
- Educational infrastructure.
- Municipal housing stock.
- Health and social infrastructure.
- Culture and sports.
- Tourism.

Integrated territorial strategies will be used. For Sofia this is the *Program for Sofia* – the integrated development plan of Sofia Municipality for the period 2021-2027, which is developed by the ME “SofiaPlan”.

Financial instruments can be used for the traditional measures for which such possibility has existed so far – energy efficiency, urban transport, urban environment, support for economic activities, sports, cultural infrastructure, tourism. In addition, during the 2021-2027 programming period extension of the scope and a greater flexibility in the financial instruments’ application is envisaged, taking into account the identified new activities based on the “bottom-up” approach.

- **Program for Competitiveness and Innovations in Enterprises (PCIE)**

The program is aimed at achieving the policy goal for a greener, lower-carbon Europe by promoting a clean and fair energy transition, green and blue investments, circular economy, climate change adaptation and prevention, risk management and the implementation is funded by the European Commission, the Regional Development Fund (ERDF) and the Cohesion Fund (CF). The main priorities are:

- Priority 1 "Innovations and growth" – supports innovations and innovative start-ups, targeting enterprises (mainly SMEs) as well as industrial parks. The use of the digitalization benefits is also supported, for SMEs again. Production investments and entrepreneurial activities are supported.
- Priority 2 "Circular Economy" – promotes measures for energy efficiency and reduction of the greenhouse gas emissions in enterprises; introduction and certification of energy management systems; introduction of systems for monitoring and control of the energy consumption; encouraging businesses to use electricity, heat and cooling produced from renewable sources. Apart from the SMEs, the large enterprises are also a target group. The other specific objective of the priority is to promote the transition to a circular economy: more efficient use of the natural resources in the production incl. water, reduction of the primary raw materials or increase of the use of by-products and scrap; increase of the durability and the possibilities for repair, modernization or reuse of the products and others related to the possibilities for recycling, reduction of the hazardous substances during the products life cycle, improvement of the waste management, etc.

- **Environment program (EP)**

The EP will contribute to the realization of the following specific objectives:

- Promotion of the sustainable water management.
- Promotion of the transition to a circular and resource-efficient economy.
- Enhancement of the biodiversity, the "green" infrastructure in urban environment, as well as the pollution reduction.
- Promotion of the adaptation to the climate change, the risk prevention and management.

The investments will be focused on 5 priority areas – water, waste, biodiversity, risk and climate change and air.

The eligible measures, under the individual priorities, include infrastructural measures for water and waste; and in the waste priority measures are envisaged to prevent the generation of municipal waste, the preparation for reuse and repair, recycling, models for optimization of the municipal waste management process, awareness raising, etc.

Priority 4 "Risk and climate change" - the following measures are eligible:

- Measures for prevention and management of the risk of floods and droughts.
- Risk analysis and application of measures for prevention and protection in processes related to the movement of land masses – landslides, landslips, erosions, abrasions, etc.
- Measures aimed at increasing the readiness of the population and the capacity of the responsible forces in case of floods, fires and earthquakes.
- Development of new and optimization and/or expansion of the existing systems for warning, monitoring, reporting; forecasting and signaling; development of digital models and analyzes and forecasts related to climate change.

Priority 5 "Air" – continues to support the reduction of the air pollution from domestic heating – step by step replacement of the solid fuel heating appliances (priority in energy efficient homes). Measures for the introduction of low-emission zones are eligible; district heating promotion, promotion of the use of RES, hydrogen and other innovative alternatives, where applicable. Support will also be given to:

- Measures to reduce air pollution from transport – step by step removal of the high-emission personal vehicles by promoting electro-mobility, including with the building of infrastructure for alternative fuels in the main directions of the national road network; introduction of low emission zones, etc.;
- Measures to deal with the secondary dusting – green infrastructure in urban areas, incl. creation of "green belts/zones", street cleaning machines, etc.
- Improving of the AQ monitoring, incl. upgrade of the National AQ Monitoring System in real time and the Information System for AQ data reporting.
- Development/update of the strategic/program/planning/analytical documents connected with the air quality, conducting scientific research, forecasting and modelling.
- Training and information-educational measures.

Operations of strategic importance are the projects for gradual elimination of the use of solid fuel heating appliances, as well as the planned pilot investments in the heating systems using hydrogen technologies - as an alternative option for the domestic heating with solid fuels.

During the 2021-2027 programming period, the following **territorial cooperation programs** will be in force, in which SM is expected to be an eligible partner:

- Danube Transnational Cooperation Program.
- INTERREG Europe Program.
- 2021-2027 Transnational Cooperation Program "Euro-Mediterranean Area" (EURO MED program).
- "Balkans Mediterranean" Program for Transnational Cooperation.
- URBACT Program IV.

The demarcation in terms of funding between the individual programs has also been clarified.

Direct funding from the European Commission's executive agencies can be obtained under the EU's Research and Innovation Framework Program "**Horizon Europe**" for the period 2021-2027 - for demonstration projects, research and other activities in partnership with other European municipalities, research and innovative organizations.

Another program, which is considered to be the only EU fund, dedicated solely to the environmental and climate purposes is the **LIFE Program**. The overall objective of the proposed LIFE Program for the period 2021-2027 is to contribute for the transition to a clean, circular, energy efficient, low carbon and climate resilient economy, including through the transition to clean energy, in order to protect and improve the quality of the environment and stop and reverse the process of bio-diversity losses.

In July 2021 an updated draft of the **Plan for Reconstruction and Resilience of the Republic of Bulgaria** was published. Its main objective is to facilitate the economic and social recovery from the crisis caused by the COVID-19 pandemic. In pursuit of this goal, a set of measures and reforms are grouped that will make significant contribution to the restoration of the potential for economic growth and its further development, ensuring the resilience to negative externalities. This will allow the achievement of the strategic goal for economic convergence and incomes that reach the average European ones in the long run. At the same time, the plan lays the foundations for a green and digital transformation of the economy, in the context of the ambitious goals of the Green Deal.

The grant component of the EU under this plan is €6.2 billion or nearly BGN12 billion, and the goal is to at least double these funds through other mechanisms and the business involvement. The investments are in various components, including single- and multi-family buildings, street lighting,

renewable energy, design, construction and commissioning of infrastructure suitable for hydrogen and low-carbon gaseous fuels, digitalization, transport and mobility, etc.

In addition to the EU operational programs, grants can be provided through the **Financial Mechanism of European Economic Area** (FMEEA). In 2021 FMEEA opened procedures for financing the municipal projects for buildings with nearly zero-energy consumption and for use of geothermal energy for heating or for heating and cooling in the state or municipal buildings, for which 100% grant will be provided.

Partial grant funding for energy efficiency projects of municipalities, in which RES measures can be implemented, is provided by the **National Trust Ecofund** (NTEF) within the "Investment Program for Climate - Energy Efficiency". The grant is between 20-70% depending on the project.

The projects with the best financial indicators can be financed with loans from the **Energy Efficiency and Renewable Sources Fund** (EERSF) for example or by energy performance contracts with Energy Service Companies (**ESCOs**). EERSF offers preferential targeted loan financing to municipalities for energy efficiency and RES projects, assistance in the project preparation, as well as loan guarantees.

Preferential financing is also provided by the Fund for Local Self-Government Bodies in Bulgaria (FLAG Fund) which, in a joint credit line with the EIB, supports investments for the modernization of the urban green spaces and open public spaces; the improvement of the sustainable urban transport and renewal and reconstruction of the public buildings (schools, health centers, administrative buildings. In addition, the fund will focus its efforts to the modernization of basic small-scale municipal infrastructure (street network, drinking water, sewerage) and measures for climate change adaptation.

The Sustainable Cities Fund (in the frames of the Sofia Urban Development Fund) also provides funding for energy and climate projects. In Priority Axis 1 "Sustainable and Integrated Urban Development" (PA 1), the eligible activities are energy efficiency improvement in single-family residential buildings and student dormitories, development of environmentally friendly and sustainable urban transport, improvement of the urban environment quality, development of sports and cultural infrastructure, investments in areas with potential for economic development – construction and repair of business and industrial zones, technical infrastructure, etc. Priority Axis 6 "Regional Tourism" (PA 6) foresees investments in projects for tourism development related to the immovable cultural heritage of a "national or global value" category.

The European Climate-KIC program operates several sub-programs, mainly funding green businesses start-ups. This program also funds project proposals in the field of green business, technologies and innovations, as well as those aimed at adaptation to climate change.

In cooperation with research institutions in Sofia and the country, with which Sofia Municipality maintains close contacts currently, funding can be attracted through projects under the Scientific Research Fund, which is especially important in the context of some of the measures regarding the adaptation to climate change.

The financing of the measures from SECAP can also be carried out with funds from the municipal budget, the Specialized Municipal Privatization Fund and other sources; one of the measures in the current plan is a proposal for the creation of a new municipal fund for housing stock renovation.

The financial mechanisms and institutions of the European Union that can be used to implement the measures in the SECAP are:

- Invest EU Program (2021-2027) – brings together the variety of EU financial instruments, currently in support of EU investments, thus making the financing of the investment projects in Europe simpler, more efficient and more flexible.
- Sustainable Europe Investment Plan - this is the investment pillar of the Green Deal. The aim is to mobilize at least €1 trillion in private and public investments in

sustainable projects over the next decade through the EU budget and the related instruments.

- The European Investment Bank - the institution announced that it will turn into the Union's Climate Bank, gradually increasing the share of its funding for climate actions and environmental sustainability to 50% of its total operations volume in 2025.
- European Energy Efficiency Fund - provides funding in the form of public-private partnerships for energy efficiency projects, renewable energy and clean urban transport. Beneficiaries are municipal, local and regional public bodies or organizations acting on their behalf.
- ELENA - provides technical assistance grants to support programs with an investment over €30 million and three years implementation period. The initiative can cover up to 90% of all costs for technical assistance and project development, such as feasibility studies, market research, program structuring, business plans, energy efficiency audits and financial planning.

At the national level, other instruments can be used, such as credit lines, municipal funds, as well as the planned National Decarbonization Fund of Bulgaria.

### 3. Characteristics of Sofia Municipality

#### 3.1. General characteristics

##### 3.1.1. Geographical location

The territory of Sofia Municipality is located at 42<sup>04</sup> north latitude and 23<sup>09</sup> east longitude, occupying part of the Sofia Valley, as the last continuation of the Sub-Balkan Valleys to the west. The valley is located between the mountainous parts of Stara Planina to the north and northeast, Viskyar, Lyulin and Vitosha mountains to the southwest, Lozenska mountain to the south, and Vakarelska mountain and Belitsa ridge to the southeast. To the west the watershed, between the rivers Slivnishka and Gaberska and the Aldomirovski heights, separates it from the Burel valley, and to the east, the low Negushevski ridge separates it from the small Saransk valley. Within these borders the valley area is 1,180 km<sup>2</sup> and is the largest of all trans-Balkan valleys in Bulgaria. The Sofia valley has the shape of a trough with a long axis of 75 km from northwest to southeast and width that varies from 5 to 20 km. Its average altitude is 550 m. The valley foot is hilly and the Sofia field is wide and flat, where low hills rise. The foot of the valley rises to 700 m above sea level and is better expressed to the west of the Iskar River. The coefficient of morphographic closure of the Sofia valley is 0.62.

##### 3.1.2. Climate, trends and factors for climate change

###### Macroclimatic factors

The territory of Sofia Municipality falls entirely in the temperate-continental climate area of the country. Within this district, the municipality is located in the climatic region "Sofia Field". This location of the municipality determines the specifics of the part of its macroclimate, that is formed under the influence of the main factor of the macroclimatic zoning – *solar radiation* (respectively local latitude). It is dominated by the temperate air masses, combined with periodic influences of tropical and arctic air masses. The movement of air masses takes place in the system of *general atmospheric circulation*, with its Icelandic and Mediterranean minima pressure centers, as well as the Azores and Eastern European maxima. The Atlantic cyclones, emitted by the Icelandic minimum, put an imprint on the climate in the area towards the end of spring and the beginning of summer. Then the resulting cool air masses are

unstable, causing significant precipitations. Mediterranean cyclones intensify most often during the cold half of the year, with a maximum from December to January and can sometimes be the cause of secondary annual precipitation peaks for the region of Sofia Municipality. The Azores and Eastern European maximums are areas with high atmospheric pressure (anticyclones), the first of which is active round the year, and the second - in the cold half of the year mainly. Depending on the season, the weather in the anticyclone is dry, clear and cold in winter, and clear and warm in summer.

The macro-climatic situation and the general atmospheric circulation define the warm summer and cold winter, the big annual amplitude of the air temperature, the spring-summer maximum and the winter minimum of precipitation, and the annual, relatively stable snow cover as the most characteristic common climatic features on the territory of Sofia Municipality.

### **Local climatic factors**

The local physical and geographical factors are no less important for the climatic look of the municipality. The leading local factor is the hollow shape of the relief, which is an obstacle to the free circulation of the ground air and contributes to the lower minimum temperatures, higher temperature amplitudes, more frequent and lasting fogs, as well as more significant cloudiness. Another important physico-geographic factor of the local climate is the orographic influence of the surrounding mountains. Their slopes can appear in leeward or against the wind position, contributing to the corresponding decrease or increase of the precipitations. In addition, the mountain barriers affect the winds, transforming their structure, speed and direction. One of the typical examples of such a transformation in the Sofia region is the foehn, typical for the transition seasons mainly. The mountain winds (mountain north wind and mountain south wind) have a local character also, although of a very different generation mechanism than that of the foehn. In many cases, the mountains create orographic shading of the horizon in relation to the cities, located in their northern foothills. Such is the case with some neighborhoods of Sofia where Vitosha mountain can take about 2 hours from the natural sunshine daily duration (especially during the winter months).

### **Temperature parameters**

The air temperature in Sofia has an average annual value of 10.5<sup>0</sup>C. It is characterized by a well-defined annual course, with a maximum in July (average monthly around 21<sup>0</sup>C) and a minimum in January (average monthly 1.7<sup>0</sup>C). According to these values, the climate of Sofia falls into the categories of "cold" in winter and "very warm" in summer. During the transition seasons the climate is "cool", with an average monthly temperature of 10.3<sup>0</sup>C in April and 11.2<sup>0</sup>C in October. The average maximum air temperature follows the same annual course, but its values are higher than those of the average temperature; by about 2-3<sup>0</sup>C in winter, by about 5<sup>0</sup>C in spring and autumn, and by about 6<sup>0</sup>C in summer. Currently, the maximum temperatures often approach and exceed 40<sup>0</sup>C. The average minimum temperatures also follow the annual course of average temperatures, but are lower than them by about 4-5<sup>0</sup>C in winter, by about 5.5-6.5<sup>0</sup>C in spring and autumn, and by about 7.0-7.5<sup>0</sup>C during the summer. The minimum temperatures are related to the phenomenon of temperature inversion in a number of cases, which is a relatively more common phenomenon for the region of Sofia, largely due to its valley relief. The temperature amplitudes in Sofia are significant. The leading role in this play the valley relief and the temperature inversions, which cause large temperature deviations from their average values, mainly of the minimum ones. A combined result of the presence of temperatures below 0<sup>0</sup>C in spring (April and May) and autumn (September and October) in the air and soil are the frosts. In Sofia, the latest date of the last spring frost is May 22, the earliest autumn frost - September 9, and the average duration of the time free from frost is 184 days. The vegetation periods, with average daily temperatures over 5<sup>0</sup>C, over 10<sup>0</sup>C and over 15<sup>0</sup>C, last respectively 249, 194 and 133 days. The temperature sums accumulated for these periods exceed 2,500<sup>0</sup>C.



## Precipitation and humidity parameters

The average annual relative humidity in Sofia is 72%. In seasonal terms, following the opposite annual course to that of the air temperature, its highest values are observed in December and January (83% on average per month), and the lowest - in August and July (62% and 64%, respectively). The hours with relative humidity from 80 to 89% have the highest recurrence, and the hours with less than 29% – the lowest.

The fogs in Sofia are often provoked by the valley relief, which causes more frequent inversions and respectively – conditions for irradiative cooling of the air, as well as increase of the amount of condensation cores from air pollution in the city. The central part of Sofia is a place with a significant number of foggy days – 64 days a year, compared to the other nearby places (Bankya - 9.0 days a year, Simeonovo – 12.4, Gorni Lozen – 14.4, Vladaia – 18.2, Sofia/Hydrometeorological Service - 31). They are unevenly distributed throughout the year, with a significantly higher number in the cold half of the year. This season, the horizontal visibility of the "very good" and "good" categories decreases to 48% of all observations, at the expense of an increase in the cases of the "medium visibility" category – 22%, "reduced visibility" – 16% and "poor visibility" – 13%.

The average annual total cloudiness in Sofia is 5.8 points, with higher values in the cold half of the year. The months with the most significant cloudiness are December and January - with 7.3-7.4 points. The lowest values of cloudiness are in August – 3.4 points.

The annual amount of precipitation in the region of Sofia is 633.6 mm. Its internal annual distribution is characterized by one main maximum (June) and a less pronounced secondary maximum (November). There are also two minima – one main (February) and one well-defined secondary (September). The monthly number of rainy days follows to a large extent, but with some discrepancy, the monthly precipitation amounts. Heavy rains in Sofia were observed in 9 months of the year - from April to December. The number of days with such precipitation amounts to a total of 2.6 days on the average per year. The intensive rainfalls ( $\geq 30$  l/s.ha) are 252 cases per year, and those with an intensity of 30 l/(s.ha) – 51 cases and with an intensity of 200 l/(s.ha) – only 1.9 cases. With a 95% annual security, the maximum daily precipitation is 22 mm, and with the lowest probability of occurrence (2%) – the maximum daily precipitation of 71 mm. Hailstorming is most often observed in the period from April to July, while in the cold half of the year they are an exception. In Sofia the average annual number of hailstorming is 1.3. Their maximum annual number was in 2018 – 5 cases. Genetically related to the torrential and intense rainfalls, as well as hailstorming, are thunderstorms. Their maximum number is in May, June and July. Their average annual frequency in Sofia is 36.4, with a maximum number in 2018 also - 57 cases.

The number of days with snowfalls in Sofia is 34 on the average per year, and on days with rain and snow - 11 days. In total, this represents 26% of the days with all types of precipitations. The days with the greatest number of snowfalls are in January (10 days), February (8 days), December and March – 7 days each, and November – 2 days. Mixed precipitation of snow and rain (2-3 days on the average per month) is almost evenly distributed over the months from November to March. The snow cover in Sofia begins to form in the first decade of December, and the last snow cover disappears in the first decade of March. The duration of the period with snow cover, between its first and last appearance, is on the average 42 days. During this period it is volatile and melts several times. The number of days with a snow cover height of  $\geq 10$  cm is a total of 27. The maximum height of the snow cover was recorded in January – 65 cm. Stable snow cover (with a continuous duration  $> 30$  days) is formed only on Vitosha mountain, at an altitude above the belt of 1100-1400 m. The duration of the period with snow cover, between its first and last appearance, is 42 days on the average. In this period it is volatile and melts several times. The number of days with a snow cover height of  $\geq 10$  cm is a total of 27. The maximum height of the snow cover is recorded in January – 65 cm. Stable snow cover (with a continuous duration  $> 30$  days) is formed on Vitosha mountain only at an altitude of over 1100-1400 m.

### **Rainless periods, minor droughts, droughts**

For Sofia, the average annual duration of the maximum period without rainfalls is 10 days. Its longest duration is in October - 13 days, and in September – 12 days. From November to April the duration of the maximum periods without rainfall decreases to 9-10 days, and in May and June they reach 6-7 days. In Sofia, of all periods with droughts, the largest relative share is of those with a duration of 11-15 consecutive days (65%), followed by periods with a duration of 16-20 days (23%), those with a duration of 21-25 days (9%), and finally – those that last > 25 days (3%).

### **Wind parameters**

The average annual wind speed in Sofia is 2.6 m/s. Its annual amplitude is relatively weakly expressed – about 0.9 m/s. The highest average monthly speed is in February and March - 3.1-3.2 m/s, and the lowest in November – 2.3 m/s. The weak winds, with a speed below 1.9 m/s are with the highest relative share during the year. The percentage of the quiet weather is high – about 31%. The maximum wind speed, that can happen once a year, is 22 m/s, once every 5 years – 27 m/s, once every 10 years – 29 m/s, etc., and once every 100 years – 37 m/s.

The average annual wind direction in Sofia is with the highest frequency from the west (21.7%), from the east and southeast (18% each), and from the northwest (17.6%). This orientation of the winds is probably determined, not only by the active pressure centers and the nature of the atmospheric circulation determined by them, but by the morphographic factor also due to the corresponding orientation of the major axis of Sofia valley. These are the directions from which the strongest winds blow (> 14 m/s). The high percentage of quiet weather and light winds, as well as their high polarization around one axis in terms of direction (west-northwest – east-southeast), characterize the wind conditions in Sofia as unfavorable in terms of opportunities for the pollutants self-cleaning discharged in the air basin. To some extent this is compensated by the local winds, which are definitely concentrated around another axis - from north to south. Such winds are the foehn and the local mountain-valley winds.

The wind energy resource on the territory of Sofia Municipality is low. It is determined by the wind speed, according to which the territory of Bulgaria is differentiated into 4 groups: below 4 m/s, from 4 to 5 m/s, from 6 to 7 m/s, and over 7 m/s average annual speed. The territory of Sofia Municipality falls into the first group, with an average annual wind speed of 2.6 m/s, at the same time about 47% of the cases are with wind speeds below 1.9 m/s. This determines the wind energy resource in this area at about 100 W/m<sup>2</sup> at a height of 10 m above the ground, about 160 W/m<sup>2</sup> at 25 m, 200 W/m<sup>2</sup> at 50 m and 255 W/m<sup>2</sup> at 100 m. It should be noted that the technological advance makes production of energy at relatively low wind speeds possible. Generators with capacities from several kW to several tens of kW can be installed in areas with such small wind potential. Small wind turbines, combined with hybrid photovoltaic systems, can be a suitable investment for homeowners, farms, greenhouses, and small and medium-size businesses.

### **Solar parameters**

The sunshine in Sofia has an average annual duration of 2,065 hours, with a maximum in July – 302 hours and a minimum in December – 55 hours. The maximum value of the annual number of sunny hours – 2,699 hours, is reached in clear skies and high transparency of the atmosphere, with the highest sunshine in August – 354 hours. The number of days without sunshine has an opposite annual course with a maximum in December (15 days) and a minimum in July and August (with none days without sunshine). An important indicator of sunshine, especially for solar energy, is its continuous duration. During the cold half of the year, the continuous sunshine has a higher relative share with duration of no more than 6-8 hours. During the warm half of the year this duration reaches 12-14 hours.

The total solar radiation (direct & scattered) in Sofia has an annual value of 121.4 kcal/cm<sup>2</sup>. In its annual course, it marks a maximum in July (average monthly amount of 17.3 kcal/cm<sup>2</sup>) and a

minimum in December (average monthly amount of 3.3 kcal/cm<sup>2</sup>). The daily amount under average cloud conditions in July is 506 cal/cm<sup>2</sup>, and in December 88 cal/cm<sup>2</sup>. At cloudless skies, these values rise to 657 cal/cm<sup>2</sup> in June and 157 cal/cm<sup>2</sup> in December.

From a phyto-climatic point of view, the photo-synthetically active solar radiation is important. In Sofia its daily amounts reach an average of 323 cal/cm<sup>2</sup> in June, while in December they are decreased to 74 cal/cm<sup>2</sup> only.

The average annual energy potential of solar radiation on the horizontal surface in Bulgaria is differentiated into three groups: (1) below 1,450 kWh/m<sup>2</sup>, (2) from 1,450 to 1,500 kWh/m<sup>2</sup> and (3) over 1,500 kWh/m<sup>2</sup>. The territory of Sofia falls into the first group, with 1,186 kWh/m<sup>2</sup>. With an optimal slope of the receiving surface relative to the solar flux, this value increases to 1,318 kWh/m<sup>2</sup>, but remains in the group of the "low helio-energy potential".

### **Potential for the atmosphere self-cleaning**

The main meteorological factors on which the potential of atmosphere self-cleaning depends are its wind and precipitation-humidity parameters, as well as those characterizing its vertical stratification. Their evaluation is performed according to the methodology for scoring the stability of the geo-systems. The complex score of Sofia Municipality is 61.1%, score 2 – "moderately favorable" climatic conditions in terms of opportunities for the air basin self-cleaning.

### **Climate change**

Currently, views on the causes of climate change focus on the following two main groups of factors:

- Natural factors - changes in the parameters of the Earth's orbit and the Earth's axis inclination; changes in solar activity; dynamics in the distribution of land and water; volcanic activity; dynamics of the ocean currents; changes in the parameters of the naturally emitted greenhouse gases.
- Anthropogenic factors - the combustion of coal, oil and gas, leading to carbon dioxide and nitrous oxide emissions generation; deforestation (helping to regulate the climate by absorbing CO<sub>2</sub> from the atmosphere) and the wetlands draining (which heaps carbon at the bottom of the water basins), as well as the degradation or destruction of other ecosystems, accompanied by soil carbon release; increased livestock breeding that releases large amounts of methane in the process of digestion; production and use of nitrogen-containing fertilizers, which generate nitrous oxide emissions; release of fluorine gases, which have a very strong warming effect on the atmosphere.

Climate change is a global phenomenon with local dimensions. In Sofia, the most visible are the changes (regardless of their type) in the average and maximum air temperatures, the fog, the number of rainy days, the number of days with snowfall, storms and wind speed. Changes in the precipitation and hail are less noticeable. If the current climate change trends are maintained (RCP 8.5 scenario), without additional measures to mitigate and adapt to climate change, in the forthcoming decades the values of the climate elements will change according to our estimations as follows,:

- The average annual air temperature will increase by about 0.5°C-0.6°C per decade.
- The average maximum annual temperature will increase by about 0.9°C/decade.
- The annual number of foggy days will decrease by about 8 days/decade.
- The annual number of days with rainfalls will imperceptibly decrease at a slow pace - from 2.4 days/decade in 2030 up to 1 day/decade in 2100.

- The annual precipitation amount will decrease only noticeably, with a decreasing step - from 1 mm/decade in 2030 up to 0.4 mm/decade in 2100.
- The annual number of days with snowfalls will decrease with 1,6/decade.
- The annual number of days with storms will increase with rising rate – from 5 days/decade in 2030 to 10 days/decade 2100.
- The annual number of days with hail will increase, initially barely noticeable - by 0.4 days/decade in 2030, and then at an increasing rate – by 1.9 days/decade in 2100.
- The average annual wind speed will increase by 0.2-0.3 m/s per decade

According to the degree of the climate hazards manifestation on the territory of the municipality, and also in accordance the trend of their future manifestation by frequency and intensity, the exposure of the municipality to these hazards is determined in *Table 1*.

*Table 1. Exposure of Sofia municipality to climate hazards*

Climate hazards	Exposure	Expected change in intensity	Expected change in frequency	Period			
				By 2023	By 2030	By 2050	By 2100
Extreme heat	3	Increase	Increase				✓
Extreme cold	2	Decrease	Decrease				✓
Temperature changes	2	Increase	Increase				✓
Change in precipitation quantities	1	Decrease	Decrease				✓
Heavy rains	1	Without change	Without change				
Intensive rainfalls	3	Increase	Increase				✓
Reduction of snowfalls	2	Increase	Increase				✓
Floods	1	Without change	Decrease				
Droughts	2	Increase	Increase				✓
Storms	3	Decrease	Increase				✓
Hailstormings	2	Decrease	Increase				✓
Strong wind	1	Without change	Increase	Unknown			
Fogs	3	Decrease	Decrease				✓
Decrease of the atmosphere self-cleaning ability	2	Unknown	Unknown	Unknown			
Contrasting changes of weather	3	Increase	Increase				✓
Bio-climatic discomfort of people	3	Increase	Increase				✓
Landslides	1	Without change	Without change				
Fires (due to natural causes)	2	Increase	Increase				✓

From what has been stated so far we can conclude that the climate of Sofia has two main aspects that characterize its specificity: (a) impact of the local physiographic and anthropogenic factors and (b) presence of significant trends for change towards the future weather horizons of some of the major climatic parameters. The detailed knowledge of this specificity is important in terms of a number of sectors and economic activities for which the climate is important: urban environment and spatial

planning, energy, renewable energy sources, water sector, transport, construction, human bio-climatic comfort, health, tourism, forestry sector, environment and biodiversity, agriculture, etc.

### 3.1.3. Area, number of settlements and population

Sofia Municipality is located on an area of 1,311 km<sup>2</sup> and includes the city of Sofia, Bankya, Buhovo, Novi Iskar towns and 34 villages.

According to the data of the National Statistical Institute (NSI) as of 31.12.2019 the population of Sofia Municipality is 1,328,790, of which the urban population is 1,270,169.<sup>31</sup> A clear trend of increase of the population of the municipality and to the greatest extent of the city of Sofia is observed. The NSI population forecast shows that despite the projected total decrease in the country's population, the population of the capital will preserve a permanent trend of increase.

### 3.1.4. Basic sectors affected by climate change

#### 3.1.4.1. Waters

*The Natural water systems* on the territory of Sofia Municipality are represented by superficial and underground fresh and mineral waters. The valley of the Iskar River and its bigger tributaries, the rivers: Lesnovska, Blato, Kakach, Kremikovska, Perlovska, Slatinska and Vladayska and their tributaries, are an integral part of the urban environment. There are 18 dams on the territory of the municipality - Ivanyane 2, Mramor, Marchaevo, Bratinska, Kremikovtsi, Suhodol 2, Seslavtsi, Ubreshta 1, Ubreshta 2, Bistritsa, Primichur, Bagata voda, Stubela, Pancharevo, Kokalyane, Iskar and Filipovtsi. Quarry lakes have been formed around the villages of Negovan, Chepintsi, Chelopechene, Dolni Bogrov, Krivina, Kazichene, Gorublyane, Vrajdebna, Katina, Svetovrachene, the town of Novi Iskar, the Iskar and Druzhba residential estates and to the east - Sofia Airport.

The abundance of water resources on the territory of Sofia Municipality provides unique opportunities for socio-economic development and determines the availability of different types of *water systems with economic significance*:

➤ *Hydro-meliorative systems*

Two groups of hydromeliorative facilities are built on the territory of the SM:

- for prevention of the harmful effects of the waters - corrections of rivers and gullies and drainage fields;
- for irrigation.

By 2016 the "Irrigation Systems" EAD - Sofia Branch managed, about 2,780 ha drainage systems, 45 km of open drainage channels, 25 km of drainage pipelines, 3 drainage pumping stations and about 103 km river corrections<sup>32</sup> on the territory of SM. According to the same study, as of 2000, on the territory of SM there are about 5,180 ha of fit for irrigation areas, and the built up amount to about 775 ha.

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<sup>31</sup> NSI, *Population by districts, municipalities, place of residence and gender*

<https://www.nsi.bg/bq/content/2975/%D0%BD%D0%B0%D1%81%D0%B5%D0%BB%D0%B5%D0%BD%D0%B8%D0%B5-%D0%BF%D0%BE-%D0%BE%D0%B1%D0%BB%D0%B0%D1%81%D1%82%D0%B8-%D0%BE%D0%B1%D1%89%D0%B8%D0%BD%D0%B8-%D0%BC%D0%B5%D1%81%D1%82%D0%BE%D0%B6%D0%B8%D0%B2%D0%B5%D0%B5%D0%BD%D0%B5-%D0%B8-%D0%BF%D0%BE%D0%BB>

<sup>32</sup> According to the "Specialized support scheme with the location and structure of the drain and irrigation fields on the territory of Sofia Municipality" <https://92.247.80.179/Monitoring.aspx?AspxAutoDetectCookieSupport=1>

The existing facilities are in poor condition and are not functioning; part of them are state-owned and the rest are municipal and private property. The lack of an up-to-date registry of the hydro-meliorative facilities is a major obstacle for the development of a plan for their future management and use.

➤ *Correction of river beds*

The river correction is necessary for flood protection, urban planning and the city environment improvement. In the period 2009-2016 critical sections of the rivers Slatinska, Vladaya, Suhodolska, Vartopo and Shindra were corrected.<sup>33</sup> In the SM Strategy for the period (2017-2025) investments for the correction of sections of the Vladayska River, Dragalevska River, Mihailovska River, Kakach River, Bistrishka, Gnilyanska River, Sheovitsa and Adjibaritsa River are foreseen. Investments are also envisaged for the improvement of the constructive state of the existing corrections of the rivers Boyanska, Vladayska, Perlovska and Slatinska. In the central urban part, the corrections are usually made by concrete beds and thresholds, and beyond the urbanized territory earth dikes are built.

➤ *Hydroelectric power plants and energy potential*

There are two large hydroelectric power plants – “Passarel” HPP and “Kokalyane” HPP and a smaller one - "Pancharevo" HPP built at the "Iskar" hydro-power system on the territory of Sofia Municipality. On the route of the Rila Plumbing (“Beli Iskar” hydro power system) another 3 plants - “Simeonovo” HPP, “Beli Iskar” HPP and “Mala Tsarkva” HPP have been built. The total nominal power of the power plants is slightly below 85 MW.

Since the main purpose of the “Iskar” dam is to provide drinking and household purposes water, the production of energy from “Passarel” HPP and “Kokalyane” HPP is directly dependent/limited by the water quantity for drinking and household needs submitted to “Pancharevo” DWWTP.

There are studies of “Sofiyska Voda” AD for the development of the hydro-energy potential of the water supply infrastructure, according to which it is possible to build small Hydroelectric Power Plants with a total installed capacity of about 8.6 MW. At this stage, however, the hydropower potential of the water supply system is not defined as a priority for Sofia Municipality.

➤ *Water supply and sewerage systems*

The Water Supply and Sewerage sector is the most significant economic sub-sector. The population of Sofia Municipality is almost 100% supplied with water, but the sewerage network is still under construction. According to SM data, 17 agglomerations of over 2,000 equivalent inhabitants are defined within the municipality, and their connection to the sewerage in % is as follows:

№	Agglomerations	Sewerage (km)			Connectivity (%)	
		Total	Accepted	Not accepted	To sewerage	To WWTP
1	"Sofia-city"				91.85%	90.37 %
2	"Bankya"	72.73	54.25	18.48	56.00%	11.00%
3	"Novi Iskar"	55.76	16.60	39.16	56.00%	11.00%
4	"Voluyak"	5.26	0.00	5.26	0.00%	0.00%
5	"Krivina - Kazichene"	9.86	0.00	9.86	0.00%	0.00%
6	"Lozen"	27.93	0.00	27.93	0.00%	0.00%
7	"Botunets"	13.68	2.98	10.70	25.00%	0.00%
8	"Kremikovtsi - Seslavtsi"	16.72	5.12	11.60	29.00%	0.00%

<sup>33</sup> According to the "Strategy for Development of Engineering Infrastructure on the territory of Sofia Municipality", 2017–2025, <https://council.sofia.bg/municipal-news/>

№	Agglomerations	Sewerage (km)			Connectivity (%)	
		Total	Accepted	Not accepted	To sewerage	To WWTP
9	"Bistritsa"	14.90	0.00	14.90	0.00%	0.00%
10	"Pancharevo - Kokalyane"	10.30	0.00	10.30	0.00%	0.00%
11	"Bladaya"	23.19	0.00	23.19	0.00%	0.00%
12	"Buhovo"	6.89	0.00	6.89	0.00%	0.00%
13	"Chepintsi"	1.74	0.00	1.74	0.00%	0.00%
14	"Mromor"	12.13	0.00	12.13	0.00%	0.00%
15	"Busmantsi"	2.28	0.00	2.28	0.00%	0.00%
16	"Svetovrachane"	2.98	0.00	2.98	0.00%	0.00%
17	"Negovan"	0.00	0.00	0.00	0.00%	0.00%

The degree of connectivity to sewerage is not sufficient to comply with the requirements of Directive 91/271/EEC in none of the listed agglomerations.

The Iskar and Beli Iskar dams are the main water sources of the municipality. The water supply network, with a length of about 4,075 km, is predominantly gravitational; only the settlements in the peripheral zone are supplied by pumping stations (12). To increase the security of the water supply, 3 strategic pumping stations have been built (Buxton, Konyovitsa, Simeonovo), but they are not currently in operation. Before submission to the network, the water is treated in 4 purification plants – Pancharevo PPDW, Bistritsa PPDW, Mala Tsarskva PPDW (on the territory of Sofia Municipality) and Dolni Pasarelthe PPDW. There are about 285 differentiated water metering zones in the water supply network, through which the real-time control of water supply and physical water losses are carried out. Water losses are still too high. By 2019, the total losses amount to 42% of the water quantities supplied to the system, of which the physical losses share is 29%.

The sewerage network is predominantly mixed and gravity, with a total length of about 1,750 km. Water pumping is necessary in the northern and eastern parts of the city, and for this purpose 5 sewage pumping stations have been built. The collected wastewater is treated in Kubratovo WWTP (1,300,000 equivalent inhabitants designed capacity). The purification process involves the removal of organic carbon, nitrogen and phosphorus. The station is equipped with methane tanks for energy production from the excess biomass resulting from the technological process. There are another 3 treatment plants on the territory of Sofia Municipality - Voynegovtsi WWTP, Kremikovtsi WWTP (owned by First Investment Bank) and Brezovitsa WWTP (currently not in operation) whose capacity is uncompareable with that of Kubratovo WWTP. The main problems of the sewerage system are its incomplete construction, depreciated sewerage collectors, which mean significant infiltration, as well as presence of sections with insufficient hydraulic capacity.

➤ *Geothermal waters*

The geothermal waters in Sofia region belong to the renewable systems (reproductive reservoirs), i.e. they can be operated without reinjection of the used waters and without any ecological consequences. However, in case of large-scale use of this resource, it is necessary to assess the speed of its recovery and the possibility of returning to the earth bowels the water used for energy purposes. The geothermal springs are of local importance in the overall balance of the city. They can be used in the basic zone to cover the heat consumption, but cannot significantly affect its efficiency.

The use of the mineral waters and geothermal energy potential is laid down in the *Strategy for the Use of the Mineral Waters and Ground Heat (Geothermal Energy) Potential on the territory of Sofia Municipality*. According to the strategy, the total possible production from all reservoirs and



associated with them thermal water zones is estimated at about 500 l/s. The total recoverable amount of geothermal energy, expressed in heat capacity, is estimated at 48-50 MW. The mineral waters yield from the known deposits and water sources in Bankya, Gorna Banya, Knyazhevo, Ovcha Kupel, the center of Sofia, Pancharevo, Zheleznitsa, Nadezhda, Chepintsi, Svetovrachane, Kazichene - Ravno Pole and Dolni Bogrov does not exceed 80 l/s or 16% of the total potential of the Sofia hydrothermal basin. The amount of mineral water, that is actually used now (the data is as of 2017, when the strategy was adopted), is even smaller (not more than 20 l/s).

➤ *Impact of climate change*

The Natural water ecosystems and water management systems are directly dependent on climate change. A brief overview of the climatic hazards, with the most significant impact on water, will be reviewed below.

✓ *Temperature*

The temperature dictates the nature of the ecosystems and the physicochemical and biological processes in the surface water bodies. The high temperatures reduce the solubility of oxygen in water, accelerate the processes of anaerobic decay and worsen the chemical and microbiological parameters of the water sources. Seasonal peaks of phytoplankton are observed in the "Iskar" Dam, which cannot be classified as significant for the water quality at present; no toxic species have been identified.

The higher water temperatures, in combination with periods of drought, accelerate the process of evaporation from water reservoirs.

✓ *Precipitation*

The rainfalls can have beneficial effect on the water sources nourishing and refreshing, as well as cause processes of erosion and deterioration of the water quality and/or hinder the operation of the water supply and sewerage systems. The intensive rains, in combination with the predominant impermeable pavements, typical for the urban environment of Sofia Municipality, can cause short-term overload of the hydraulic capacity of certain sections of the sewerage network and local, short-term floods. Material damages are also possible.

The decrease of the total annual precipitation amount, combined with the average annual temperatures increase, has a negative effect on the useful water volume in the dams. At present, based on studies as of 2011, it is considered that "Iskar" Dam and "Beli Iskar" Dam can provide the necessary water quantities for Sofia Municipality with 100% security. However, it is recommended to perform an up-to-date assessment of the adequacy and security of the water supply from "Iskar" Dam and "Beli Iskar" Dam in the medium and long terms.

✓ *Floods*

There are areas in Sofia plain with a potential risk of flooding<sup>34</sup>. These are areas from the Iskar river valley, after the Pancharevo dam, to the confluence of Gostilya river; Blato river - from the spring to the confluence with Iskar river; Bankenska River - from the spring to the confluence with Iskar river; Vladayska River - from Vladaya to the confluence with the Iskar River, incl. the tributaries - Perlovska, Suhodolska and Slatinska rivers; Stari Iskar River - from the confluence of the Eleshnitsa River to the confluence with the Iskar River and the Makotsevka River.

The analysis of the data from the Flood Risk Management Plan (FRMP) and other sources of information shows that the percentage of the infrastructure facilities and buildings that could be

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<sup>34</sup> Detailed maps of the zones on the territory of Sofia Municipality with high potential risk of floods are given in the 2016-2021 FRMP.

affected by floods with a probability of once per 20, once per 100 and once per 1,000 years is relatively small (between 0.1% to 1.2%). Probably this is due to the fact that most of the riverbeds on the territory of Sofia Municipality have already been corrected and are with higher passability. Nevertheless, floods should not be underestimated. SM has developed a Disaster Protection Plan of Sofia Municipality, Part I: Flood Protection. The Municipality implements also an annual program for riverbeds maintenance activities on its territory.

#### ✓ *Droughts*

The long periods of drought have an extremely negative effect on the water systems by reducing the natural supply of water sources and deteriorating the quality of water in the reservoirs. This, in turn, can complicate the technological process of drinking water purification.

### ***3.1.4.2. Urban management, planning, spatial planning and development***

The urban planning sector<sup>35</sup> is the integrating sector in the local government, which covers the activities for the justification and regulation of the future mutual various activities locations in urban and rural areas in order to balance the individual and common interests. The sector covers strategic planning documents, structural regimes, and a set of measures and tools for the coordination of the spatial impact of the individual sectoral policies in order to achieve a favorable and even distribution of the economic and social development on the territory. It aims to achieve a rational territorial organization of the various ways of using the land and the links between them, as well as balancing the construction requirements with the need of environment protection in order to create conditions for the wide range of social and economic tasks of the social development.

The object of analysis of the “Urban Planning” sector are the urban factors influencing the existing and planned vulnerability and adaptability of the physical structures in Sofia Municipality<sup>36</sup> in relation to the expected climate change impacts. A comparison of the planned (through basic and additional planning instruments) and implemented so far urban measures for adaptation of the city of Sofia and the rest of the settlements in Sofia Municipality to the expected climate changes has been made. The available mapping of the vulnerable elements and parts of the physical settlement environment and key tangible assets, potentially endangered and assessed as risky on the basis of the spatial models for the risk of extreme weather events assessment has been studied. Recommendations have been formulated for the planning of measures and activities related to the structure, restoration and development of the city of Sofia and the settlements in Sofia Municipality with regard to the reduction of the vulnerability to climate threats and risks and the forms of interaction between the participants in the process. The main factors in the “Urban Planning” sector, related to the vulnerability of the urban system to the expected climate change and its capacity to adapt to them, include:

- Current state of the urban environment, technical and green infrastructure.
- Goals and priorities for the municipality spatial development management.
- Planning instruments and planning security at the strategic and operational levels (including for development and construction), as well as public works investments in tangible assets.
- Public participation in the processes of urban planning and management.

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<sup>35</sup> Using the term "spatial planning" instead of narrower "urban planning" would be in line with the terminology used and the wording in key documents at the global, European and national levels, as well as the need to cover all urban and non-urban areas within of Sofia Municipality in this report.

<sup>36</sup> The urban system of Sofia is considered in the scope of the territory of Sofia Municipality in its capacity of the main administrative-territorial unit in which the local self-government is carried out, according to Art. 2., para. 1 of the Law on Local Self-Government and Local Administration (LLSGLA).

The analysis examines the current state of the urban system as a result of the historical development and the implementation of previous development plans. The binding of the basic spatial characteristics (technical and green infrastructure, building stock, urban surfaces, types of activities, sources of pollution, etc.) with the peculiarities of the demographic and social characteristics of the city's residents (location of the basic vulnerable groups by age and social-economic status, etc.) have been traced to highlight spatially the places with increased vulnerability and relatively low adaptation capacity at present. The amendments of the urban system, envisaged in the current plans (GDP, DDP), or possibly caused by their application which would have impact on the adaptation capacity of the city and the municipality as a whole are reviewed.

### **3.1.4.3. Civil protection, disasters and accidents**

The main environmental impacts on the “Civil protection, Disasters and Accidents” sector in the context of climate change can be expected mainly due to fires and their impact on the environment as a major source of carbon dioxide. For this reason, the greatest attention is paid to the *fire* factor in the sectoral analysis and the attention is directed in two main directions:

- fires and their consequences; and
- ways of extinguishing and their consequences.

The “Civil Protection” sector develops in conditions of shortage of financial resources, trained staff, implementation of advanced technologies and staff capacity. Compared to other EU countries, the technological equipment of the sector is at an inadequate level – lack of modern control center, technological monitoring equipment, modern communication systems, etc. The existing Aerospace Center, which is related to the remote monitoring of fires and their consequences has shortage of software and hardware, trained staff and efficient communication to society. The summary analysis of the technical security and modernization of the fire safety departments and protection units is developed in the *Program for Modernization and Technical Security of the Territorial Units for Fire Safety and Protection of the Population in the Republic of Bulgaria from 2012*.

The social perception of the sector's activity is at a very good level. The population estimates the management efforts, the rapid response to crisis situations (floods, fires, land slides, etc.), the communication of the managers with the media, and the efficiency as a whole. However, the reaction of the population and the efficiency of the civil protection in extreme crises - explosions of ammunition depots, mass fires, chemical accidents, severe earthquakes, prolonged drought, prolonged rainfalls leading to floods, possible rupture of dam walls along the Iskar river cascade, etc. remains unknown. An essential component is the correct and timely communication with the media, the social networks and other high-tech media for information transfer. The technologies related to the society development and the administrative capacities of the sector are conservative and slowly changing. This leads to a relatively stable trend of gradual and slow change in the number of fires. Other extreme phenomena in the sector are characterized by relatively low recurrence of high intensity (e.g. earthquakes). Earthquakes are very often source of secondary negative phenomena such as landslides, ruptures of the earth crust, destruction and many fires. In this sense, the early warning systems development can be useful, especially if the gas distribution network, the chemical plants, the thermal power plants, etc. are equipped with automatic circuit breakers. However, these systems are expensive and with low-performance, and strong earthquakes are rare in our country. However, the establishment of monitoring systems for monitoring and management of the risk phenomena is essential for the efficiency increase of the “Civil Protection” sector.

Another important direction of the highly efficient activity of the sector is the use of various scenarios simulating real situations (i.e. modelling of the dangerous phenomena and processes using real data), verification and correction of the mistakes made.

The use of coordination remote monitoring systems (drones, low-orbit and high-resolution satellites, real-time GIS, GPS devices, high-speed internet, etc.) is essential for the modernization of the civil protection in its fight with the climate risks.

The firefighting technologies are developing more dynamically recently. The widespread use of foams, carbon dioxide mixtures and other similar substances burden the environment with greenhouse gases. Unfortunately, the control of the carbon dioxide and the other toxic gases is virtually impossible in the event of fire that has already broken out. In this sense, the prevention is a major factor, but is an expensive and difficult to manage activity.

#### ***3.1.4.4. Environment and biodiversity***

On the territory of Sofia-city and Sofia-region are presented eight of the nine ecosystem types that occur in Bulgaria (except the marine). About 30% of the territory is occupied by protected areas and territories. 972 species and habitats are protected, as well as natural landmarks and individual sites, incl. old trees. With the exception of the NATURA 2000 zones, the rest of the protected areas are very small and highly fragmented, which makes their conservation difficult in the long run.

The boundaries between the places of the ecosystem services creation - most of the territory outside the settlements and the places of their use (demand) - the settlements, among which the city of Sofia is structure determining, are clearly outlined. The characteristics of these two parts of the territory in question are very different in terms of population, economic and social characteristics.

For the purposes of the SECAP analysis of the demand and supply of ecosystem services approach was used - the benefits of nature, many of which are key for the adaptation (such are the regulatory ecosystem services of the classes: Erosion control, Buffer and Regulation of the mass movement, Regulation of the hydrological cycles and water flows (incl. flood control and riversides protection), Fire protection, Wind protection, Temperature and humidity regulation, incl. ventilation and transpiration; as well as the material service from the groups: Surface water for food, materials and energy and Groundwater for food, materials and energy, hereinafter referred to as Water supply. Many of these services have no market currently or are only partially subject to market transactions and their evaluation is at an early stage. For this reason, we give here a brief description of the two elements of the socio-ecological system: creation of ecosystem services from the natural capital in and around Sofia; and use of ecosystem services by the residents of Sofia and the smaller settlements in the district.

#### **Creating ecosystem services:**

The predominant ecosystems in the protected areas and territories are forests; there are also forests outside the protected areas and territories in the northwestern and southwestern part of the territory. The forests are among the most important net carbon sinks and in this sense they are important for the climate change mitigation (ecosystem services from the groups "Biomass" and "Soil formation and soil composition improvement"). In terms of adaptation, they provide services from the groups "Air and gas flows" and "Fluid movement" (important for the mitigating of the heat islands effects), "Disease and pest control" and "Water status". To a lesser extent, most of these services are also provided by the grassland ecosystems and shrub and the ericoid ecosystems, which are the next most important net providers of regulatory ecosystem services. Grass ecosystems and agro-ecosystems are among the important sources of biomass for food security and livestock breeding.

#### **Consumption of ecosystem services:**

The main part of the population is concentrated in the city of Sofia, which leads to a significant deterioration of some of the characteristics of the urbanized city ecosystem. According to the City Atlas data of the Copernicus Program for 2012, territorially adjusted according to the established urban ecosystem scope, the areas with a high degree of sealing (built-up areas with over 50% sealing,

road and airport infrastructure) in Sofia make up about 26% of the urbanized area but they are home to over 85% of the population. The analysis of the “Urban Planning” sector shows the significant spatial coverage of the heat islands areas, their strong correlation with the soil sealing and the large number of high risk population (over 438,000 inhabitants) and medium risk population (nearly 374,000 inhabitants). Additional pressure on the urban environment is exerted by the visitors periodically coming to the city for work or once for tourism, which significantly increases the city's population, especially during the day (according to NSI data Sofia's population was 1,242,568 in 2019, but according to other estimates, the city is inhabited by about 2,000,000, i.e. the share of newcomers is about 38%).

#### **Mechanisms for providing ecosystem services:**

In the districts of Sofia and Sofia-city, most of the ecosystem types are net providers of ecosystem services, whose consumption - where available - takes place outside the ecosystem. Particularly important in this regard are the water supply zone of the Iskar River and the green wedges of Sofia, which support the city's climate regulation through the ventilation provided, but are also vital elements of the ecological connectivity of the large urban parks, supporting the maintenance of the urban biodiversity. The visual inspection of the suburban areas outside Natura 2000 also shows the presence of a number of linear elements (mostly on the boundaries between the individual cultivated plots, along the roads and the water basins), which create a precondition for the conservation of the field biodiversity and can serve as a basis for the ecological cohesion, which is the goal of the European strategy documents until 2030.

In turn, the urban biodiversity is a source of important ecosystem services that are used at the site of their creation or in the immediate vicinity. Such are microclimate regulation, FFPs reduction and flood protection in urban environments. The level of provision of these services depends not only on the availability of green infrastructure in the places of consumers concentration, but also on whether the existing green infrastructure is in sufficiently good condition to allow it to bring the desired benefits or mitigate the adverse impacts.

The virtually missing wetlands, which could provide important ecosystem wastewater treatment services, but act as climate control areas as well, flood retention volumes and sites for the provision of the "Outdoor Recreation" cultural ecosystem services, create unrealized potential for adaptation.

#### **3.1.4.5. Waste**

The European policies for adaptation to climate change in the “Waste” sector are focused on the prevention and minimization of the waste, resource recovery and drastic reduction of the landfills. Separate collection and recovery of the biodegradable waste is key to the methane and CO<sub>2</sub> emissions from the landfills limiting and the climate impact mitigation.

Sofia Municipality is an independent region for waste management according to the 2014-2020 National Waste Management Plan. The planned costs for waste management activities for 2020 amount to BGN 217,2 million, of which: BGN 67 million for waste collection and transportation; BGN 60,2 million for research, design, construction, maintenance, operation, closure and monitoring of the landfills or other installations or facilities for disposal, recycling and recovery of the municipal waste, incl. the deductions under Art. 60 and 64 of the WMA; BGN 85 million for public places cleaning and BGN 4.8 million for others, incl. control activities. The municipal waste fee for physical persons is determined on the basis of the real estate tax assessment, and legal entities are given the opportunity to pay the annual municipal waste fee for two of the services based on the generated amount of waste.

The NSI data for 2018 show that the total amount of the generated municipal waste on the territory of Sofia Municipality amounts to 662,987 tons, of which 539,439 tons of the municipal waste submitted for preliminary treatment, 82,267 tons of the municipal waste submitted for recycling, and

the directly deposited household waste is 21,281 tons only. The norm for totally generated municipal waste in kg/inhabitant/year is 500 kg for 2018. The collection of mixed household waste is organized on the whole territory of the municipality and is assigned under the Public Procurement Act (PPA) to companies holding a permit under Art. 35, para. 1 of the WMA. Sofia Municipality has concluded contracts with OUPWs and introduced schedules for separate collection of the 6 groups of widespread waste, and is also expanding its activities with regard to the textile waste. This contributes to the achievement of the recycled waste amount per capita/year twice the national average and meets the recycling targets. In 2017, Sofia Municipality achieved a recycling rate of 56%, and in 2018 the recycling rate increased to 64% in result of the increased efficiency of the measures, such as the larger number of containers for collection of recyclable waste. Separate collection of bio-waste has been introduced in schools, kindergartens, large shopping centers/malls, grocery chains, hotels, pizzerias, restaurants, fast food restaurants, markets, small sites offering fresh fruit juices, fruit and vegetable stores, markets; separate collection of green waste has been introduced for public parks and gardens; free home composting containers are provided.

The treatment and disposal of the collected household waste is carried out mainly by the *Sofia Waste Treatment Enterprise*, which operates:

- The Biological Treatment Plant (BTP), "Khan Bogrov" site, with a capacity of 24 thousand tons/year, where separately collected bio-waste enters for anaerobic decomposition of the food waste; and an installation for composting green waste with a capacity of 20 thousand tons/year.
- A Plant for Mechanical-Biological Treatment (MBT), "Sadinata" site, and production of RDF-fuel with a capacity of 180 thousand tons, which receives the collected mixed household waste. A landfill for non-hazardous waste and a WWTP have been built on the same site.
- The closing down and reclamation of the "Suhodol" and "Dolni Bogrov" landfills for non-hazardous waste, as well as the maintenance, monitoring and post-operational care for both sites are carried out by "Sofekostroi" EAD, a sole proprietorship of Sofia Municipality.

#### 3.1.4.6. Buildings

The analysis of the data from the cadastral map of Sofia, including the buildings built-up area and the number of storeys, allows to determine the approximate total built-up area of all existing buildings, which is about 103,9 million square meters. The predominant part of the buildings in Sofia are residential with a total area of about 67,7 million sq.m. The largest is the share of the multifamily residential buildings with a total area of 51,4 million sq.m., the single-family residential buildings have a total area of 12,77 million sq.m., and the buildings with mixed purpose, but predominantly for residential needs, (mainly residential buildings with shops and offices on the ground floors) have a total area of 3,8 million sq.m. All buildings in the services sector, regardless of their purpose and form of ownership, have a total built-up area of 15,76 million sq.m. The total built-up area of the buildings, entirely municipal property, is below 3%, and that of the buildings wholly state-owned - just under 4% of the built-up area of all buildings.

The new buildings construction in Sofia is developing at an increasing pace. According to NSI data, in the period between 2014 and 2019 the construction of more than 3,600 new buildings has started. The residential buildings are predominant again, with strongly expressed growth trend (about 60% average growth in the number of new constructions per year in the period 2014-2019), while in the other groups of buildings for which data is available - administrative and "other" buildings, the growth is relatively small. The same new buildings construction growth trend is observed in the total built-up area by types of buildings. In the residential buildings, there is a tendency of increase of the new buildings average built-up area (almost twice the average built-up area of the new residential buildings

in 2019 compared to 2014), which is reflected in a higher average number of dwellings under construction in new buildings in the individual years, as well as in a larger average built-up area of the new residential buildings over the years (nearly twice the average number of the dwellings in the constructed residential buildings in 2019 compared to 2014).

The expected introduction and practical application of the mandatory requirement that all new buildings should meet the national definition of buildings with nearly zero-energy consumption implies the introduction of different from the traditional approaches in construction, higher quality construction, use of new materials and modern installations in the new buildings. According to some specialized assessments, the construction sector is not prepared for this process; and the lack of staff with the necessary qualifications, as well as the training programs for acquiring such qualifications will be strongly felt. This is even more relevant when sustainable or "green" buildings are constructed, where the innovations and the specific requirements for the construction process and the buildings are even higher.

The market trend of growth of the number and size of the homes in new residential buildings is dictated by the desire for optimization of the investors' profits, as the price of the land is a very important component in the cost of the building. On the other hand, this is a favorable limitation of the potential cost of the construction related to the achievement of high levels of energy efficiency and ensuring a significant share of renewable energy production, as well as the possible fulfillment of other "green" criteria, as it will be distributed among a larger number of home buyers. Meeting the high efficiency and environmental friendliness of buildings criteria will significantly reduce the energy and maintenance costs compared to those of the traditional construction, which should be taken into account both in the commercial offers for buildings and in the bank lending conditions negotiations for the purchase of highly efficient housing.

According to the data of NSI, the total area of the new construction on the territory of Sofia Municipality is a little over 5.5 million sq.m. for the last 9 years. Considering the pace of new construction, it can be concluded that over 90% of the buildings were built before the beginning of the 21st century, when significant regulatory requirements, regarding the energy efficiency of buildings were not present. This means that the renovation of the existing buildings is an opportunity with great potential for the future development of the sector on the territory of Sofia Municipality.

In order to achieve a "deep" energy renovation of these buildings, all economic conditions listed above must be met, which are also valid for the new construction. In addition, it is necessary to change the conditions of the funding programs both in terms of requirements for the renovation results and in increase of the owners' participation share; and in multifamily residential buildings by applying differentiated funding conditions for the different social groups.

So far, the renovations of the state and municipal buildings have been mostly carried out with grants from the EU operational programs, while the residential buildings have been renovated mostly with funds from the National Program for Energy Efficiency of Multifamily Residential Buildings (NPEEMFRB) mostly. There are a considerable number of other renovated residential buildings in Sofia, but apparently information about these renovations has not been submitted to SEDA by the owners of the buildings.

The role of the municipality in the buildings sector is mainly related to the bringing its building stock to the highest possible levels of efficiency and environmental friendliness, which should be adequately communicated to the society in order to serve as an example for the private building owners, as well as to exercise a strict control over the application of the highest regulatory requirements in the building construction. Last but not least, the role of the municipality is of great importance for the information dissemination about the requirements for the buildings performance and especially about the benefits of the highly efficient and environmentally friendly construction.



### 3.1.4.7. Agriculture and forestry, landscaping and land

The “Agriculture and Forestry, Landscaping and Land Use” sector is dedicated to the natural resources and the human activities in the non-urbanized territories of Sofia Municipality and the urban environment green components. It is directly related to the complex interests in the land use and finding the balance between the economic activities, conservation of biodiversity, provision of key components for the population’s quality of life. Characteristic for the sector is that its decisions affect the long time horizon to a large extent. Within the Sofia Municipality, the forest territories occupy 37.7% of the territory, the arable lands - 27%, the landscaping territories, including the special green areas - 7%. A high percentage of the landscaping is also available in the villa areas. As a whole, they all perform a number of ecosystem services that have a great, but often underestimated effect, on the overall quality of life in Sofia Municipality. The management of these territories requires the coordination between different institutions and the owners in most cases. Within the frames of Sofia Municipality, large areas are occupied by four Natura 2000 Protected Areas declared under the Habitats Directive, three Natura 2000 Protected Areas declared under the Birds Directive, two reserves, the “Vitosha Nature Park”, eight protected areas, two natural landmarks that territorially overlap partially or completely. The ownership of the forest territories is mostly state and to a lesser extent municipal, while the agricultural lands are mostly private.

Forest and agricultural areas have an extremely important role to play in relation to climate change mitigating as a major carbon sink. At the same time, they are extremely vulnerable to climate change. The expected more severe summer droughts, the likelihood of an increase of extreme weather events and phenomena, are with potential to have a significant impact on the forest vegetation, crops and urban landscaping. While some climate changes may play a positive role, most of them are associated with possible negative effects. This requires the establishment of systems for efficient monitoring of the processes in the forest and agricultural areas and green spaces and taking of well-planned measures to adapt and mitigate the negative effects of climate change. This will allow the sector to continue to perform the expected favorable functions in terms of regulating the environmental conditions and ensuring a high quality of life for the population of Sofia Municipality.

#### ➤ *Biomass for energy purposes and bio-fuels*

The use of biomass for energy purposes on the territory of Sofia Municipality is estimated at 981.37 TJ (272,603 MWh) in 2018 (in the range of the sectors included in the 2012-2020 SECAP - Source: Inventory of greenhouse gas emissions in Sofia Municipality), which makes 1.9% of the fuel and electricity consumption in the year of the survey. Mostly firewood is used, but with the implementation of projects for the replacement of the wood and coal heaters the use of pellets and the replacement of wood burning with other fuels (natural gas) and electricity (for heating with heat pumps) is expected to increase.

Local source of forest biomass is the municipal forest fund and the municipal parks of Sofia Municipality and a feasibility study for its utilization has been conducted. The total area of the municipal forests is 8,272.0 ha, of which 4,604.6 ha are afforested. Within the boundaries of the “Vitosha” nature park, owned by Sofia Municipality, are included 856.2 ha of forests. The peculiarity is that on the territory of Sofia Municipality all forests have a special purpose (Source: General Development Plan: water protection, anti-erosion, reclamation, recreational and other forests and 7,203 ha of forests in protected areas), which reduces their economic importance, but does not exclude the utilization of the forest biomass for energy purposes if obtained under the forest management plans.

Sofia Municipality has developed a *Management Plan for the forest territories managed by Sofia Municipality within the scope of TD "DGS Sofia"* (Commercial Enterprise “State Forestry Enterprise Sofia”), *TD "DLS Vitinya"* (Commercial Enterprise “State Hunting Enterprise Vitinya”), *TD "DLS Iskar"* and

TD "DGS Samokov"<sup>37</sup>, which includes the forestry activities and the related economic activities for a period of ten years, from 01.01.2019 till 31.12.2028. The assessment, made in the plan, is that the yield of the ME "Municipal Lands and Forests Management" satisfies to a large extent the needs of construction timber of the municipality users and largely satisfies the needs of the local population for firewood. In the 10-year plan from the intended for felling 118,770 m<sup>3</sup> standing mass (with branches) is expected to be obtained 43,230 m<sup>3</sup> firewood and 21,875 m<sup>3</sup> waste wood, respectively 36.4% and 18.4% of the total amount. The energy equivalent of this amount of biomass is about 160,000 MWh for the period of 10 years or about 5.7% of the biomass needs while preserving the consumption in comparison with 2018.

According to the 2020-2022 PPUERSB of SM, in the transport sector as part of its policy for clean air, Sofia Municipality is working on the implementation of measures to reduce the use of traditional fuels and their replacement with electricity and natural gas. The share of bio-fuels, as part of traditional fuels in transport, is regulated by the national legislation.

### 3.1.4.8. Transport

Transport, due to its specific nature, is characterized by direct exposure and dependence on the natural and geographic conditions, including climatic factors and risks. With its infrastructural predetermination, the vulnerability of the transport to climate risks is assessed in two main aspects - vulnerability of transport infrastructure and maintenance, operation and safe operation of the transport systems (services).

The main conclusions concerning the transport sector in the report of MoEW from 2014 "Analysis and assessment of the risk and vulnerability of the Bulgarian economy sectors to climate change" are that in general the transport sector can be classified as very resistant to climate change until 2035, but the capacity for adaptation is insufficient. The high resilience of the transport sector is due firstly on the expected moderate climate changes by 2035, and secondly to the fact that the transport system is designed and built taking into account the local climatic condition.

The adaptation to climate change in the Sofia Municipality transport sector will lead to improved resilience of the transport infrastructure and services to climate change. The proposed adaptation measures are aimed at building the adaptation capacity of the transport system serving the municipal territory, as well as the implementation of specific adaptation activities in the sector.

Transport also plays an important role for the climate change mitigation measures, namely by limiting the greenhouse gas sources. In 2018 20.4% of the greenhouse gas emissions on the territory of Sofia Municipality were due to the transport sector. The Sustainable Urban Mobility Plan until 2035, adopted in 2019, defines as its first common goal – the negative impact of transport on human health and the environment reduction. To achieve this goal, the plan provides for the implementation of the following policies:

- Stimulation and promotion of pedestrian and bicycle traffic.
- Stimulation of the development and use of ecological public transport (metro, trams, trolleybuses, electric buses, railway transport).
- Stimulation of the purchase and use of electric vehicles, accelerated construction of charging infrastructure.
- Reduction of the private cars use, stimulation of the shared mobility.
- Renovation and enhancement of the ecology of the car park.

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<sup>37</sup> Sofia Municipality, *Forestry plan of the forest territories managed by Sofia Municipality within the scope of TD "DGS Sofia", TD "DLS Vitinya", TD "DLS Iskar" and TD "DGS Samokov", Sofia Municipality, 2019*  
<https://air.sofia.bg/media/Documents/%D0%93%D0%BE%D1%80%D1%81%D0%BA%D0%BE%D1%81%D1%82%D0%BE%D0%BF%D0%B0%D0%BD%D1%81%D0%BA%D0%B8%20%D0%BF%D0%BB%D0%B0%D0%BD.pdf>

The main indicator for the achievement of the set common goals is 80% of all trips on the territory of Sofia Municipality in 2035, to be performed with sustainable means of transport (pedestrian, bicycle, public transport), and only 20% with personal cars.

#### **3.1.4.9. Tourism**

In the last 10 years (until 2019) the tourism sector in Sofia is developing with a general upward trend. The number of beds in accommodation establishments is increasing, which is accompanied by an increase in the number of overnight stays and the income from them as well. In addition, Sofia Municipality is emerging as one of the leaders in the tourist sector in Bulgaria, along with the Black Sea coast and the mountain resorts. According to NSI data for 2019, 3.5% of the accommodation facilities (129) and 3.7% of the accommodation beds in Bulgaria (12,619 beds) are located in Sofia. In 2019, the capital was visited by about 1.16 million tourists with at least one night stay, of which 68% were foreigners. The total number of realized overnight stays is about 2 million (71% by foreigners), and the revenues from them amount to BGN 167 million (80% by foreigners). Until the pandemic beginning, the tourist sector in Sofia accounted for approximately 3% of the city's economy and directly employed about 5% of the working population (35-40,000 persons).

In March 2020, after declaring a state of emergency, related to the COVID-19 pandemic, 6% of the accommodations were closed down (5% decrease in the number of beds), and in April - 57% of them (46% decrease in the number of beds). In May 41% (also 41% decrease in beds in operation) did not function, and in June - 19% of the accommodations (with 13% decrease in beds). The commented indicators predetermine the similar significant recession of the revenues from overnight stays also, which is the largest in April (94%); in June the recovery is very weak and their amount is with 83% lower than that in the same month of 2019.

The functions of the organization for tourist destination management of Sofia Municipality are performed by the ME "Tourism" as a specialized unit of the municipal administration, which provides and supports the Sofia Municipality Mayor's activities in the fulfilment of his powers under the Tourism Act and the issued on its basis regulations. Sofia Municipality, respectively the ME "Tourism", will play a leading role in the established Organization for Management of the Sofia Tourist Region, based in Sofia.

Climate has the greatest influence on the various types and forms of tourism of all natural components. All tourist activities are performed in a specific air environment, with characteristic microclimatic elements (bio-climate). Of all natural components, the climate has the greatest influence on the various types and forms of tourism. Very important for the practice and for the general physiological state of the person are not only the individual climatic elements, but their manifestation in unity at a given moment or during a given day. The analysis of the sensitivity of tourism to climate change and the degree of Sofia region vulnerability shows that the sector is sensitive and vulnerable to all identified climate hazards related to climate change and the accompanying extreme phenomena, but especially to the reduction of snowfall and droughts (for the ski tourism on Vitosha mountain), as well as to the extreme heat and cold, the heavy rainfalls, the floods and the contrasting weather changes. In addition, climate has a major impact on the operating costs of the tourist businesses, such as heating, cooling, snow removal, irrigation, food, water supply and insurance costs.

#### **3.1.4.10. Human health**

The "Human Health" sector is particularly important when it comes to monitoring the effects of climate change on the local communities. Climate change will affect the lives of the citizens of Sofia Municipality, therefore it is extremely important that the activities envisaged in the plan are especially focused on the public health protection and improvement of the municipality inhabitants quality of life.

Climate change will provoke new health risks and deepen many of the already existing. Human health will be endangered by both direct and indirect mechanisms. The direct impact of climate change is associated with changes in the frequency and intensity of extreme weather events, such as heat waves and floods. The indirect effects include changes in the frequency and prevalence of diseases transmitted by vectors such as mosquitoes, ticks and rodents, as well as changes in water, air and food quality.

The only million city in Bulgaria, Sofia, fully experiences the challenges and problems of urbanization, some of which are related to the more specific vulnerability of the population to climate change. The numerous, densely disposed population is particularly vulnerable to extreme hot weather, for example, and in central urban areas, for which the phenomenon "heat island" is characteristic, the risk is particularly high in such periods. A study, comparing the death rate from different weather hazards in Europe shows, that Eastern Europe has the highest number of human casualties from cold and heat waves<sup>38</sup>. And while the climate warming is expected to reduce the frequency and duration of the cold waves (in addition, the municipality is currently taking measures to protect the vulnerable groups in cold weather), the impact of the hot weather on health is relatively underestimated at this stage. With the projected increase in the frequency, duration and intensity of the hot waves in warming climates, adaptation measures should be taken in this area, especially since the large group of people with chronic cardiovascular and lung diseases is the most affected; and the cardiovascular diseases are the leading cause of deaths in the country. The group of vulnerable residents includes also the little children, the elderly people, the pregnant women, the marginalized population, people at risk of poverty and social exclusion, etc.

Viewed from another angle, given the many political and socio-economic advantages, Sofia Municipality has opportunity to implement measures to adapt to climate change in the health sector to the greatest extent, compared to the other municipalities in the country. The health care system in Sofia Municipality is well developed and covers the health care needs of the population. The region is the best supplied in terms of technology, science and personnel; the qualification of the working in the healthcare sector is the highest one in the country. The level of financial well-being of both the municipality and the average resident of the capital is higher and is directly related to the opportunities for adaptation to the adverse weather phenomena. The level of the citizens' education as a factor for the adaptation to climate change, the opportunities for interaction with the national institutions, media and civil society organizations are also a favorable factor for future activities in this direction.

The analysis of the sensitivity to climate change and the degree of vulnerability of the Sofia Municipality region shows that the sector is sensitive and vulnerable to all identified climate hazards related to climate change and the accompanying extreme phenomena, but especially to extreme heat and cold, intense rainfalls, storms, fogs, contrasting weather changes and bioclimatic comfort lowering.

## 4. Climate change mitigation

### 4.1. Scope determination

According to the GHG emissions inventory of Sofia Municipality for 2018, prepared in connection with the implementation of the 2012-2020 SEAP, by this period the municipality has achieved 18.2% reduction of the emissions compared to the 2007 base year. For the 2007 base year the total GHG emissions level of the sectors, included in the SEAP scope, is 5,672 thousands tCO<sub>2e</sub>, and for 2018 – 4,639 thousands tCO<sub>2e</sub>.

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<sup>38</sup>European Environment Agency (EEA), 2017. *Climate change, impacts and vulnerability in Europe 2016 An indicator-based report*. EEA Report 1/2017, EEA Copenhagen

Table 2 presents the summarized results for all sectors included in the GHG emissions inventory for the 2007 base year, the calculated adjusted GHG emissions for 2007 relative to the population growth and the reported GHG emissions for 2018.

Table 2. Summary of the total amount of GHG emissions by sectors for the 2007 base year, with possible adjustments by population for 2007 and 2018

Sector	GHG emissions, thousand tCO <sub>2e</sub> , 2007	GHG emissions, thousand tCO <sub>2e</sub> , 2018	Change in GHG emissions in 2018 compared to 2007	Share of GHG emissions in 2018
Residential buildings	2,270.1	1,722.8	24.1%	37.1%
Tertiary sector	608.6	638.5	-4.9%	13.8%
Municipal buildings	69.4	45.5	34.4%	1.0%
Outdoor lighting	24.1	20.8	13.6%	0.4%
Industry and construction	1,693.0	1,031.5	39.1%	22.2%
Agriculture and forestry	11.2	7.3	34.5%	0.2%
Accidental emissions	31.7	22.9	27.8%	0.5%
Road transport	798.7	947.2	-18.6%	20.4%
Railway transport	17.3	10.4	39.9%	0.2%
Aviation	0.5	0.5	0.0%	0.0%
Waste	147.8	190.3	-28.7%	4.1%
<b>Total</b>	<b>5,672.4</b>	<b>4,637.8</b>	<b>18.2%</b>	<b>100.0%</b>

\* The reduction is calculated by comparing the emissions for 2018 with those for the 2007 base year

According to the rules of the GCMCE, the mandatory sectors are: "Residential buildings", "Tertiary sector", "Municipal buildings" and "Transport". The very presence of sectors in which no emission reductions have been registered so far, such as "Tertiary sector buildings" and "Transport", but there is an increase on the contrary, as well as their high relative shares in the total GHG emissions for 2018, makes the task of reducing GHG emissions by 40% by 2030 compared to the 2007 emissions challenging, and the target itself quite ambitious.

Having in mind the high ambitions of Sofia Municipality, the scope of the 2021-2030 SECAP includes sectors that are under the direct control of the municipal administration - in addition to the mandatory "Municipal Buildings", such are "Outdoor Public Lighting" and "Waste" (incl. wastewater) for instance. Both additional sectors offer a high potential for emission reductions within the sectors themselves. Many measures have been implemented in the "Waste" sector since 2007 that lead and will lead to GHG emissions reductions in the future.

As can be seen from Table 2 above, the Industry and Construction sector have already almost reduced their GHG emissions by 40% compared to 2007. This sector has a high share of electricity consumption. In view of the expectations for further reduction of the electricity emissions value factor, as well as the impact that the economic crisis related to the COVID-19 pandemic will inevitably have, as well as the modernization of the sector which will take place by 2030, additional reduction of the emissions in this sector can be expected. Given its large share in the total emissions, this reduction will also affect the overall result for all sectors covered.

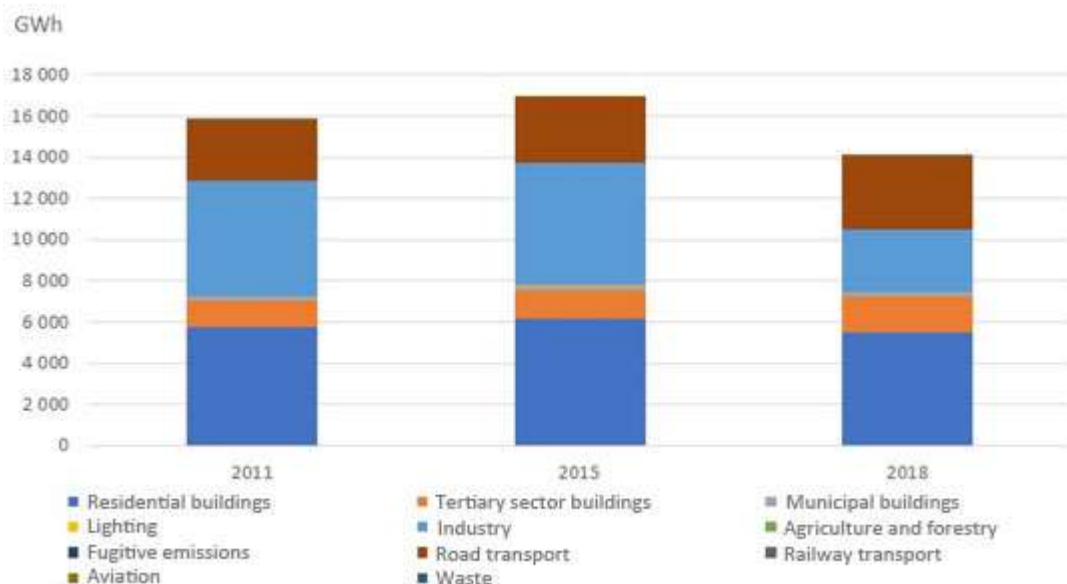
In accordance with the above arguments and the SWOT analysis on the potential of the GHG emissions reduction activities in the individual sectors performed and presented in Annex 2, as most suitable for inclusion in the scope of SECAP 2021-2030, are outlined the following sectors:

- Residential buildings (mandatory)
- Tertiary sector (mandatory)
- Municipal buildings (mandatory)
- Transport (mandatory), with the exception of Aviation (not mandatory)
- Waste
- Outdoor public lighting
- Industry and construction

The SWOT analysis confirms the preliminary conclusions that the biggest challenge in terms of achieving significant emission reductions is in the “Transport” and “Tertiary” sectors. However, these sectors are mandatory and cannot be excluded from the scope of the future inventory. On the other hand, in the “Residential Buildings” sector, which has the largest share of generated emissions on the territory of Sofia Municipality, and at the same time has limited opportunities for direct impact of the municipality, there are very good opportunities for the achievement of high results offered by the external environment. For all optional sectors that are proposed to be included in the scope of the baseline inventory for SECAP, there are sufficiently favorable conditions to achieve the desired GHG emissions reduction.

#### 4.2. Characteristics of the energy production and consumption

Among the predominant number of sectors included in the GHG emissions inventory for 2018 under the 2012-2020 SEAP, the final energy consumption is the reason for the generated emissions. This section examines the change in the energy consumption according to the data from the last three GHG emission inventories. The total final energy consumption for the period 2011-2018, broken down by sectors, is presented in *Figure 4*. Normally, the overall picture is similar to that for the GHG emissions, highlighting the same four main sectors with the highest energy consumption – “Residential buildings”, “Industry and Construction”, “Transport” and “Tertiary Sector”.



*Figure 4. Energy consumption in Sofia Municipality for the period 2011-2018 by sectors*

The shares of the individual sectors in the final energy consumption for 2018 are presented in *Figure 5*.



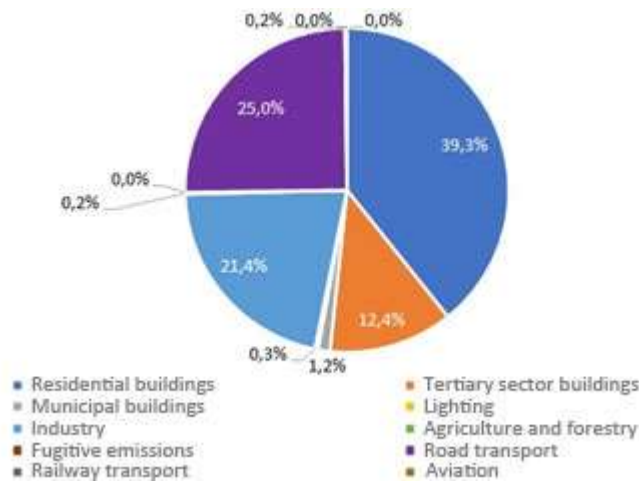


Figure 5. Share distribution of the individual sectors in the final energy consumption for 2018

The “Residential Buildings” sector is leading with a 39% share of the total final energy consumption. Unlike the data shown in *Table 2*, which presents the share of GHG emissions in the sectors, in the final energy consumption the “Road Transport” sector, with a share of 25%, is ahead of the “Industry” and “Construction” sector, which is with a share of just over 21%. The higher GHG emissions of the “Industry and Construction” sector are due to the considerably higher electricity consumption in this sector, as seen from the data below, where the energy consumption is reviewed by sectors.

#### “Residential buildings” sector

A downward trend in the total energy consumption of the “Residential Buildings” sector since 2011 is observed and it is largely due to the reduction of the final heat consumption from district heating. The change in the final energy consumption in the sector for the period 2011-2018 is presented in *Figure 6*.

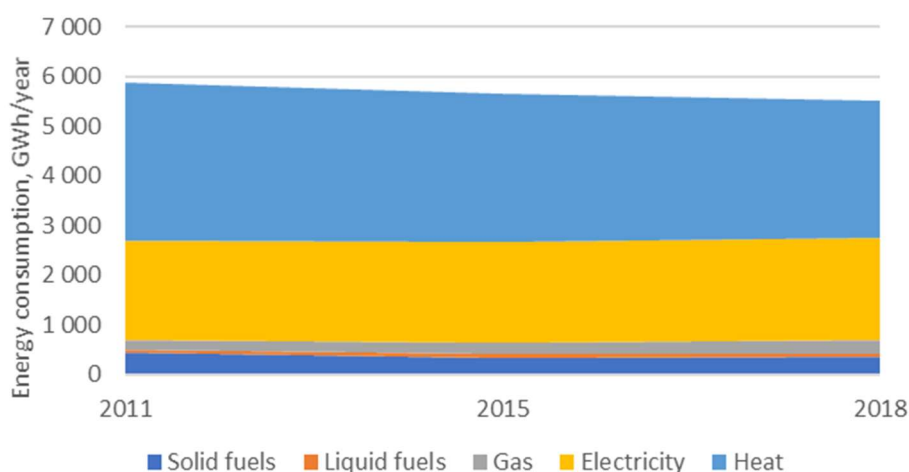


Figure 6. Energy consumption in the “Residential Buildings” sector for the period 2011-2018 by fuels and energy

In addition to heat, there is a decrease of the solid and liquid fuels use also, and an increase in the consumption of natural gas and electricity. There is also a change in the mix of solid fuels, with increase of the share of wood and pellets at the expense of coal share reduction.



At increased population number of Sofia Municipality during the inspected period, the main factor influencing the reduction of the total energy consumption can be considered the new housing construction, which is developing at a sustainable rate of growth. The new residential buildings, although not with the highest energy performance, are much more energy efficient than the existing old residential buildings. These new buildings are inhabited both by newcomers to the capital and by residents who change their homes in old buildings with those in the newer buildings. As a result, old energy-inefficient homes remain vacant. The energy renovation of the existing residential buildings, carried out both in the framework of specialized national programs and on the initiative of the building owners themselves, is also important.

### “Tertiary sector”

This sector includes all non-municipal buildings in the trade and services sector. There is a decrease of the total energy consumption, the main reason for which is the decrease of the electricity and heat consumption. Growth is observed in the natural gas and liquid fuels consumption, and the natural gas has increased its share significantly. As with the residential buildings, the gradual relocation of offices from old buildings to newly built, much more efficient buildings, is likely to play a key role in the overall energy consumption reduction. The reduction of the electricity consumption is probably due to the use of more efficient heat pumps and office equipment as well.

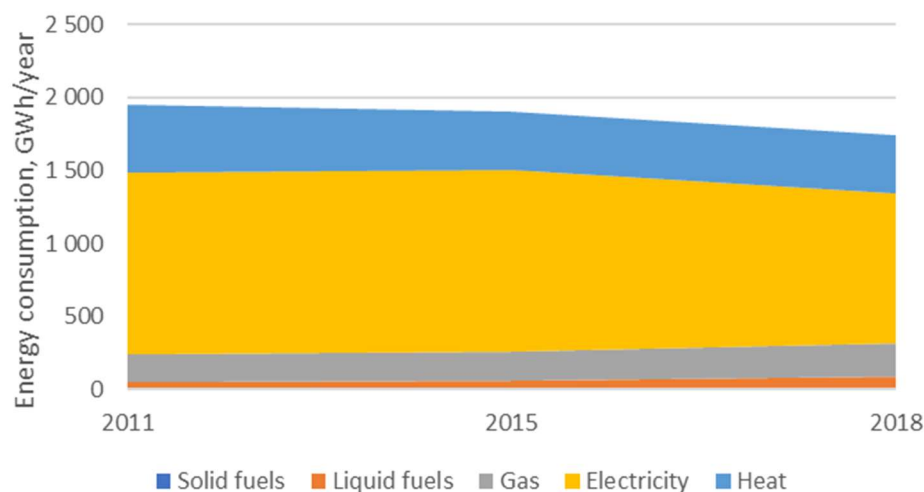


Figure 7. Energy consumption in the "Tertiary sector" for the period 2011-2018 by fuels

### “Industry and Construction sector”

There is a very serious decrease of the sector’s energy consumption in the period 2007-2011, which can be explained both by the great financial and economic crisis at the end of the previous decade and by the closing of the large "Kremikovtzi" metallurgical plant in this period. The energy consumption change in the sector for the period 2011-2018 is presented in Figure 8. The chart shows a significant increase in the energy consumption until 2015, which can be explained to the greatest extent by the recovery of the enterprises from the previous economic crisis. In parallel a modernization process of these enterprises was carried out, which had an impact on the energy efficiency improvement, as the energy consumption was maintained at significantly lower levels compared to 2007. By 2018 a slight decline in the total energy consumption of the sector was registered. However, it is entirely due to the drop of the heat consumption from district heating plants, while the consumption of electricity and natural gas, which are with the two most significant shares, was growing. However, this increase is much slower compared to the period 2011-2015. The main role in this is probably played by the modernization of enterprises production.

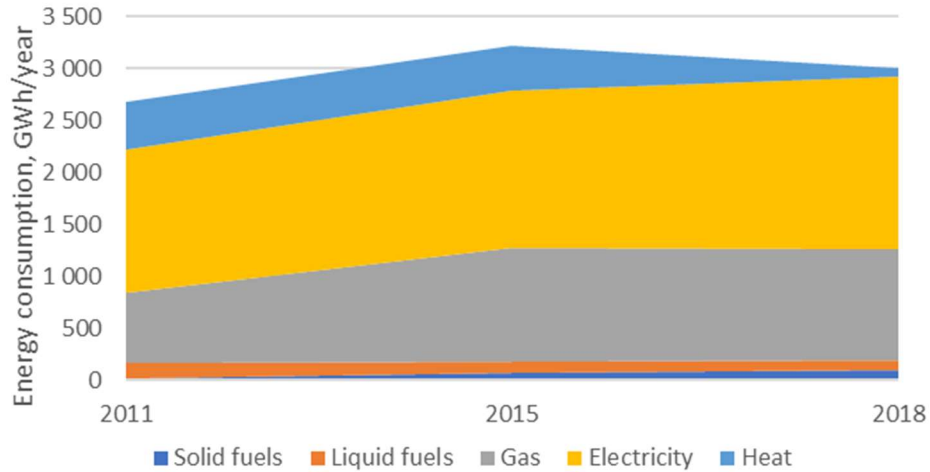


Figure 8. Energy consumption in the "Industry and Construction sectors" for the period 2011-2018 by fuels

### "Transport" sector

In the GHG emissions inventory, the "Transport" sector is allocated in three sub-sectors: road transport, rail transport and aviation. The road transport includes private and commercial transport, public transport and interdepartmental transport. The rail transport includes only the trains performing initial and endpoint courses within Sofia Municipality and manoeuvring locomotives. In a similar way the aviation includes flights with initial and endpoint within Sofia Municipality only. Figure 9 shows the share of each of these subsectors in the total energy consumption for 2018. The road transport stands out significantly by 98.9%, the rail transport has a share of just over 1% and the aviation - a less than 0.1% share.

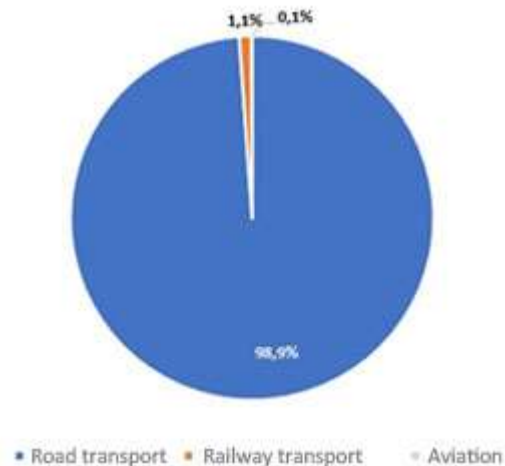


Figure 9. Shares in the total energy consumption of the individual subsectors of the "Transport" sector for 2018

The change in the energy consumption in the "Road Transport" subsector for the period 2011-2018 is presented on Figure 10. Energy consumption increase is observed in all subsectors, but the most significant one is in the private transport. The smallest increase is in the public transport - 19% for the period reviewed.



Figure 10. Change in the energy consumption of the “Road Transport” subsector for the period

The following Figure 11 shows the change in the “Public Transport” subsector energy consumption in the period 2011-2018. The tendency to reduce the consumption of liquid fuels at the expense of the gaseous fuels and electricity consumption increase is clearly expressed. In 2018, electricity already was with the largest share in the public transport, and the total energy consumption in the subsector was also increasing.

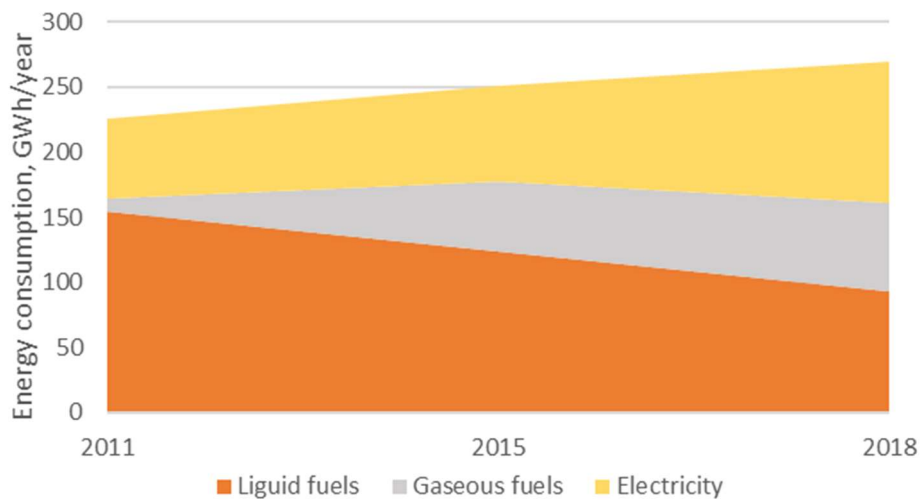


Figure 11. Change of the “Public transport” subsector energy consumption for the period 2011-2018 - by fuels and energy

Figure 12 shows the energy consumption change for the whole transport sector in the period 2011-2018. The consumption of liquid fuels stands out with a much larger share than the others, mainly due to the private and commercial transport.

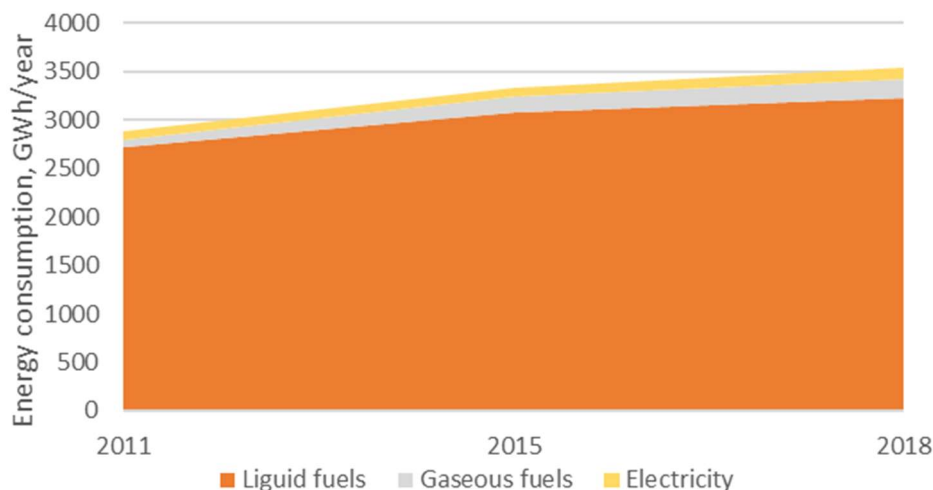


Figure 12. Change of the energy consumption in the “Transport” sector for the period 2011-2018 - by fuels

Special comment should be made here on the reliability of the private and commercial sectors data. The energy consumption in these sectors is determined by computational manner relying on the data for the number of registered cars by fuel types and on the aggregated data of the average mileage and average fuel consumption of the cars determined at national level. Thus, it cannot be reflected that among the registered cars exist such that are not often used or that are not used at all, and that there are many cars, supplied with additional gas systems, that are officially registered as cars on gasoline.

“Outdoor lighting” sector

Figure 13 presents a comparison of the annual electricity consumption for outdoor public lighting for 2010, described according to the 2012-2020 SEAP, and respectively the annual electricity consumption for 2018 according to the data provided by Sofia Municipality. As can be seen from the graph, the energy consumption increased by about 5% over the eight-year period under review. Despite this increase in the energy consumption, the emissions inventory data shows a decrease in the GHG emissions by over 13% for the sector in 2018 compared to the 2007 base year. This decrease is due to the significant reduction of the national electricity emissions factor.

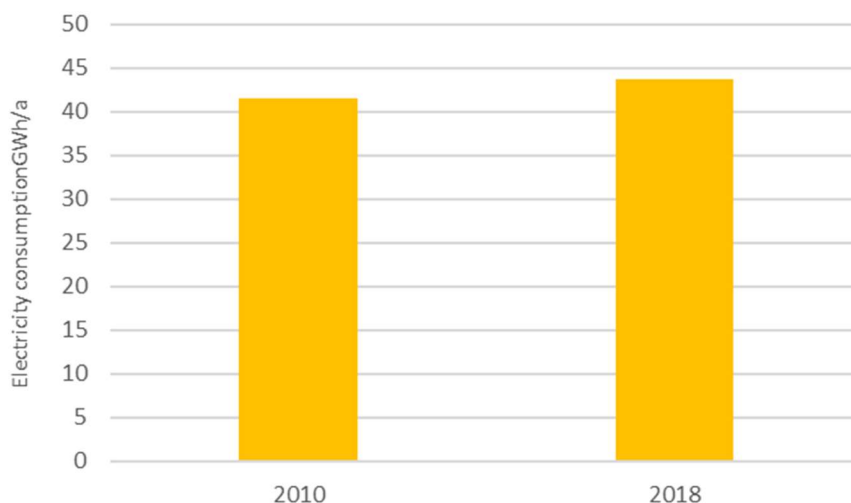
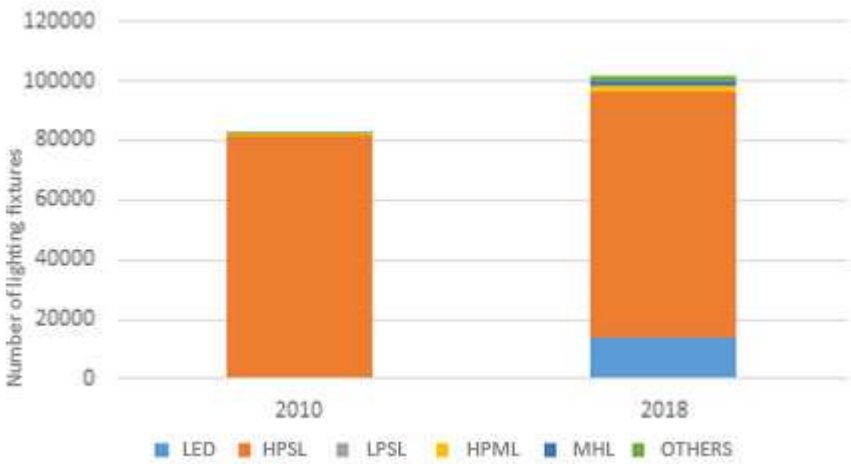


Figure 13. Comparison of the energy consumption for outdoor public lighting for 2010 and 2018

Apart from the comparison of the annual energy consumption, it is important to compare the condition and scope of the outdoor public lighting during these two years. *Figure 14* presents information on the number and type of lighting fixtures in 2010 and 2018. The information is from the same two sources as that for the energy consumption.



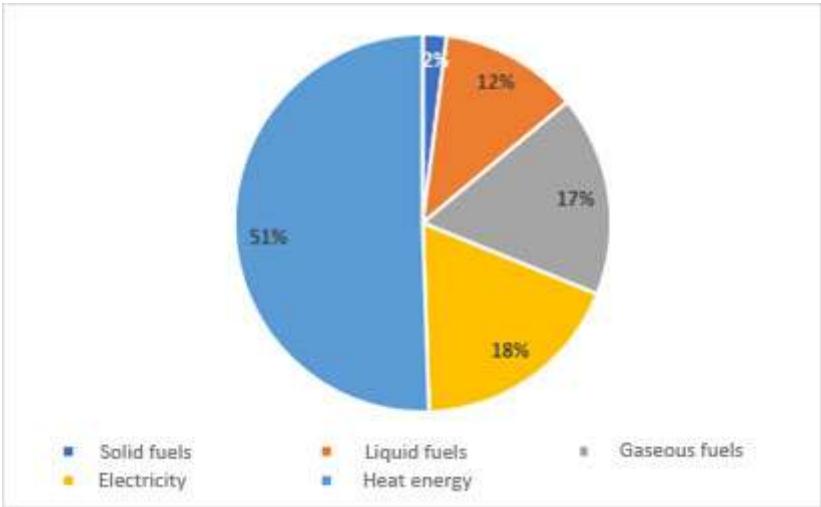
*Figure 14. Comparison of the number of lighting fixtures by type of light source in 2010 and 2018*

The graph shows that the total number of lighting fixtures in Sofia Municipality for the period reviewed has increased by nearly 23%. This means that a reduction, in the specific energy consumption per number of lighting fixtures, has been achieved and the increase in the total annual energy consumption is due to the increased number of lighting fixtures in result of the addition of new illuminated areas.

On the other hand, it can be seen that the percentage of the efficient LED luminaires is still relatively small (13.7%), which is indicative that this sector has still a lot of potential for GHG emissions reduction.

“Municipal buildings” Sector

The annual energy consumption in the “Municipal Buildings” sector for 2018 and the current ratio of the different types of fuels and energy used is presented in *Figure 15*.



*Figure 15. Ratio of the fuels and energy used in the “Municipal Buildings” sector for 2018*

The largest energy consumption share in the "Municipal buildings" sector has the heat energy from district heating - 51%. The energy consumption of natural gas is 17% and of electricity - 18%. The share of energy from liquid fuels is also significant - 12%.

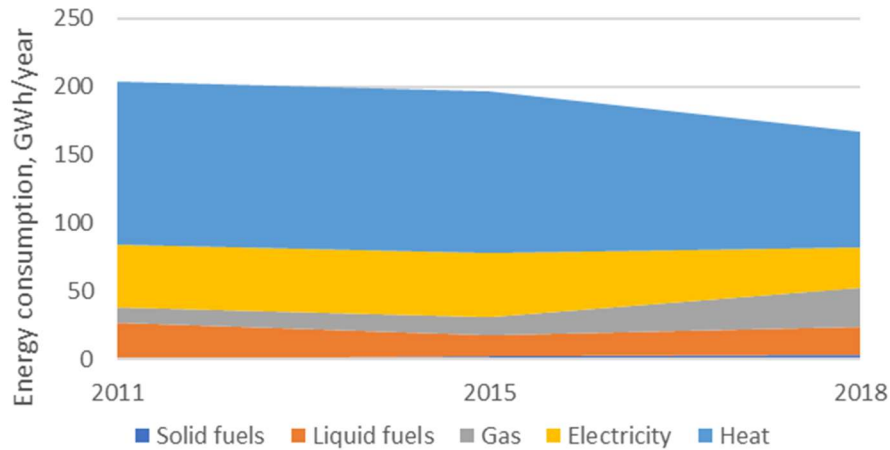


Figure 16. Energy consumption in the "Municipal Buildings" sector for the period 2011-2018 by fuels

There is a decrease in the total energy consumption in the period 2011-2018, and in terms of the different energy types shares there is a decrease in the share of heat and electricity, which is largely due to the energy renovation of the buildings and the increase on the part of energy from natural gas. The increase in natural gas is mainly related to the gasification of many municipal buildings in this period. The change in the energy consumption in the "Municipal Buildings" sector for the period 2011-2018 is presented in Figure 16.

### 4.3. Trend in the generation of green house gas emissions

It has already been noted that by 2018 Sofia Municipality has achieved a reduction of the emissions compared to the baseline 2007 year by 18.2%. For the 2007 base year the total level of GHG emissions, for the sectors included in the scope of SEAP, is 5,672 thousand tCO<sub>2e</sub>, and for 2018 it is 4,639 thousand tCO<sub>2e</sub>. The result obtained by 2018 means that SM is very close to achieving the goal set in the SEAP for 22% GHG emissions reduction by 2020. The rules of GCMCE allow the calculated level of GHG emissions for the base year to be adjusted in the event of significant change in the municipality population number. According to the NSI data, the population of Sofia Municipality increased from 1,240,788 to 1,328,790 in the period from 2007 to 2019, i.e. there is an increase of 7.1%. If the rule for adjusting the amount of emissions in the base year to the population increase is applied, in practice this will mean that SM has already achieved its goal. The adjusted total level of GHG emissions of SM for the 2007 base year compared to the population growth in 2018 would be 6,025 thousand tCO<sub>2e</sub>. This means that the rules of the Covenant of Mayors allow, as early as 2018, Sofia Municipality to be able to report over 23% reduced GHG emissions. In the emissions inventory for 2018 this adjustment by population has not been done. Graphically, these general results are presented in Figure 17. The 2020 COVID-19 pandemic can also be expected to further reduce the emissions by 2020, as a significant reduction of the national gross domestic product has already been reported.



Figure 17. Level of SM GHG emissions in 2018 compared to the 2007 base year emissions and the adjusted SM GHG emissions for 2007 in relation to the population growth

The following Figure 18 shows the emissions distribution during these years by the sectors included in the inventory.

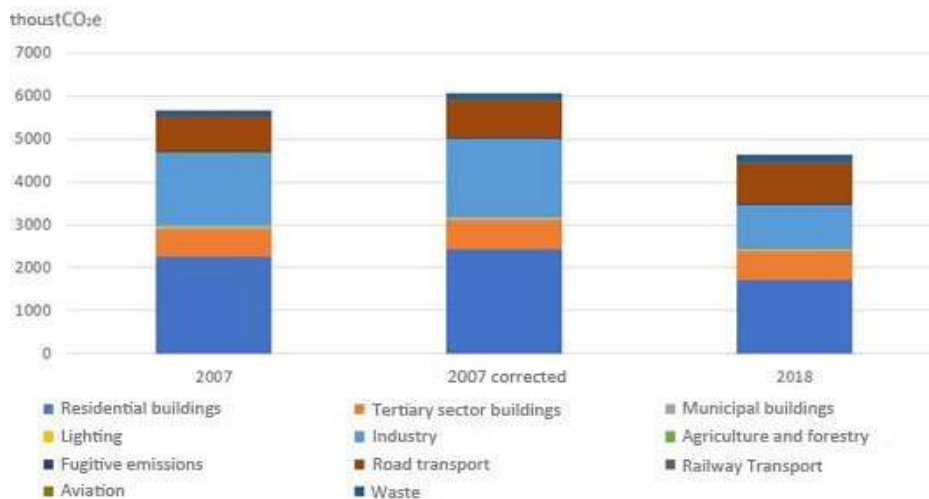


Figure 18. Level of the SM GHG emissions in 2018 compared to the emissions in the 2007 base year and the adjusted GHG emissions for 2007 in relation to the population growth - distribution by sectors

Four sectors, that are essential for the emissions generation, namely “Residential Buildings”, “Industry and Construction”, “Tertiary sector buildings” and “Transport”, are clearly distinguishable. The graph shows the significant reduction of GHG emissions in the “Industry and Construction” and in the “Residential buildings” sectors, which is respectively 39.1% and 24.1%. In the other sectors, with a large share of GHG emissions, there is an increase in the emissions, and for the “Tertiary sector buildings” it is 4.9%, and for the “Road transport” sector - 18.9%.

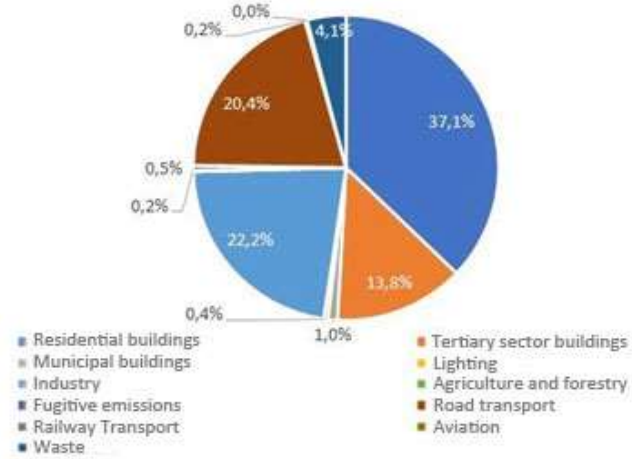
In the “Municipal Buildings” sector, a large emissions reduction of 34.4% was also achieved. In another sector, which is under the direct control of Sofia Municipality – the “Outdoor Lighting”, the reduction of emissions is 13.6%. Unfortunately, however, these sectors have a very small share in the total amount of GHG emissions of Sofia Municipality and do not have such big impact on the overall end results.

In the “Waste” sector, which has a relatively larger share in the total amount of GHG emissions, an increase in the emissions has been registered, which is mainly due to the fact that the process of generating emissions from landfilled municipal solid waste is inert; and towards this year



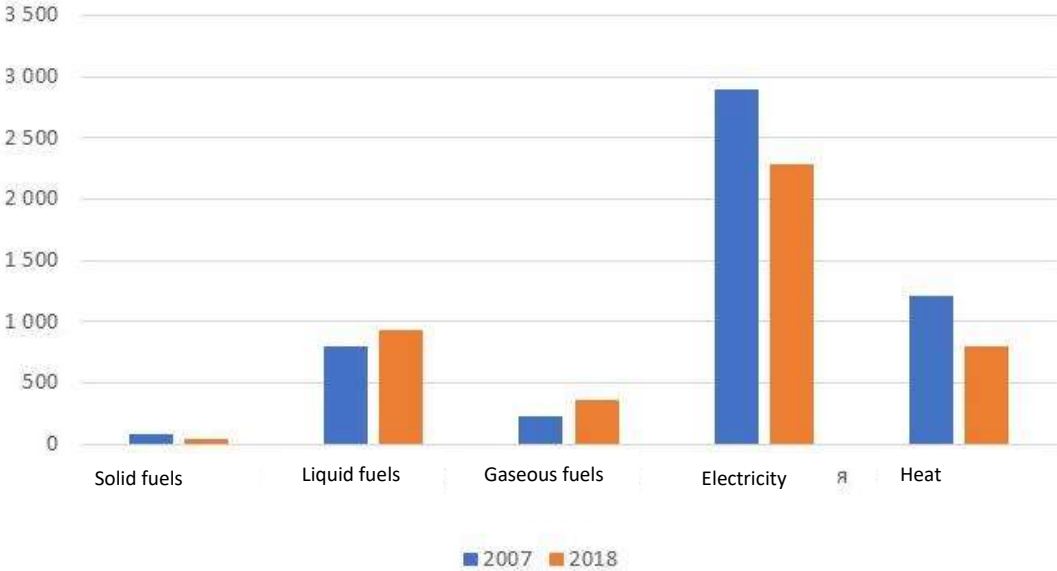
the reduction effect of these quantities, after the implementation of the first two stages of the integrated waste management system of Sofia Municipality, is not yet reflected as GHG emissions reduction.

The shares of the individual sectors emissions, in the total amount of GHG emissions for 2018, are presented in *Figure 19*.



*Figure 19.* Shares of the individual sectors in the total amount of GHG emissions for 2018

It is interesting to compare the GHG emissions in 2007 and 2018 by fuel types and energy, which is presented graphically in *Figure 20*. A decrease is observed for all types of fuels except for the liquid fuels and the electricity. The increase of the emissions from liquid fuels is due to the private transport subsector. The reduction of the emissions from electricity is largely due to a change in the value of the applied national emissions factor for emissions calculation, which has a steady downward trend over the years in result of the changes in the fuel mix for the electricity generation at the national level, and is also due to the increasing share of the energy from renewable sources.



*Figure 20.* Level of SM GHG emissions in 2018 compared to the emissions in the 2007 base year and the adjusted GHG emissions in 2007 compared to the population growth - distribution by fuel types

## 4.4 Baseline inventory of the CO<sub>2</sub> emissions for the purposes of 2021-2030 SECAP

The report on the baseline inventory of GHG emissions is presented in *Annex 1*.

### 4.4.1. Determination of the base year

The 2012-2020 Sustainable Energy Action Plan (SEAP) defines 2007 for a base year as the year is the closest to 1990, for which all necessary data are available. In accordance with the requirements of the GCMCE, in the 2021-2030 Sustainable Energy and Climate Action Plan (SECAP) the base year against which the achieved GHG emission savings should be determined must be the same.

### 4.4.2. Population of Sofia Municipality during the base year

The rules of the GCMCE allow the calculated level of GHG emissions for the 2007 base year to be adjusted in the event of a significant change in the municipality population number. In the period from 2007 to 2019, the population of Sofia Municipality according to the NSI data has increased from 1,240,788 to 1,328,790, i.e. the increase is 7.1%. Due to the steady trend of population growth of Sofia Municipality, for the assessment of the achieved GHG emissions reductions, **the method "per capita"** was chosen for the period **2021-2030** in the **SECAP**, which is acceptable according to the rules of the covenant.

### 4.4.3. Energy consumption within the scope of the SECAP during the base year

The baseline inventory of the greenhouse gas emissions includes:

- Direct CO<sub>2</sub> emissions from stationary and mobile combustion processes (within the municipality)
- Indirect emissions from the production and consumption of heat and electricity (regardless of where it is produced)
- Other direct emissions: CH<sub>4</sub> and N<sub>2</sub>O emissions from the wastewater treatment and CH<sub>4</sub> emissions from the municipal solid waste treatment.

The inventory of the direct greenhouse gas emissions is carried out on the base of the final energy consumption within the municipality – electricity and heat, fossil fuels and renewable energy sources (including biomass) in the following categories:

- Buildings and facilities: municipal; tertiary (non-municipal); residential; public lighting. Tertiary buildings, equipment/facilities are all buildings and facilities of the tertiary sector (services sector) that are not municipal property and are not managed by the local authorities (such as offices of private companies, banks, small and medium size enterprises, commercial activities and retail sales, hospitals, etc.)
- Industry
- Transport: municipal car park; public transport; private and commercial transport

The total energy consumption on the territory of the municipality in 2007 was 15,821,731 MWh, and the distribution by sectors is presented in *Table 3*.

Table 3. Final energy consumption in 2007 within the scope of the SECAP - by sectors

Sector	Energy Consumption, MWh	Share of the total energy consumption, %
Households	5 748 842	36.3%
Trade and services	1 279 559	8.1%
Municipal buildings	196 995	1.2%
Lighting	39 345	0.3%
Industry and Construction	5 564 457	35.2%
Road transport	2 961 397	18.7%
Railway transport	31 136	0.2%
<b>TOTAL</b>	<b>15 821 731</b>	

The largest share in the final energy consumption (*Figure 21*) in the 2007 base year have the sectors households (36.3%) and industry and construction (35.2%), followed by road transport (18.7%) and trade and services (8.1 %). The share of the other sectors is below 2%.

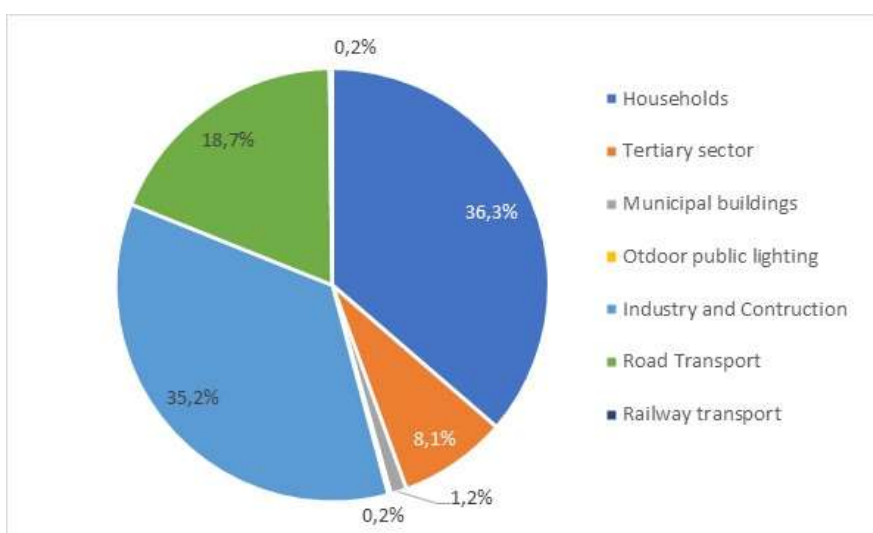


Figure 21. Share distribution of the 2007 final energy consumption by sectors

The final energy consumption by types of energy sources in the sectors covered by the plan, is distributed as follows:

Table 4. Final energy consumption in 2007 within the scope of the SECAP - by fuel types and energy

Sector	Energy consumption, MWh	Share of the total energy consumption, %
Solid fuels	371 922	2.4%
Liquid fuels	3 332 404	21.1%
Gaseous fuels	3 740 474	23.6%
Electricity	4 140 818	26.2%
Heat energy	4 236 112	26.8%
<b>Total</b>	<b>15 821 730</b>	

The largest share in the final energy consumption (*Figure 22*) have: heat (26.8%),

electricity (35.2%) and gaseous fuels (natural gas) (23.6%), followed by liquid fuels (21.1%). The solid fuels have a share of only 2.4%.

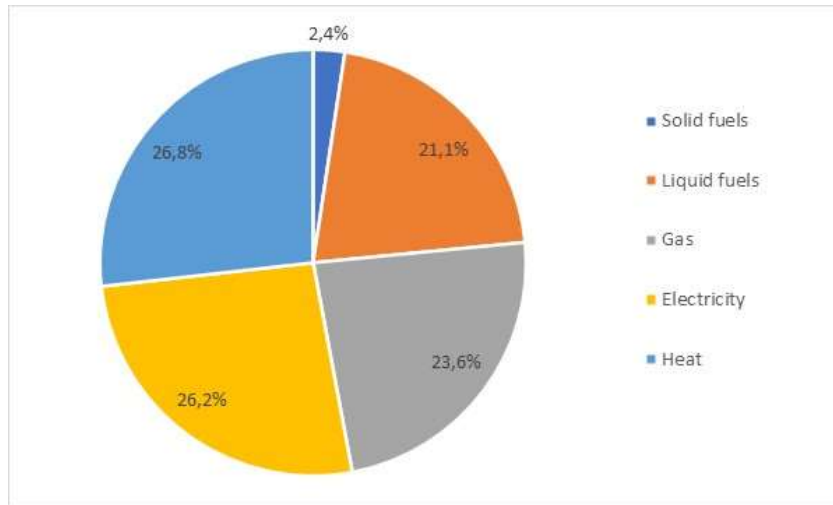


Figure 22. Share distribution of the final energy consumption for 2007 by fuel types and energy.

#### 4.4.4. Method for greenhouse gas emissions calculation and reporting

##### 4.4.4.1. Stationary combustion processes

The consumed fuels direct emissions are calculated in accordance with the 2006 IPCC Guidelines for the National Greenhouse Gas Inventory, Volume 2, Chapter 2 - Stationary Combustion of Fuels<sup>39</sup>, according to the following Formula 1:

$$Emissions_{GHG,fuel} = AD_{fuel} * EF_{GHG,fuel} \quad (1)$$

where:

- $Emissions_{GHG,fuel}$  are the emissions of the respective greenhouse gas by fuel type in tonnes;
- $AD_{fuel}$  – amount of the used fuel type in energy units (TJ or MWh);
- $EF_{GHG,fuel}$  – emission factor for the respective greenhouse gas and for the respective fuel, expressed in t/TJ or t/MWh. For CO<sub>2</sub>, this emission factor includes the oxidation factor, defined by default as 1

To calculate the total greenhouse gas emissions of the relevant source category, the emissions calculated in formula (1) are summed for all fuels:

$$Emissions_{GHG} = \sum_{fuels} Emissions_{GHG,fuel} \quad (2)$$

The total emissions for a given source category are expressed in tCO<sub>2</sub> equivalent, applying the global warming potential, which expresses with how much 1 kg of greenhouse gas (CH<sub>4</sub> and N<sub>2</sub>O) contributes to the global warming, expressed in kilograms of CO<sub>2</sub> equivalent for a period of 100 years, according to the IPCC Fourth Assessment Report (IPCC Assessment Report 4)<sup>40</sup>. For the conversion of the CH<sub>4</sub> and N<sub>2</sub>O emissions into CO<sub>2</sub> equivalent, the values are 25 and 298, respectively

The natural units - t, m<sup>3</sup>, l are converted into energy units - TJ or MWh using the Net

Calorific Value (NCV).

For the purposes of the GCMCE, the MWh unit has been adopted for use. Therefore, it is necessary to convert the data and the emission factors from TJ to MWh. The conversion factor is 0.0036 or 1 MWh = 0.0036 TJ.

#### 4.4.4.2. Indirect emissions

The estimation of the consumed electrical energy emissions is based on the electricity consumption, as the emission factors are expressed in tCO<sub>2</sub>/MWh, kg CH<sub>4</sub>/MWh, kg N<sub>2</sub>O/MWh. The data for the activities are expressed in MWh of the electricity consumed. Emissions for the respective greenhouse gas are calculated according to Formula 3.

$$Emissions_{GHG} = AD * EF_{GHG} \quad (3)$$

where:

- $Emissions_{GHG}$  are the emissions of the corresponding greenhouse gas in tonnes;
- $AD$  – output data for the total electricity consumption (MWh);
- $EF_{GHG}$  – national emission factor for electricity for the respective greenhouse gas expressed in t / MWh.

The total GHG emissions expressed in CO<sub>2</sub> equivalent are determined by formula 4, applying the global warming potential, which expresses with how much 1 kg of greenhouse gases (CH<sub>4</sub> and N<sub>2</sub>O) contribute to the global warming, expressed in kilograms of CO<sub>2</sub> equivalent for a period of 100 years, according to the IPCC Assessment Report 4. For the conversion of the CH<sub>4</sub> and N<sub>2</sub>O emissions into CO<sub>2</sub> equivalent, the values are 25 and 298, respectively.

$$Emissions_{el} = \sum_{GHG} Emissions_{GHG,el} \quad (4)$$

The estimation of the emissions from the consumed heat energy is based on the used heat energy, as the emission factors are expressed in tCO<sub>2</sub>/MWh, kgCH<sub>4</sub>/MWh, kgN<sub>2</sub>O/MWh. The data about the activity are expressed in MWh of the heat consumed. The emissions are calculated according to formula 5.

$$Emissions_{GHG} = AD * EF_{GHG} \quad (5)$$

where:

- $Emissions_{GHG}$  are the emissions of the corresponding greenhouse gas in tonnes
- $AD$  – output data for the total heat consumption (MWh)
- $EF_{GHG}$  – national emission factor for heat for the respective greenhouse gas expressed in t / MWh

The total GHG emissions expressed in CO<sub>2</sub> equivalent are determined by formula 6, applying the global warming potential, which expresses with how much 1 kg of greenhouse gases (CH<sub>4</sub> and N<sub>2</sub>O) contribute to the global warming, expressed in kilograms of CO<sub>2</sub> equivalent for a period of 100 years, according to the IPCC Assessment Report 4. For the conversion of the CH<sub>4</sub> and N<sub>2</sub>O emissions into CO<sub>2</sub> equivalent, the values are 25 and 298, respectively.

$$Emissions_{heat} = \sum_{GHG} Emission_{GHG,heat} \quad (6)$$

#### 4.4.4.3. Mobile combustion processes

The calculation of the GHG emissions in the transport sector is performed according to the *EMEP/EEA Air Pollutant Emission Inventory Guidebook* by the general formula:

$E_i = AD_i * EF_i$ , where

- $E_i$  are the greenhouse gas emissions in tonnes
- $AD_i$  are the primary data for the total annual mileage of the specific vehicle category (in km)
- $EF_i$  is the emission factor for the relevant category, expressed in g/km.

#### 4.4.4.4. Other direct emissions

The calculation methodology described in the *Guide to the National Greenhouse Gas Inventory (2006 IPCC Guidelines)* of the *Intergovernmental Panel on Climate Change* was used to determine the emissions from the "Waste" sector.

#### 4.4.5. Assumptions and resources used

The main source of primary data on the final energy consumption of fuels is the National Statistical Institute (NSI). As the NSI cannot provide information on the energy consumption on the territory of Sofia Municipality but only at the national level, an assessment of the consumption has been made.

To estimate the households fuel consumption, data on the fuel consumption at the national level, data on the number of households in the country and in Sofia Municipality, as well as the structure of the households heating according to the *2011 Census of the Population and Housing* was used.

Data at the national level, provided by the NSI, was also used to estimate the consumption of fuels and energy in the trade and services sectors.

The data on the consumption of natural gas from the tertiary sector was obtained from "Overgas Networks" AD. The data on the heat consumption provided by "Toplofikatsia Sofia" EAD contain the consumption divided into household and business consumers, which includes both the enterprises in the services sector and the industrial enterprises. The data on the electricity, supplied by the electricity distribution company "CEZ Electro Bulgaria" AD, is divided into household and business consumers. To the electricity supplied by "CEZ Electro Bulgaria" AD is added the electricity supplied to customers registered on the free market, data for which were provided by "CEZ Distribution Bulgaria" AD. As for the purposes of reporting it is necessary to give the consumption of the services and the industrial sector separately, the relative share of the two sectors to the data at the national level was calculated.

For the needs of the SECAP 2021-2030 development, an organization was set up for collection of the most reliable data on the energy consumption in the "Municipal buildings" sector; building by building, including the buildings of the municipal companies and enterprises. Within the deadline for the data collection, a very good representative sample was provided, with detailed information on the buildings, which cover over 47% of the total built-in area. The data was carefully checked for reliability and all unreliable data was removed. The specific energy consumption was then calculated in relation to the total built-up area of each building type. Data for the total built-up area of all municipal buildings by their functional purpose was extracted from the cadastral map of Sofia Municipality. The total amount of energy for the sector was calculated according to the identified specific energy consumptions by building types.

The data for the natural gas consumption of the industrial sector was obtained from “Overgas Networks” AD and “Bulgargaz” EAD, without redistribution. With regard to the electricity and heat consumption, the data provided by “Toplofikatsia Sofia” EAD divide the consumption as households and commercial consumers, in which both enterprises of the services sector and the industrial enterprises are included. The distribution between the two sectors is based on the calculated shares of the total electricity consumption at the national level.

The data on the number of vehicles in Sofia Municipality and their distribution by category and type of fuel was provided by the Ministry of the Interior (Moi). Additional processing of the data was performed, as in the information system of the Moi the vehicles are grouped in 21 categories (including trailers and semi-trailers). In addition, there are 15 fuel categories, and for some of them the information on the exact fuel used is not enough (e.g. for the petrol/gas, diesel/gas and gas categories it cannot be specified whether the vehicles are fuelled with methane or propane-butane). The number of vehicles is grouped in 4 categories: cars, vans, trucks and motorcycles/ mopeds, divided in 4 types of fuels: gasoline, diesel, propane-butane and methane.

For the estimation of the GHG emissions from the public transport, data on the annual mileage and the fuels used (diesel and methane) were collected both for the buses of “Stolichen Avtotransport” EAD and for the private carriers. For the calculation of the GHG emissions from the municipal transport, data on the mileage and the fuels used by the interdepartmental transport of Sofia Municipality were collected. For the assessment of the GHG emissions from the railway transport, data from the “National Railway Infrastructure” State Company on the electricity consumption from the substations on the territory of Sofia Municipality, was used. Data from the “Holding Bulgarian State Railways” EAD on the used diesel fuel in directions with a starting or ending station on the territory of the municipality, was also used.

For the emissions from the waste sector is used data, provided by Sofia Municipality - “Waste Management and Control Activities” Directorate, for the quantities of generated, landfilled, biologically treated and incinerated waste.

Data on the quantities of waste, provided by the Executive Environment Agency, were used to determine the greenhouse gas emissions from the incineration of clinical and hazardous waste.

#### 4.4.6. Greenhouse gas emissions in the base year

The total calculated GHG emissions in SM for 2007 by sectors are presented in the following *Table 5*.

*Table 5. Greenhouse gas emissions in 2007 within the scope of the SECAP - by sectors*

Sector	GHG emissions, tCO <sub>2e</sub>	Share of the total GHG emissions, %
Households	2 270 125	40.3%
Trade and services	608 627	10.8%
Municipal buildings	69 378	1.2%
Lighting	24 140	0.4%
Industry and Construction	1 693 027	30.1%
Road transport	798 669	14.2%
Railroad transport	17 255	0.3%
Waste	147 815	2.6%
<b>TOTAL</b>	<b>5 629 036</b>	

With the largest contribution to the GHG emissions (*Figure 23*) in the 2007 base year are the households (40.3%) and industry and construction (30.1%), followed by the road transport (14.2%),



trade and services (10.8%).

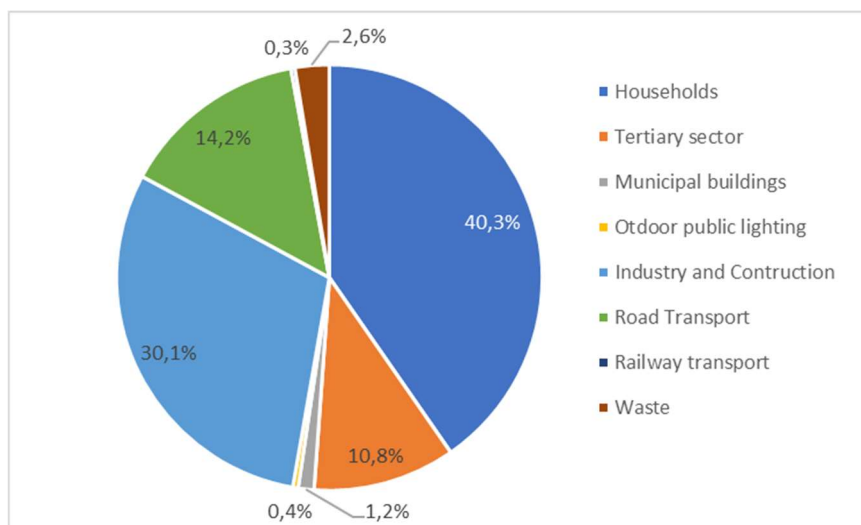


Figure 23. Share distribution of the greenhouse gas emissions for 2007 - by sectors

The emissions by energy carriers are presented in Table 6.

Table 6. Greenhouse gas emissions in 2007 within the scope of the SECAP - by fuel types and energy

Sector	GHG emissions, tCO <sub>2e</sub>	Share of the total GHG emissions, %
Solid fuels	72 366	1.3%
Liquid fuels	881 428	16.1%
Gaseous fuels	744 285	13.6%
Electricity	2 540 570	46.4%
Heat energy	1 242 573	22.7%
<b>Total</b>	<b>5 481 222</b>	

The largest contribution to the GHG emissions (Figure 24) in the 2007 base year has the electricity consumption (46.4%), the heat energy (22.7%) and the liquid and gaseous fuels, respectively with 16.1% and 13.6%. The emissions from the solid fuels use are only 1.3% of the total emissions from energy used.

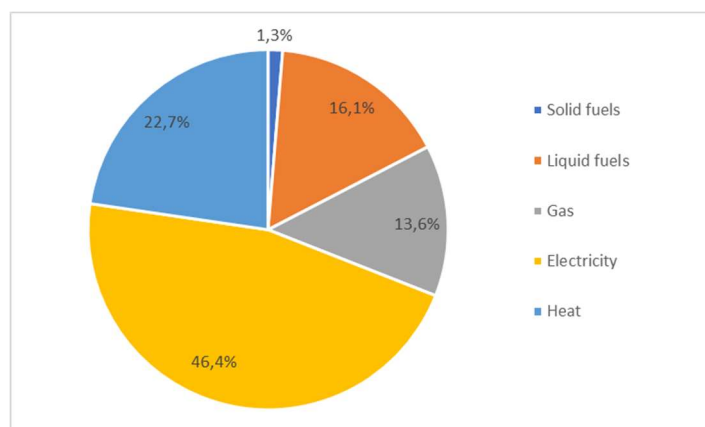


Figure 24. Share distribution of the greenhouse gas emissions for 2007 - by fuel types and energy

“Residential Buildings” Sector

The estimated energy consumption and GHG emissions from the Housing sector are presented in the following *Table 7*.

*Table 7. Greenhouse gas emissions of the “Residential Buildings” Sector in 2007*

<b>Fuel</b>	<b>TJ</b>	<b>Emissions, t CO<sub>2e</sub> e</b>
Anthracite coal	0.2	17
Black coal	327	34 700
Lignite and brown coal	32	3 656
Briquettes	149	15 737
Wood	674	5 859
Propane-butane	204	12 901
Gas oil/diesel fuel	7	541
Natural gas	360	19 945
Electricity	7 121	1 213 588
Heat	11 821	963 181
<b>TOTAL</b>	<b>20 695</b>	<b>2 270 125</b>

The main sources of household emissions are the electricity consumption (53.5%) and the heat energy (42.4%), with the total remaining emissions from fuel combustion being 4.1%.

“Tertiary sector buildings”

The estimated energy consumption and the GHG emissions from the tertiary sector are presented in the following *Table 8*:

*Table 8. Greenhouse gas emissions of the "Tertiary sector " in 2007*

<b>Fuel</b>	<b>TJ</b>	<b>Emissions, t CO<sub>2e</sub> e</b>
Anthracite coal	0.5	45
Black coal	2.7	270
Lignite and brown coal	1.3	139
Briquettes	3	297
Wood	17	144
Propane-butane	0	0
Gas oil/diesel fuel	120	8 964
Heavy fuel oil	54	4 192
Natural gas	412	22 784
Electricity	2 767	471 653
Heat	1 229	100 141
<b>TOTAL</b>	<b>4 607</b>	<b>608 629</b>

The main sources of emissions in the tertiary sector are the electricity consumption with 77.5% and the heat consumption with 16.5%.

### “Industry and Construction” Sector

Below is the final estimate of the consumption and GHG emissions in the “Industry and Construction” sector for 2007.

*Table 9. Greenhouse gas emissions of the “Industry and Construction” Sector in 2007*

Fuel	MWh	Emissions, t CO <sub>2e</sub>
Total solid fuels	36 801	11 503
Total liquid fuels	340 390	92 989
Natural gas	3 464 337	688 915
Electricity	1 231 161	755 370
Heat	491 767	144 249
<b>TOTA</b>	<b>5 564 457</b>	<b>1 693 027</b>

The main source of emissions in the “Industry and Construction” Sector is the consumption of electricity with 44.6%, followed by the natural gas with 40.7%.

### “Transport” Sector

The estimated energy consumption and the GHG emissions from private and commercial transport (excluding the public and the interdepartmental) are presented in *Table 10*:

*Table 10. Greenhouse gas emissions of the “Private and Commercial transport” subsector in 2007*

Fuel	Total fuels, TJ	Emissions, tCO <sub>2e</sub>
Liquid fuel	9 552	699 510
Gaseous fuels	148	84 65
<b>TOTAL:</b>	<b>9 700</b>	<b>707 975</b>

The emissions main sources are the liquid fuels with 98.8%. *Table 11* presents the fuel consumption and the GHG emissions from the public transport.

*Table 11. Greenhouse gas emissions of the “Public transport” subsector in 2007*

Fuel	Total fuel, TJ	Emissions, t CO <sub>2e</sub>
Diesel oil	679	50 740
CNG	36	2 070
Electricity (MWh)	56 792	34 844
<b>TOTAL:</b>		<b>87 654</b>

The main source of emissions here is the diesel oil with 57.9%, followed by the electricity with 39.8.

The fuel consumption and the GHG emissions from interdepartmental transport are presented in *Table 12*.

Table 12. Greenhouse gas emissions in the "Interdepartmental transport" sub-sector in 2007

Fuel	Total fuels, MWh	Total fuels, MWh
Liquid fuels	3 611	3 025
Gaseous fuels	8 056	13
<b>TOTAL:</b>	<b>11 667</b>	<b>3 039</b>

The main source of emissions are the liquid fuels with 99.5%.

"External Public Lighting" Sector

The emissions from the municipal street lighting and traffic lights are 24,140 tCO<sub>2e</sub>, and the electricity consumption is 39,345 MWh.

"Municipal Buildings" Sector

The energy consumption and the GHG emissions from all municipal buildings are presented in Table 13.

Table 13. Greenhouse gas emissions of the "Municipal Buildings" Sector in 2007

Fuel	TJ	Emissions, t CO <sub>2e</sub>
Biomass	0	0
Gas oil/Diesel fuel	61	4 567
Fuel oil	33	2 562
Natural gas	38	2 092
Electricity, MWh	148	25 155
Heat, MWh	430	35 001
Coal	0	0
<b>TOTAL</b>	<b>710</b>	<b>69 377</b>

The main source of emissions from the municipal enterprises, companies and buildings is the use of heat (50.5%) and electricity (36.3%).

"Waste" Sector

The GHG emissions from the "Waste" sector are presented in the following table:

Activity	Emissions, t CO <sub>2e</sub>
Landfilling of solid household waste	123 633
Waste incineration	1 437
Wastewater treatment	22 746

The main source of GHG emissions are the CH<sub>4</sub> emissions from the municipal solid waste disposal - 83.6%.

## 4.5. Forecast development scenario until 2030 without additional measures, projects and activities for climate change mitigation

### 4.5.1. Energy consumption without additional measures in the SECAP

In the energy consumption analysis from item 4.2. some of the various important factors that have influenced the change in the GHG emissions until 2018 were commented. In the table below these factors are summarized and an expert opinion is provided, on whether and to what extent these factors will also have an impact in the period up to 2030, assuming that no new specific measures are taken outside the existing measures and the inevitable new ones related to the changes in the regulatory framework.

Table 14. Factors / measures influencing the change in the level of greenhouse gas emissions by 2018

Main factors for the change in GHG emissions by 2018	Expected future influence of the factors
<b>Residential buildings</b>	
New, more efficient construction of residential buildings and relocation of residents from the old to the new buildings	Continue to have a greater impact due to the higher regulatory requirements for the energy performance of the new buildings
Residential buildings energy renovation	Continues to influence to a <b>probably</b> greater extent due to the higher regulatory requirements for the energy performance of the renovated buildings and <b>probably</b> on the larger number of renovated buildings
Higher average winter temperatures	Continue to have a greater impact due to climate change
Higher average summer temperatures	Continue to have a greater impact due to climate change
Reduction of coal and liquid fuel consumption	Continues to influence with a similar level of impact
Increase in of the residential buildings gasification	Continues to influence with a similar level of impact
Reduction of the heat consumption from district heating	Continues to have a <b>likely</b> similar level of impact due to the combined effect of factors 1 and 6
Significant reduction of the national emission factor for electricity	Continues to influence with a slightly lower level of impact, as a lower rate of reduction is expected
<b>Buildings of the tertiary sector</b>	
New, more efficient construction of office buildings and relocation of the companies' offices from the old to new buildings	Continues to have a greater impact due to the higher regulatory requirements for energy performance of the new buildings
Improvement of the efficiency of the heat pumps and the office equipment in the offices in old buildings	Continues to have a similar level of impact, as the effect of the higher efficiency will be somewhat offset by the growing number and variety of office equipment
Higher average temperatures in winter	Continue to have a greater impact due to climate change
Higher average temperatures in summer	Continue to have a greater impact due to climate change
Significant reduction of the emission factor for electricity	Continues to influence with a slightly lower level of impact, as a lower rate of decline is expected
<b>Industry and construction</b>	
Decreased production due to the economic crisis	No future impact
Modernization of the production and higher energy efficiency improvement	Continues to have a greater impact due to the need of the enterprise's competitiveness increase and the relatively low level of modernization achieved so far
Reduction of the solid fuels use	Continues to influence with a similar level of impact

<b>Main factors for the change in GHG emissions by 2018</b>	<b>Expected future influence of the factors</b>
Reduction of the heat consumption from district heating	Continues to influence with a similar level of impact
Significant reduction of the national emission factor for electricity	Continues to influence with a slightly lower level of impact, as a lower rate of reduction is expected
<b>Transport</b>	
Implemented measures in the public transport, e.g. metro extension; replacement of the public transport park	Continues to influence with a similar level of impact
Implemented measures related to private transport, e.g. introduction of paid parking areas; restricting access to trucks	Continues to influence with a similar level of impact
<b>Residential buildings</b>	
Building energy renovations implemented	Continues to have influence, with <b>probably</b> greater impact, due to higher energy performance requirements for the renovated buildings and probably more renovated buildings
Implemented measures for renewable energy use in the buildings	Continue to have an impact with <b>probably</b> greater effect due to the larger number of installations put in operation
Change of the type of energy used for heating in buildings	Continues to have an impact with <b>probably</b> greater influence due to the higher requirements for the renovated buildings energy performance and probably a larger number of renovated buildings
Higher average winter temperatures	Continue to have a greater impact due to climate change
Significant reduction of the electricity emissions factor	Continues to influence with a slightly lower level of impact, as a lower rate of reduction is expected
<b>Lighting</b>	
Modernization of the street lighting	Continues to have influence with <b>probably</b> greater impact due to a larger number of upgraded sections
Construction of new sections of the street lighting system	Continues to have a similar impact
Significant reduction of the national emissions factor for electricity	Continues to influence with a slightly lower level of impact, as a lower rate of reduction is expected

Along with the factors that have acted so far and will continue to act in the future, new external factors from the point of view of the municipality are expected to influence the final energy consumption in the considered sectors. These new external factors are summarized in the following table.

*Table 15. Estimated additional factors/measures influencing the change of the greenhouse gas emissions levels by 2030*

<b>Main new factors / measures for the GHG emissions change by 2030</b>
<b>Residential buildings</b>
1. Implementation of new more ambitious programs for deep energy renovation of residential buildings.
<b>Buildings of the tertiary sector</b>
1. Targeted campaigns to persuade the representatives of the sector to take measures to increase the energy efficiency and the use of energy from renewable sources.
2. Decline in the trade and services due to the impact of the COVID19 pandemic.
<b>Industry and Construction</b>
1. Targeted campaigns to convince the representatives of the sectors in the benefits of the energy efficiency measures implementation and the use of energy from renewable sources; and for the establishment of energy cooperatives of the enterprises for shared production and consumption of renewable energy for their own needs.
2. Decline in production due to the impact of the COVID pandemic.
<b>Transport</b>

<i>Main new factors / measures for the GHG emissions change by 2030</i>
1. New measures in the transport sector, such as: expanding the metro network; renewing the public transport fleet by reducing the use of liquid fuels; new car parks; new paid parking areas; restricting car access to central areas of the city, etc.
2. Gradual renewal of the private cars and wider penetration of the gaseous fuels and electric cars.
<b>Municipal buildings</b>
1. More ambitious, deep energy renovation of unrenovated so far buildings with good potential for energy savings.
2. Measures introduced for the use of renewable energy in the renovated buildings and in the buildings that are to be renovated.
3. Implementation of additional energy efficiency measures in the already renovated buildings.
<b>Outside public lighting</b>
1. Larger scale modernization of the street lighting

On the other hand, in the municipal sectoral plans and programs adopted, that will be implemented in the period after 2021, there are a number of measures and projects, whose implementation will lead greenhouse gas emissions reduction as an additional benefit. During the analysis of the planning documents of Sofia Municipality the following measures with similar effect were identified:

<i>Measure / Project</i>	<i>Sector of influence in SECAP</i>
<b>Sustainable Urban Mobility Plan of Sofia Municipality, 2019-2035</b>	
Continued application of the temporary measure "green ticket" and "white ticket" for the public transport during the days with expected significant exceeding of the PM norms	Private transport
Introduction of a system of pedestrian spaces, shared streets and speed limit zones up to 30 km/h in large residential neighborhoods	Private transport
Traffic calming, parking reduction and transformation of streets in the central part of Sofia and in the big residential neighborhoods.	Private transport
Completion of the main bicycle network on the territory of Sofia.	Private transport
Completion and construction of the supporting bicycle network in the residential neighbourhoods	Private transport
Completion and construction of the recreational bicycle network on the territory of the city and the suburbs.	Private transport
Introduction of a system for shared bicycles on the territory of Sofia – 2,800 pcs.	Private transport
Deviation from the third metro line from "Evlogi Georgiev" Blvd. at the Military Academy to the County Hospital.	Public transport
Continuation of the third metro line between "Hadji Dimitar" metro station (MS5) and "Botevgradsko Shosse" Blvd. (MS1)	Public transport
Extension of the first line of the metro from "Lyulin" MS in western direction (towards the Sofia ring road) along "Tsaritsa Yoana" Blvd. with another two stations	Public transport
Delivery of rolling stock for the public transport – 1,137 psc. – trams, trolleybuses, electric buses, buses with hybrid or alternative fuel sources – 850 psc. by 2030.	Public transport
Introduction of a flexible charging policy for the public transport	Private transport
Creation of a comprehensive transport model and application of a systematic approach to the optimization of the route network.	Public transport
Construction of 5 intermodal nodes and implementation of an intermodal information system for mobility management as a service.	Private transport
Construction of new buffer car parks and other that buffer the central part of the city. Increase of the parking spaces covered by the "Park and travel" system.	Private transport
Expanding the territorial and temporal scope of the paid parking zones and taxes increase. Reduction of the maximum allowable number of vignette stickers for a separate residential property in the paid parking zones - up to 1. Reduction of the number of parking spaces in the paid parking subzones.	Private transport



Measure / Project	Sector of influence in SECAP
Development of a charging infrastructure for electric vehicles on the territory of Sofia Municipality - 70 municipal charging stations and 300 private charging stations.	Transport
<b>Complex program for improvement of the air quality on the territory of Sofia Municipality for the period 2021-2026.</b>	
Scenarios for the household firewood and coal consumers switching to natural gas and pellets	Жилищни сгради
Introduction of a low emissions transport zone in the central part of Sofia	Транспорт
<b>Short-term program of Sofia Municipality to promote the use of energy from renewable sources and bio-fuels, 2020-2022</b>	
Construction of solar installations for DHW energy production	Municipal buildings
Change of the fuel base of 2 schools and transfer to wood pellets	Municipal buildings
Projects aimed at improving the air quality by replacing the old solid fuel heating appliances in the households under the 2014- 2020 LIFE Program of the European Union and the "Environment 2014-2020" Operational Program.	Residential buildings
<b>Waste management program, 2015-2020</b>	
CHP installation in Sofia with RDF waste utilization - stage III of the Integrated System	Indirect influence through the heat emission factors of the sectors: Residential buildings, Tertiary sector, Industry and Municipal buildings.

According to documentation of the project "CHP installation in Sofia with RDF waste utilization" – Stage III of the Integrated System, a reduction of 20 thousand tCO<sub>2</sub> greenhouse gas emissions per year is expected after its implementation. As the district heating sector is outside the scope of the SECAP, and this reduction would be realized in the production of heat, it does not have a direct impact on the plan outcomes. Indirectly, this reduction in emissions will affect the "Residential Buildings", the "Tertiary Sector Buildings", the "Industry" and the "Municipal Buildings" sectors through the lower emission factor of the heat that will be used by the end users in the sectors. Since the SECAP provides for a measure for reduction of the heat emission factor (Measure C.1.4) there is a prerequisite for duplication of the effect; therefore the influence of the project is not taken into account in the scenario considered in this chapter.

In result of the joint action of all above factors, the measures and projects outside the plan, the final energy consumption in the sectors, covered by the current plan by 2030, is expected to decrease by about 1,216 GWh/year compared to the consumption registered in 2018. It should be especially emphasized that in order to achieve this result, the successful implementation of the measures provided for in the SUMP of SM is of particular importance.

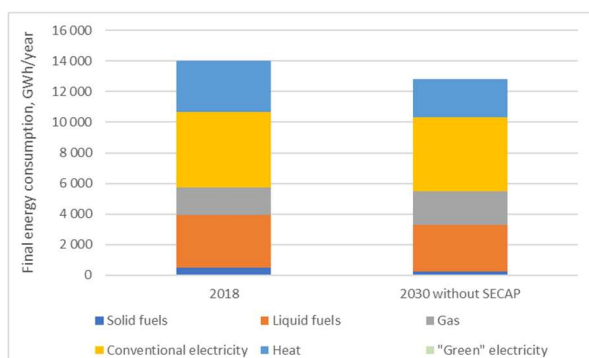


Figure 25. Final energy consumption in 2030 without additional measures in the SECAP, compared to the consumption in 2018 - distribution by fuels and energy, GWh/year

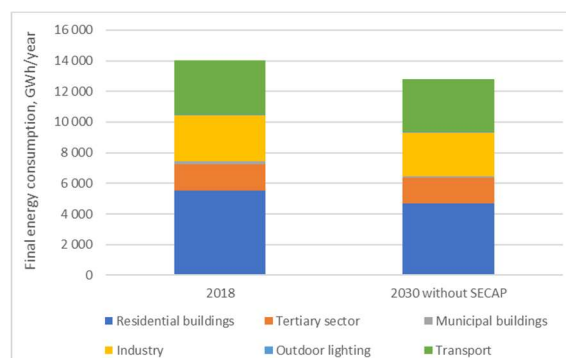


Figure 26. Final energy consumption in 2030 without additional measures in the SECAP, compared to the consumption in 2018 - distribution by sectors, GWh/year

The two figures above present the comparison of the final energy consumption in the defined SECAP scope during the two years - broken down by type of fuel and energy (Figure 25) and by sectors (Figure 26).

**4.5.2. Use of renewable energy without additional measures in the SECAP**

According to the assessment of the factors, measures and projects outside the SECAP, listed in the previous chapter, the annual consumption of renewable energy in the sectors covered by this plan is expected to be around 281 GWh by 2030. The share of the biomass is still expected to predominate, but the utilized energy by heat pumps and electricity from photovoltaics are expected to prevail, especially in tertiary buildings.

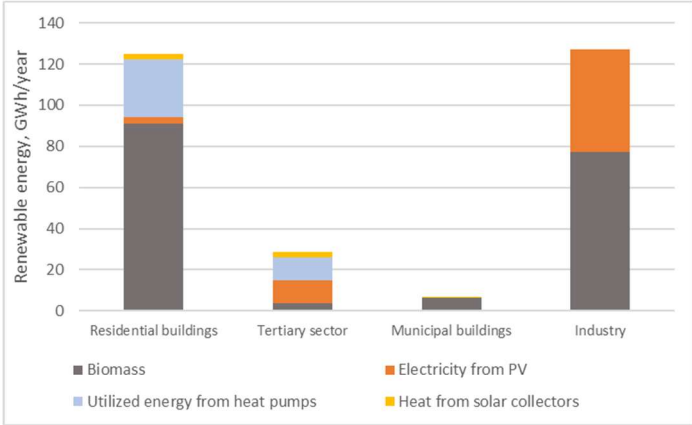


Figure 27. Annual renewable energy consumption by 2030 in the scenario "without measures in the SECAP" - distribution by type of renewable sources

**4.5.3. Greenhouse gas emissions related to the energy consumption, without additional measures in the SECAP**

In accordance with the presented forecasts for the final energy consumption changes within the defined scope by 2030, but without the implementation of the additional measures recommended in this plan, as well as for the use of renewable energy by 2030, the greenhouse gas emissions related to energy consumption for 2030 have been calculated. It is expected that the total annual of emissions by 2030 will decrease to 3,878 thousand tCO<sub>2e</sub>, which is a decrease of about 12.3% compared to the emissions related to the energy consumption in the considered scope in 2018.

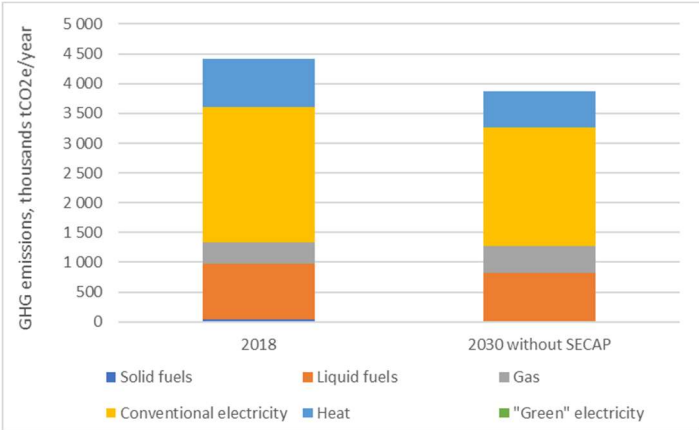


Figure 28. Comparison of the level of GHG energy emissions of Sofia Municipality in 2030 in the scenario "without measures in the SECAP" and the level of GHG emissions in 2018 - distribution by fuel types

#### 4.6. Potential for reduction of the greenhouse gas emissions without measures in the SECAP

Besides the GHG emissions reduction related to the energy consumption described in the previous chapter, the emissions in the “Waste” sector are expected to be reduced by 2030 also, again without taking into account the measures defined in this plan. This is mainly due to the activities implemented during the implementation of the first two stages of the integrated waste management system of Sofia Municipality, as a result of which the amount of landfilled waste is reduced. By 2030, without taking additional measures in the SECAP, the annual emissions from the “Waste” sector are expected to decrease to 137.6 thousand tCO<sub>2e</sub>, which is 27.8% less than those in 2018.

The total amount of expected annual GHG emissions without additional measures in the SECAP by 2030 is 4,015.7 thousand tCO<sub>2e</sub>. Compared to the total annual emissions in 2018, the decrease is 12.9% (Figure 29).

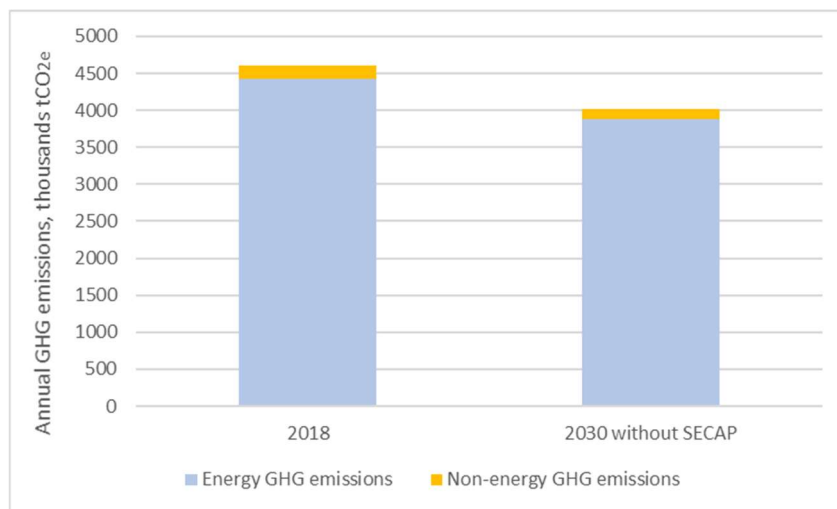


Figure 29. Comparison of the overall level of GHG emissions of Sofia Municipality in 2030 in the scenario "without measures in the SECAP" and the level of GHG emissions in 2018

#### 4.7. Selection of measures, activities and projects for the climate change mitigation

The choice of measures to mitigate the climate change is in line with the first strategic goal of the plan – *Sofia - Climate Neutral City* and the expectations of GCMCE for the associated municipalities to reduce their greenhouse gas emissions by at least 40%. In addition, the measures contribute to the final energy consumption reduction and increase of the use of renewable energy.

The developed measures are systematized in four categories depending on the field of their application, and fully cover the proposed types of measures according to the recommended by SEDA instructions for preparation of municipal programs for the promotion of the use of renewable energy and biofuels - administrative and financial and technical measures. The groups of measures (categories) in the SECAP are as follows:

1. **Legal-administrative and management framework for climate policy** - measures related to the legislative initiative and the development of normative documents, including internal rules and municipal regulations.
2. **Improvement of the climate change mitigation activities management** - measures

related to the information base improvement for the implementation of the plans, programs and projects.

3. **Investment measures to reduce the greenhouse gas emissions and/or increase the share of renewable energy used**, investment measures to intervene in the physical environment (urban and suburban).
4. **Establishment of a system for broad public involvement in the measures implementation** - measures related to communication with stakeholders, provision of information, engagement of the individual sectors representatives in the realization of the activities for support of the plan objectives implementation.

Each measure is described separately in the respective category, having a specific identification number, consistent with the numbering of the categories. When presenting each measure, its most important characteristics are displayed in separate color fields. For each measure, in a special field at the top right corner, are listed the numbers of the measures with which the described measure is logically connected. Another field, on the right side of the list, indicates the addressed specific “mitigation” targets, the sectors concerned, and the expected effect of the measure implementation, the required budget and the deadlines for the envisaged actions implementation. The measures budgets are calculated with VAT. A description of the activities is included in the presentation of the measures, their scope and benefits, as well as the managers and stakeholders.

The specific mitigation targets are derived from the strategic objectives set and the measures developed and are presented in section 4.8.

## C.1 Legal-administrative and management framework for climate policy

### C.1.1

#### Introduction of gradual restriction of the use of high-emission fuels and open combustion heating devices

### C.1.1 – C.2.1

#### Description

The measure envisages the gradual restriction of the use of high-emission fossil fuels for heating on Sofia Municipality territory, namely coal and liquid fuels, as well as a ban on the use of low-efficiency heating devices with open combustion chambers. By 2030, a complete restriction on the use of coal as well as of liquid fuels for heating purposes must be introduced. The measure is related to the greenhouse gas emissions reduction, as coal and liquid fuels are the two with the highest greenhouse gas emission factors; but also with the improvement of the air quality, the living comfort and the restriction of the forest biomass and coal inefficient use (having a share of 23% and 19%, respectively, in PM pollution according to the NIMH data for a assessed period in 2020). The replacement of the combustion installations will increase the heat production efficiency and will reduce the final energy consumption in the affected sectors.

The creation and entry into force of a municipal ordinance is required. It can be developed on the basis of Art. 28a, para. 1, item 2 of the Clean Air Act.

The measure complements the 2021-2026 AAQP, which examines scenarios for the transition of the domestic sector from wood and coal heating to heating with more environmentally friendly alternatives.

The parties, affected by the measure will need to be re-equipped to use different, more environmentally friendly and efficient ways for heat production. The measure can be combined with the targeted support of the vulnerable households. The schedule for the gradual introduction of the restrictions should be developed in the ordinance, providing sufficient time for the affected parties to prepare for the new conditions after the normative document enters into force.

The measure does not affect the use of liquid fuels for technological needs in the enterprises.

#### Scope

The whole territory of Sofia Municipality

#### Responsible

“Climate, Energy and Air” Directorate

Stakeholders: citizens / businesses

The role of SM: establishment of ordinance / promotion / control

#### *Specific objectives of the plan:*

**Reduction of the greenhouse gas emissions by 40% per capita until 2030 compared to the 2007 levels**

**800 GWh reduction of the final annual energy consumption by 2030 compared to 2018**

**400 GWh final annual renewable energy consumption by 2030**

#### *Sectors concerned:*

**Residential buildings  
Tertiary sector  
Municipal buildings  
Industry**

#### *Expected effect by 2030:*

**EE: 59 GWh/year  
RES: 113,6 GWh/year  
Emissions: 28 thousand tons CO<sub>2e</sub>/year**

#### *Budget required:*

**BGN 12 thousand for the development**

#### *Potential sources:*

**SM budget**

#### *Deadline for implementation:*

**2022 for the creation of a schedule and gradually, up to 2030 according to the schedule**

## C.1 Legal-administrative and management framework for climate policy

### C.1.2

**Gradual increase of the share of electricity from renewable energy sources to meet the needs of the public and the interdepartmental transport**

**C.1.2 – C.1.6 – C.1.7 – C.3.4**

#### Description

Electricity use in the transport sector is expected to increase due to the wider market penetration of the electric vehicles. Because of the high national emission factor for electricity, the electricity consumption is associated with a large amount of greenhouse gas emissions. These emissions will be significantly reduced if part of the conventional electricity is replaced with RES energy.

Due to the higher price of the energy from renewable sources, it will be associated with an increase in the energy costs of the municipality and the respective municipal companies. Therefore, the increase of the share of the purchased renewable energy, should be gradual. The calculations made for the measure are based on the assumption that by 2030 the electricity share from RES, used for the needs of public and interdepartmental transport, will reach 50% by 2030. This percentage can be adjusted after further interim greenhouse gas emissions inventories and revisions of the plan depending on the implementation of its objectives, the investments made in own "green" electricity production, the development of "green" charging infrastructure for the electric mobility in the municipality and the development of a regulatory framework that allows the "green" energy produced at one location to be used for own needs at another location.

#### Scope

The whole territory of Sofia Municipality

#### Responsible

"Transport and Urban Mobility" Division

Support unit: "Climate, Energy and Air" Directorate

The role of SM: creation of regulation / control

#### *Specific objectives of the plan:*

**Reduction of the greenhouse gas emissions by 40% per capita until 2030 compared to the 2007 levels**

**400 GWh final annual renewable energy consumption by 2030**

#### *Sectors concerned:*

**Transport  
Street lighting**

#### *Expected effect by 2030:*

**RES: 92,5 GWh/year  
Emissions: 42,8 thousand tons  
CO<sub>2e</sub>/year**

#### *Budget required:*

**Depending on the needs after the intermediate inventories of greenhouse gas emissions**

#### *Potential sources:*

**SM budget**

#### *Deadline for implementation:*

**2030**

## C.1 Legal-administrative and management framework for climate policy

### C.1.3

**Creation of preconditions for the renovation of buildings to the highest levels of energy performance and the construction of new buildings with zero-energy consumption and plus energy buildings**

A.1.1 – C.1.3

#### Description

The implementation of the measure aims to expand the private initiative and to direct more private funds in the buildings renovation to high efficiency levels and the construction of new buildings with nearly zero-energy consumption or plus energy buildings.

The existing incentives at the national level (recorded in the LLTF, Art. 24, item 18 and item 19) related to the energy renovation of buildings are outdated, encourage the renovation of buildings to less energy efficient consumption classes such as "C" and even "D". These outdated incentives are in conflict with the policies for buildings renovation to the highest levels of efficiency. Sofia Municipality will take a legislative initiative to change these incentives in the direction of supporting the renovation of buildings to higher levels of efficiency.

According to the provisions of the *Energy Efficiency Directive* and the *National Plan for Nearly Zero-Energy Buildings* as of the beginning of 2021, all new buildings must be built according to the national definition of buildings with nearly zero-energy consumption. The shared by Sofia Municipality higher ambitions related to the full decarbonization of the economy in the long run until 2050, suggest the gradual moving to an even higher level of energy efficiency – nearly zero energy and plus energy buildings. So far, the national legislation does not provide any incentives for this type of construction.

In order to achieve its high political goals in terms of energy and climate policies, Sofia Municipality needs to introduce new appropriate incentives in line with these policies. This will also favour the early introduction of high energy efficient buildings construction, greater savings in greenhouse gas emissions and increase of the renewable energy use in the building stock of Sofia Municipality. At the same time, a smooth transition will take place and the businesses will be better prepared to quickly adapt to the higher requirements that will inevitably be introduced in the coming periods.

**Scope:** The whole territory of Sofia Municipality

**Responsible:** "Architecture and Urban Planning" Division

Support unit: "Public Constructions" Division / "Climate, Energy and Air" Directorate

The role of SM: establishment of regulations / control

*Specific objectives of the plan:*  
**Reduction of the greenhouse gas emissions by 40% until 2030 compared to the 2007 levels**

**800 GWh reduction of the final annual energy consumption by 2030 compared to 2018**

**400 GWh final annual renewable energy consumption by 2030**

*Sectors concerned:*

**Residential buildings  
Tertiary sector**

*Expected effect by 2030:*

**EE: 53,9 GWh/year  
RES: 33,6 GWh/year  
Emissions: 19,1 thousand tons CO<sub>2e</sub>/year**

*Budget required:*

**Not applicable**

*Potential sources:*

**Not applicable**

*Deadline for implementation:*

**2023**



## C.1 Legal-administrative and management framework for climate policy

### C.1.4

**Reduction of the emissions factor of the heat supplied by “Toplofikacia Sofia” EAD, including taking into account the possibilities for use of renewable energy sources**

### C.1.4

#### Description

The share of energy from district heating in the final energy consumption in key sectors of the plan scope is high. In 2018, it was 50% in the “Residential sector”, 23% in the “Tertiary sector” and 55% in the “Municipal buildings”. “Toplofikacia Sofia” EAD can reduce the value of the heat emissions factor by at least 5% by 2030 by implementing energy efficiency measures in the heat production and transmission and by use of renewable energy sources. This will help to realize savings in greenhouse gas emissions in the three listed sectors within the plan scope. As the heat supply is outside the scope of SECAP, there are no prerequisites for “double accounting” of the reduced emissions in Sofia Municipality. The measure should be taken into account when conducting the study for modernization of the company, for which it has concluded an agreement with the US Agency for Trade and Development; the results of the study should be included in the business plan and the investment program of the company.

The district heating company is an obligated person under Art. 14a, para. 4 of the EEA and must meet annual targets for energy consumption reduction by end users. For the implementation of this measure the company could plan activities that also lead to the implementation of these annual objectives.

Sofia Municipality will suggest to the company to include in its business plan the implementation of activities for a 5% reduction of the emission factor achievement, after the cited study is prepared.

#### Scope

The whole territory of Sofia Municipality

#### Responsible

“Toplofikatsiya Sofia “ EAD

Support units: “Climate, Energy and Air” Directorate / “Architecture and Urban Planning” Division

The role of SM: initiation / control

#### *Specific objectives of the plan:*

**Reduction of the greenhouse gas emissions per capita by 40% until 2030 compared to the 2007 levels**

#### *Sectors concerned:*

**Residential buildings**

**Tertiary sector**

**Municipal buildings**

#### *Expected effect by 2030:*

**EE: 8,4 GWh/year**

**RES: 1,1 GWh/year**

**Emissions: 27,1 thousand tons CO<sub>2e</sub>/year**

#### *Budget required:*

**Not applicable**

**To include in the business plan of the company the implementation of activities for the emissions factor reduction by 5% achievement after the cited study has been prepared.**

#### *Deadline for implementation:*

**2022 for the preparation of the plan-schedule and in accordance with it – the implementation until 2030**

## C.1 Legal-administrative and management framework for climate policy

### C.1.5

**Introduction of a requirement for all new municipal buildings to be built up to the "nearly zero energy building" level**

### C.1.5 – C.3.6

#### Description

According to the provisions of the Energy Efficiency Directive and the National Plan for Nearly Zero-Energy Buildings, as of the beginning of 2021, all new buildings must be built according to the national definition for "nearly zero-energy buildings". Despite the delay in the introduction of this requirement in the regulations affecting the new buildings construction at the national level, Sofia Municipality must begin to apply this requirement in the construction of the new municipal buildings in accordance with its high policy goals in the field of energy and climate. This can most easily happen if a requirement is introduced when announcing contracts under the Public Procurement Act for the construction of a new building to set requirements for mandatory application of the national definition for "nearly zero-energy buildings", defined in the additional provisions, para. 1, item 28 of the EEA. If the construction of new buildings, with a lower level of energy efficiency and without renewable energy installations continues, the municipality will get into a situation to reinvest in these buildings for improvement of their energy performance at a later stage.

#### Scope

The whole territory of Sofia Municipality

#### Responsible

"Public Construction" Division

#### *Specific objectives of the plan:*

**Reduction of the greenhouse gas emissions by 40% per capita until 2030 compared to the 2007 levels**

**800 GWh reduction of the final annual energy consumption by 2030 compared to 2018**

**400 GWh final annual renewable energy consumption by 2030**

#### *Sectors concerned:*

**Municipal buildings**

#### *Expected effect by 2030:*

**EE: 0,5 GWh/year**

**RES: 0,2 GWh/year**

**Emissions: 0,1 thousand tons CO<sub>2e</sub>/year**

#### *Budget required:*

**Not applicable**

#### *Potential sources:*

**SM budget**

#### *Deadline for implementation:*

**2021**

## C.1 Legal-administrative and management framework for climate policy

### C.1.6

**Provision of access to the data for the actual annual mileage and the fuels used by the registered vehicles on the territory of the municipality**

#### Description

To account more accurately the emissions from the private road transport, it is necessary to provide data on the actual mileage of the cars and the type of fuels used. Such data are collected during the mandatory annual technical inspections.

The measure envisages the written notification of the initiative addressed to the Ministry of Transport and Information Technology and Communications on behalf of Sofia Municipality to create the necessary prerequisites for the preparation and provision of the necessary information. The minimum required information is: 1) number of vehicles that have passed technical inspection on the territory of Sofia Municipality in the previous year and are registered in Sofia Municipality - by type (passenger cars, light trucks, heavy-duty trucks, motorcycles and mopeds) and by fuels/energy used; 2) average annual mileage of the cars that have passed technical inspection on the territory of Sofia Municipality in the previous year and are registered in Sofia Municipality - by types and fuels/energy used. The reports should be submitted annually.

For the purposes of the additional analyzes, outside this plan' scope and related to the air quality, information on the environmental categories (Euro norm) may be requested to be added in the reports also.

#### Scope

The whole territory of Sofia Municipality

#### Responsible

"Climate, Energy and Air" Directorate

Stakeholders: MTITC

The role of SM: negotiations

### C.1.6

#### *Specific objectives of the plan:*

**Implementation of a fully functional information system for the purposes of reporting on the climate change mitigation measures and the future planning**

#### *Sectors concerned:*

**Transport**

#### *Expected effect by 2030:*

**See measure C.1.7**

#### *Budget required:*

**Not applicable**

#### *Potential sources:*

**Not applicable**

#### *Deadline for implementation:*

**2023**

## C.1 Legal-administrative and management framework for climate policy

### C.1.7

Creation of favorable conditions for the construction of "green" electric charging stations, including through public-private partnerships

A1.1 – C.1.7 – C.1.10 – C.1.2

#### Description

The increase of the electric cars share will be achieved gradually, in a natural way, by increasing the production and marketing of this type of cars. As the national emission factor for electricity is high due to the characteristics of the national energy system, this process cannot lead to a reduction of the greenhouse gas emissions in the transport sector.

In the adopted and currently acting SUMP of SM for 2019-2035, the implementation of the measure *Intensive construction of charging infrastructure for electric vehicles* is planned. This measure is complementary, and aims to improve the electrical infrastructure and approaches to the charging points, which is necessary for the implementation of the measure of SUMP, to provide also conditions for the development of "green" charging points for vehicles.

The use of "green" electricity from renewable energy sources for cars charging will allow the emissions reduction. This is very important given the significant share of the "Transport" sector in the total emissions in the scope of SECAP. For this purpose, it is necessary to create conditions by building "green" power charging stations, offering energy from renewable sources, including those produced near the site.

Sofia Municipality will take a legislative initiative with a letter to the Ministry of Regional Development and Public Works and the Ministry of Energy to introduce requirements for the car charging stations which will enable the customers to charge "green" electricity. It is also necessary to create a regulatory opportunity for the investors in electric charging stations to be able to produce electricity from renewable energy sources for their own needs in a place far from the site of the charging stations and to use it profitably for themselves in the charging station. In this way, Sofia Municipalities will have the opportunity to support the projects for the "green" charging stations construction by providing areas for the construction of installations for the production of electricity from renewable sources through public-private partnerships (Measure C.1.10).

#### Scope

The whole territory of Sofia Municipality

#### Responsible

"Transport and Urban Mobility" Division

Support structure: "Climate, Energy and Air" Directorate

The role of SM: assignment / control / promotion / implementation

#### *Specific objectives of the plan:*

**Reduction of the greenhouse gas emissions by 40% per capita until 2030 compared to the 2007 levels**

**400 GWh final annual renewable energy consumption by 2030**

#### *Sectors concerned:*

**Transport**

#### *Expected effect by 2030:*

**EE: 190,3 GWh/year**

**RES: 60,1 GWh/year**

**Emissions: 49,5 thousand tons CO<sub>2e</sub>/year**

**! This effect is achieved by the joint actions of measures C.1.6 and R.1.7 !**

#### *Budget required:*

**Not applicable**

#### *Potential sources:*

**Not applicable**

#### *Deadline for implementation:*

**2023**

## C.1 Legal-administrative and management framework for climate policy

### C.1.8

Creation of a local eco-label/certificate and rules for the buildings, using renewable energy, awarding

C.1.8 – C.3.1 – C.3.2 – C.3.4

#### Description

Creation of a local eco-label/certificate to promote the use of renewable sources in buildings and multiply these measures by collecting information on the type of technology used and evaluation of the "clean" energy used for own consumption. The measure will also support the analysis and planning in the field of energy use.

#### Scope

The whole territory of Sofia Municipality

#### Responsible

"Climate, Energy and Air" Directorate

The role of SM: assignment / control / promotion

#### *Specific objectives of the plan:*

**Provision of a broad public support for the climate change mitigation policies, in order to build a positive attitude towards the policies of more than half of the population of the capital**

#### *Sectors concerned:*

**Residential buildings  
Tertiary sector  
Municipal buildings**

#### *Expected effect by 2030:*

**EE: 33,2 GWh/year  
RES: 33,2 GWh/year  
Emissions: 14,6 хил. тона  
CO<sub>2e</sub>/year**

**! This effect is achieved by the joint actions of measures C.1.8, C.1.10, C.3.1 and C.3.2 !**

#### *Budget required:*

**BGN 8 thousand**

#### *Potential sources:*

**SM budget**

#### *Deadline for implementation:*

**2023**

## C.1 Legal-administrative and management framework for climate policy

### C.1.9

**Creation of procedures, rules and model for the construction of heat pump installations that utilize the heat of shallow waters, geothermal energy and the energy of the sewerage systems wastewater**

**C.1.9 – C.3.3 – C.3.4**

#### Description

The creation of manuals and models for the construction of heat pump installations using water heat will contribute to the wider penetration of the technology that provides a high seasonal conversion factor above 5. Water-connected heat pumps can be two or more times more efficient than the aero-thermal ones, but there are obstacles and/or regulatory ambiguities regarding the use of energy of this source. The main obstacles are the lengthy procedures for obtaining a water use permit and the price of the water drawn for energy purposes. There is no practice in Bulgaria and a model developed for the wastewater energy use in the sewerage system and its use in private sites. The development of a guide for promotion of working models for utilization of these energy sources will help for the wider introduction of the technology into practice.

It is also necessary to study the potential places of the sewerage system, where is technically feasible and economically advantageous to install heat exchangers and connect them to the heat pump installations. The analytical part of the guide will also include the location of the suitable areas in Sofia, with high groundwater or surface water sources that are suitable for the buildings heating and cooling and provision of domestic hot water.

#### Scope

The whole territory of Sofia Municipality

#### Responsible

“Architecture and Urban Planning” Division

The role of SM: assignment / control / promotion / implementation

#### *Specific objectives of the plan:*

**Reduction of the greenhouse gas emissions by 40% per capita until 2030 compared to the 2007 levels**

**400 GWh annual final annual renewable energy consumption by 2030**

#### *Sectors concerned:*

**Residential buildings  
Tertiary sector  
Municipal buildings**

#### *Expected effect by 2030:*

**See measure C.3.3**

#### *Budget required:*

**BGN 50 thousand**

#### *Potential sources:*

**SM budget**

#### *Deadline for implementation:*

**2022**

## C.1 Legal-administrative and management framework for climate policy

### C.1.10

**Creation of rules and a model of public-private partnership to ensure the wider penetration of RES in the municipal building stock**

**C.1.10 – C.1.8 – C.2.1 – C.3.3**

#### Description

Sofia Municipality owns over 850 buildings and parts of buildings, and in practice each of these sites can use a renewable energy source. As part of the process of technical passports preparation and the energy performance certification, an analysis of their structural condition is made and the potential for energy use from renewable energy sources is assessed. This data needs to be summarized and systematized and, where such information is missing, to be updated. The typification of the sites by functionality and way of use, construction and features of the potential for use of RES is also important for the identification of the potential opportunities in the form of a database, which could be part of the monitoring system along with the database under measure 3.5.

Installations for the use of energy from renewable sources require a higher initial investment compared to the conventional technologies, but in the long run the investment pays back and significantly reduces the energy costs at the site where it is built. Attracting private investment through public-private partnerships will accelerate the introduction of these technologies and ensure their good management and operation. The lack of such investments in Sofia municipal buildings requires the creation of rules and a model of which the owner of the buildings - Sofia Municipality, or their users, secondary and tertiary spending units can benefit. The model/models of work must ensure the protection of the public interest and create a favorable environment for the investments in the use of "clean" energy. Examples of such public-private partnerships are: renting rooftops of municipal buildings to build photovoltaic installations for own use by selling the surplus energy; energy performance contracts which include renewable energy sources (incl. obligated persons under the Energy Efficiency Act); and other initiatives with private investors.

The models must comply with the Public-Private Partnership Act and the applicable legislation for development of renewable energy capacities.

#### Scope

The whole territory of Sofia Municipality

#### Responsible

"Climate, Energy and Air" Directorate

Support units: "Public Construction" Division / "Architecture and Urban Planning" Division

The role of SM: assignment / control / promotion / implementation

#### *Specific objectives of the plan:*

**Reduction of the greenhouse gas emissions by 40% per capita until 2030 compared to the 2007 levels**

**400 GWh final annual renewable energy consumption by 2030**

#### *Sectors concerned:*

**Residential buildings  
Tertiary sector  
Municipal buildings**

#### *Expected effect by 2030:*

**See measure C.1.8.**

#### *Budget required:*

**BGN 18 thousand**

#### *Potential sources:*

**SM budget**

#### *Deadline for implementation:*

**2022**



## C.1 Legal-administrative and management framework for climate policy

### C.1.11

#### Introduction of a system of incentives to increase the separate collection of municipal waste at source

### C.1.11 – C.3.11

#### Description

Legislative initiative through a letter to the Ministry of Finance and the Ministry of the Environment and Waters, on the possibility of introducing a system of incentives for meeting the requirements of the WMA for separate collection of municipal waste at source. This measure is part of a comprehensive approach to improve the separate collection of waste, incl. introduction of separate collection of bio-waste from households in multifamily residential buildings. Depending on the system that the municipality will choose to apply, specific incentives can be formulated.

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*\* It should be kept in mind that the Waste Management Program of Sofia Municipality for 2021-2028 has not been developed yet. The measures to encourage the citizens for separate waste collection will be examined and developed in the program.*

#### Scope:

The whole territory of Sofia Municipality; the system can start to operate in selected areas and then expand gradually.

#### Responsible:

“Waste Management and Control Activities” Directorate

The role of SM: legislative initiative initiation, promotion

#### *Specific objectives of the plan:*

**Reduction of the greenhouse gas emissions by 40% per capita until 2030 compared to the 2007 levels**

#### *Sectors concerned:*

**Waste**

#### *Expected effect by 2030:*

**See measure C.3.11**

#### *Budget required:*

**BGN 20 thousand**

#### *Potential sources:*

**SM budget**

#### *Deadline for implementation:*

**2022**

## C.2 Improvement of the climate change mitigation activities management

### C.2.1

#### Creation of spatial map of RES sites by type of technology

C.1.8 – C.1.10 – **C.2.1** – C.2.2  
– C.2.4

#### Description

With each passing year, the number of sites that use RES on the territory of Sofia Municipality is growing, and their importance for the final energy consumption increases. At the same time, there is lack of systematic information about the installations used, which would allow an accurate assessment of their operation effect. SEDA collects information only on the energy produced by installations for which guarantees of origin are issued.

The measure proposes the creation of a spatial map of the sites with RES by technology types in order to monitor the development of the sector, promote its potential and plan the measures in this direction. The creation of the map will help to analyze the applicability of the technologies by districts and territorial units and plan the measures for their development. The map will include administrative data for each of the sites, data on the technology, the installed capacity and expected amount of energy. Data may be collected from the new sites commissioning permits, from the energy audits and other information on the existing ones. The installation companies can also take part with data for the installations made in previous years, as well as for the heat pumps using aero-thermal energy, whose installation is not subject to a permit or notification regime.

Similar maps have already been created as a result of private initiatives and whose authors' cooperation can be sought for exchange of information. The collected data will be gradually supplemented with data from the register, that will be created under measure C.2.3, data from the energy audits and information entered by the suppliers and/or installers and investors.

#### Scope

The whole territory of Sofia Municipality

#### Responsible

“Climate, Energy and Air” Directorate

Support unit: ME “Sofiaplan”

The role of SM: initiation / partnership / promotion

#### *Specific objectives of the plan:*

**Implementation of a fully functional information system for the purposes of reporting on the climate change mitigation measures and the future planning**

**Provision of a broad public support for the climate change mitigation policies, in order to build a positive attitude towards the policies of more than half of the population of the capital**

#### *Sectors concerned:*

**Residential buildings  
Tertiary sector  
Municipal buildings  
Industry**

#### *Expected effect by 2030:*

**See measure C.1.8**

#### *Budget required:*

**BGN 50 thousand**

#### *Potential sources:*

**SM budget**

**European Climate Initiative (EUKI)**

#### *Deadline for implementation:*

**2023**

## C.2 Improvement of the climate change mitigation activities management

### C.2.2

**Practical guide preparation related to the regulatory and other requirements and principles for the establishment of renewable energy communities**

C.1.8 – C.1.10 – **C.2.2** – C.2.1

#### Description

The creation of renewable energy communities as well as consumers of self-produced electricity are supported in the European RES Directive; in practice this happens at the local level, at a building or group of buildings level and covers mainly household; partnership with legal entities is also possible. The acceleration of the process, of which Sofia Municipality will also benefit, requires the clarification and promotion of the models of cooperation and financing; construction installation; the use of energy for own needs or sales; as well as other legal and financial issues. The development of a practical manual aims to provide information and examples of such projects implementation and the benefits for the participants in the models.

#### Scope

The whole territory of Sofia Municipality

#### Responsible

“Climate, Energy and Air” Directorate

The role of SM: assignment / control / promotion

#### *Specific objectives of the plan:*

**Provision of a broad public support for the climate change mitigation policies, in order to build a positive attitude towards the policies of more than half of the population of the capital**

#### *Sectors concerned:*

**Residential buildings  
Tertiary sector  
Municipal buildings  
Transport**

#### *Expected effect by 2030:*

**See measure C.1.8**

#### *Budget required:*

**BGN 30 thousand**

#### *Potential sources:*

**SM budget**

**EUKI**

#### *Deadline for implementation:*

**2025**

## C.2 Improvement of the climate change mitigation activities management

### C.2.3

**Establishment of a unified register for the energy performance of the new buildings on the territory of Sofia Municipality, including the production of energy from renewable sources**

C.1.8 – **C.2.3** – C.3.6 – C.3.7

#### Description

SEDA has developed a national register of the energy performance of buildings. However, only information on the existing buildings, obtained after conducting energy audits and issuance of energy performance certificates for the buildings in operation, reaches in full the register.

According to the requirements of the EEA, before commissioning of all new buildings it is mandatory to issue an energy performance certificate for the building, which indicates its specific annual energy consumption and the share of energy from renewable sources. This document is submitted by the investor together with the project documentation to the bodies responsible for its approval, which in most cases are part of the municipal administrations. The creation of a unified online register of the energy performance of the new buildings in Sofia Municipality and of internal rules for the timely data entry by the responsible persons will allow the municipality to have clear and with high level of accuracy information for the estimation of the energy consumption of the new buildings and the renewable energy used. It should be developed taking into account the characteristics of the national register and allow easy transfer of information to it.

#### Scope

The whole territory of Sofia Municipality

#### Responsible

“Architecture and Urban Planning” Division

Support units: District administrations

The role of SM: assignment / control / implementation

#### *Specific objectives of the plan:*

**Implementation of a fully functional information system for the purposes of reporting on the climate change mitigation measures and the future planning**

#### *Sectors concerned:*

**Residential buildings  
Tertiary sector  
Municipal buildings**

#### *Expected effect by 2030:*

**Existence of a rich database for assessments and analyzes related to energy efficiency, use of renewable energy and GHG emissions in the building sector**

#### *Budget required:*

**BGN 30 thousand**

#### *Potential sources:*

**SM budget**

#### *Deadline for implementation:*

**2022**

## C.2 Improvement of the climate change mitigation activities management

### C.2.4

#### Expansion of the system for food waste separate collection

C.1.11 – C.1.12 – **C.2.4** –  
C.3.11

#### Description

A module, aimed at registering the food waste "suppliers", could be developed within the existing Information System of Waste Management of the Municipality. Sofia Municipality has categorized the food and entertainment establishments, each of which is a potential food waste supplier. Also, the district administrations maintain files for the "Commercial sites", some of which also generate food waste (term expired). The integration of the existing databases would make it possible to identify a larger number of sites to be serviced by the ME "Sofia Waste Treatment Plant". The functionalities of the module could be extended with an interactive map of the registered suppliers and possibilities for generating optimal schedules for collection and transportation of the food and kitchen waste, depending on the number of submitted applications and the amount of waste. The system could also register manufacturers from the food industry, which in cases of rejects or production of non-standard products can make requests to the system. In this way, the necessary additional amounts of food waste could be provided to reach the capacity of the Khan Bogrov waste treatment plant and prevent the disposal of bio-waste and the generation of greenhouse gas emissions during landfilling.

The steps that could be taken are: analysis of the existing information files, assessment of the possibilities for their integration, discussion of the desired functionality of the module, incl. degree of information publicity, development of terms of reference, assignment of the service, programming and implementation.

#### *Specific objectives of the plan:*

**Reduction of the greenhouse gas emissions by 40% per capita until 2030 compared to the 2007 levels**

#### *Sectors concerned:*

**Waste**

#### *Expected effect by 2030:*

**See measure C.3.11**

#### *Budget required:*

**BGN 50 thousand**

#### *Potential sources:*

**SM budget**

#### *Deadline for implementation:*

**2024**

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*\* It should be kept in mind that at present the Waste Management Program of Sofia Municipality for 2021-2028 has not been developed yet, in which the specific measures will be examined and developed.*

#### Scope

The whole territory of Sofia Municipality

#### Responsible

"Waste Management and Control Activities" Directorate

The role of SM: assignment / control / promotion / implementation

## C.2 Improvement of the climate change mitigation activities management

### C.2.5

#### Introduction of a system for data collection on the morphological composition of the waste entering the landfills for accurate greenhouse gas emissions calculation

C.1.11 – C.2.5 – C.3.11

#### Description

The generation of landfill gas (average methane content about 50% and CO<sub>2</sub> about 35%) is a function of the anaerobic decomposition of the waste bio-degradable components. In this sense, the morphological composition of the waste and more precisely, the content of bio-degradable fractions in it, as well as the amount of landfilled waste distributed over time, is the basis for the assessment of the possibilities for landfill gas generation in the landfills. The “Suhodol Depot” stages I and II have been decommissioned; and in 2014 and installation for disposal and utilization of the landfill gas in “Suhodol Depo” stage II was built, which produces electricity and heat. There are 18 vertical exhaust wells in the “Dolni Bogrov” landfill, which is closed for reclamation, but the generated landfill gas is not burned on a torch and is not utilized, as the last working horizon has not been reached yet and horizontal gas drainage has not been built. The same applies to the “Sadinata Depot”, where 11 gas wells have been built. In the Annual Environmental Reports of both sites, the amounts of methane and CO<sub>2</sub> generated are calculated according to the CORINAIR 94 methodology, based on results from the periodic measurements of the gas wells emissions. The methodology used to determine the greenhouse gas emissions for the purposes of the SECAP is based on the morphological composition of the waste entering the landfill. With the commissioning of the MBT plant in 2015, the annual amount of landfilled waste and the content of bio-degradable fractions in them is drastically reducing, which leads to a reduction in the generated landfill gas. This measure provides for the introduction of a system for periodic morphological and physical-chemical studies of the landfill waste, in order to accurately calculate the amount of greenhouse gases emitted by the landfills. The implementation of the measure will allow the correct reflection of the greenhouse gas emissions changes.

#### *Specific objectives of the plan:*

**Implementation of a fully functional information system for the purposes of reporting on the climate change mitigation measures and the future planning**

#### *Sectors concerned:*

**Waste**

#### *Expected effect by 2030:*

**See measure C.3.11**

#### *Budget required:*

**BGN 30,000 per study**

#### *Potential sources:*

**SM budget**

#### *Deadline for implementation:*

**2024 and every two years**

#### Scope

The whole territory of Sofia Municipality

#### Responsible

“Waste Management and Control Activities” Directorate

Support unit: “Climate, Energy and Air” Directorate

The role of SM: assignment / control

## C.3 Investment measures to reduce the green gas emissions and/or to increase the share renewable energy used

### Residential buildings renovation

#### C.3.1

#### C.3.1 – C.4.1 – C.4.2

#### Description

In the draft of the *National Recovery and Resilience Plan (NRRP)* of the Government of the Republic of Bulgaria, published in July 2021, in the pillar "Green Bulgaria", component 2.B.1. *Low-carbon Economy* investments for energy efficiency in the building stock (*Investment 1*) are envisaged, in which the main place is occupied by the funding of the measures for renovation of the housing stock, for which funds in the amount of BGN1,227 million are provided. The renovation of the buildings is envisaged to be in line with the objectives of the *Long-Term Strategy for the Renovation of the National Building Stock of Residential and Non-Residential Buildings* by 2050. It should be kept in mind that the NRRP has not yet been finally adopted, but the renovation of the building stock to the highest cost-effective levels is a top priority of the EC and the "Green Deal", which will finance the activities. That's why it is expected to remain among the priorities of the Bulgarian plan.

Sofia Municipality will make every effort, through active cooperation with the citizens, to ensure by the new energy efficiency program the financing of a maximum number of buildings in Sofia Municipality, with a minimum goal being the renovation of 200 multi-family buildings with funds from NRRP. In this regard, SM is implementing the project "Integrated services for energy renovation of residential buildings" (with the acronym SHEERenov), financed by EC under Horizon 2020 program, which has been identified in the NRRP as one of the possibilities for introducing the one-stop shop reform in order to promote the activities for the introduction of energy efficiency measures in residential buildings. Within the project between 30-50 multifamily residential buildings will be supported and encouraged to implement EE measures by providing incentives in the form of free technical and organizational support, including the preparation of energy audits.

The calculations in the measure were made assuming that the total area of the buildings to be renovated is 800 thousand square meters. The energy class to which the buildings will be renovated and the specific measures that will be implemented in each of them will be determined by the energy efficiency audits.

#### Scope

According to the conditions of the managing authority

#### Responsible

District administrations

Support units: "Architecture and Urban Planning" Division / "Climate, Energy and Air" Directorate

Stakeholders: the citizens of SM / MUDPW / ME/ SEDA

The role of SM: promotion / provision of technical assistance to citizens / coordination

#### *Specific objectives of the plan:*

**Reduction of the greenhouse gas emissions by 40% per capita by 2030 compared to the 2007 levels**

**800 GWh reduction of the final annual energy consumption by 2030 compared to 2018**

**400 GWh final annual renewable energy consumption by 2030**

#### *Sectors concerned:*

**Residential buildings**

#### *Expected effect by 2030:*

**EE: 48,6 GWh/year**

**RES: 1,2 GWh/year**

**Emissions: 14,8 thousand tons CO<sub>2e</sub>/year**

#### *Budget required:*

**BGN 144 million**

#### *Potential sources:*

**Recovery and Resilience Plan**

#### *Deadline for implementation:*

**2021–2026**

## C.3 Investment measures to reduce the green gas emissions and/or to increase the share renewable energy used

### C.3.2

#### Gradual renovation of the residential buildings to the highest cost-effective levels

C.2.1 – C.3.2 – C.4.1 – C.4.2

#### Description

According to the *Long-Term Strategy for the Renovation of the National Building Stock of Residential and Non-Residential Buildings* by 2050 the cost-effective levels for the residential buildings renovation are around the borders between "A" and "B" energy classes. The renovation of the buildings to this level, in addition to being financially justified, will allow the achievement of greater energy savings and, accordingly, greenhouse gas emissions reductions, compared to the common practice for renovation of residential buildings to a level around the borders of "B" and "C" energy classes.

The strategy states the establishment of the National Decarbonization Fund (NDF). The same statement was made in the version of the *National Recovery and Resilience Plan* published in July 2021. The NRRP states that the fund will be used to offer grants, financial and technical assistance, combined with financial instruments including credit lines and guarantees and/or a combination of both and is aimed at supporting the energy end users. The establishment of the NDF is planned to take place by mid-2023.

Sofia Municipality will organize the implementation of a phased program for renovation of residential buildings in order to renovate buildings with a total area of 3 million square meters by 2030. The funds for the buildings renovation should be provided through various financial instruments, such as NDF, the FLAG Fund and the EIB, etc., as well as by own co-financing of the citizens and loans from commercial banks.

The experience from the implemented programs for renovation of residential buildings so far shows that there is a great need to provide technical assistance to the citizens when applying for funding. It is reasonable to organize the provision of such services ("one-stop shop") at the district administrations.

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\* Both multi-family and single-family residential buildings should be supported.

#### Scope

The whole territory of Sofia Municipality

#### Responsible

"Architecture and Urban Planning" Division

Support units: District administrations / "Finance and Healthcare" Division / "Climate, Energy and Air" Directorate

Stakeholders: the citizens of SM / MRDPW / ME / SEDA

The role of SM: promotion / provision of technical assistance to citizens / coordination

#### *Specific objectives of the plan:*

**Reduction of the greenhouse gas emissions by 40% per capita by 2030 compared to the 2007 levels**

**800 GWh reduction of the final annual energy consumption by 2030 compared to 2018**

**400 GWh final annual renewable energy consumption by 2030**

#### *Sectors concerned:*

**Residential buildings**

#### *Expected effect by 2030:*

**EE: 241 GWh/year**

**RES: 22,8 GWh/year**

**Emissions: 84,6 thousand tons CO<sub>2e</sub>/year**

#### *Budget required:*

**BGN 600 million**

#### *Potential sources:*

**Existing financial instruments and co-financing by the owners/loans**

**RDP, Priority 1. Integrated urban development**

#### *Deadline for implementation:*

**2025–2030**



## C.3 Investment measures to reduce the green gas emissions and/or to increase the share renewable energy used

### C.3.3

#### Gradual certification and energy renovation of the municipal buildings to the highest cost-effective level

C.1.5 – C1.9 – C1.10 – C.2.1 –  
**C.3.3** – C.3.5 – C4.1 – C 4.2

#### Description

In order to achieve the maximum reduction of greenhouse gas emissions in the “Municipal Buildings” sector, after the adoption of this plan all municipal buildings in Sofia Municipality will be renovated only to the highest cost-effective levels, instead of the minimum required for compliance with the current regulations – energy class “C”.

According to Art. 38 of the EEA, the municipality is obliged to certify all its public service buildings with a built-up area of over 250 sq.m. The energy performance certificates are issued on the basis of performed energy audit of the building. Contractors should be required to consider different packages of energy saving measures and identify cost-effective solutions for deep renovation of buildings. Under such conditions, by 2030, the buildings with built up area of 300 thousand square meters (\*) should be renovated, excluding the buildings that have already been renovated by implementation of energy efficiency measures to achieve energy class “C” or higher. In the accommodation facilities for the vulnerable to climate change groups - e.g. social homes, homes for the elderly, shading of the southern facades and air conditioning of the premises should be provided in order to reduce the health risks in extremely hot weather.

Funds from various sources will be sought for the renovation of the buildings. It is very useful to make a preliminary assessment of the building stock - initially on the basis of the already collected structured information about the buildings before the development of this plan, which should be updated and supplemented up to the C.3.5. measure implementation. This will help for the buildings allocation into separate target groups, projects and measures, for which the appropriate funding will be provided. In general, the buildings with low energy consumption, high energy costs and high occupancy are suitable for financing under an energy performance contracts with an energy services company (ESCO) or from the municipal budget. The measures in such buildings should have good financial indicators. The measures in the buildings with poor indicators, but low load and energy consumption, will have a long payback period. For them is appropriate to seek funding that includes grants.

In the case of buildings that are of real cultural heritage, funds must be provided for the adequate protection of their value.

#### *Specific objectives of the plan:*

**Reduction of the greenhouse gas emissions by 40% per capita by 2030 compared to the 2007 levels**

**800 GWh reduction of the final annual energy consumption by 2030 compared to 2018**

**400 GWh final annual renewable energy consumption from RES by 2030**

#### *Sectors concerned:*

**Municipal buildings**

#### *Expected effect by 2030:*

**EE: 33 GWh/year**

**RES: 8,7 GWh/year**

**Emissions: 7,2 thousand tons**

**CO<sub>2e</sub>/year**

#### *Budget required:*

**BGN 60 million**

#### *Potential sources:*

**RDP, Priority 1. Integrated urban development and co-financing by SM;**

**EERSF; NTEF; NRRP; FMEEA;**

**EPC with ESCO**

#### *Deadline for implementation:*

**2022–2030**

\* In the data collection template that the regional administrations of SM completed and which needs to be supplemented (as complete information has not been collected), exist 149 buildings with a total area of 508 thousand square meters, for which is indicated that main renovation measures have not been implemented.

**Scope:** The whole territory of Sofia Municipality

**Responsible:** Public Construction Division

Support units: District administrations / “Climate, Energy and Air” Directorate

The role of SM: assignment / coordination / control

## C.3 Investment measures to reduce the green gas emissions and/or to increase the share renewable energy used

### C.3.4

#### Implementation of renewable energy installations in already renovated municipal buildings

#### Description

In the already renovated municipal buildings, greater reductions in the energy costs and greenhouse gas emissions will be realized by adding appropriate renewable energy installations for own needs, as in most of them such installations are not implemented. It will be very useful to carry out a preliminary assessment of these sites in order to determine the appropriate technologies for each of them and to group them and form individual projects for which appropriate funding should be sought. The possibilities for adding such installations should be analyzed during the mandatory energy audits under the EEA and proving the economic feasibility of the measures. The calculations for the measure were made at the assumption that 20 solar installations, with 20 sq.m. thermo-solar panels each, would be built; but the exact choice of the RE technology and the installed capacity must be determined by the technical analysis of the individual buildings.

Such projects may attract private investments from energy traders, other persons liable under the energy obligations scheme, ESCOs and/or other investors.

#### Scope

The whole territory of Sofia Municipality

#### Responsible

“Public Construction” Division

Support units: District administrations / “Climate, Energy and Air” Directorate

The role of SM: assignment / coordination / control

C.1.5 – C1.10 – C1.11 – C.2.1 –  
**C.3.3** – C.3.5 – C4.1 – C 4.2

#### *Specific objectives of the plan:*

**Reduction of the greenhouse gas emissions by 40% per capita by 2030 compared to the 2007 levels**

**400 GWh final annual renewable energy consumption by 2030**

#### *Sectors concerned:*

**Municipal buildings**

#### *Expected effect by 2030:*

**EE: 0,9 GWh/year**

**RES: 0,9 MWh/year**

**Emissions: 0,4 thousand tons CO<sub>2e</sub>/year**

#### *Budget required:*

**BGN 1 million**

#### *Potential sources:*

**RDP, Priority 1. Integrated Urban Development and co-financing by SM; EERSF; NTCF; NRRP; FMEEA**

#### *Deadline for implementation:*

**2021–2030**

## C.3 Investment measures to reduce the green gas emissions and/or to increase the share renewable energy used

### C.3.5

**Introduction of a system for monitoring the energy and water consumption, including that from renewable energy sources and street lighting**

#### Description

The introduction of a monitoring system for the energy and water consumption in the municipal buildings is the basis for energy management, implementation of the measures for energy efficiency and ensuring the sustainability of the energy savings results. The measure includes the design of a database and digitization of the information for the municipal building stock which includes: project documentation, projects for repairs and major renovations, audit reports and documents from facilities and structures inspections, other documents related to the construction and operation of the buildings. The database will also include climatic data, a library of good practices and various information that may be useful for the building users and for the analyses and benchmarking of the energy and water consumption.

In the municipal sites with RE installations, separate devices for measurement of the energy production and consumption have not been installed. In all such sites, as well as in the sites where RE installations are planned to be built, measurement of the produced and consumed energy should be provided and a common system for remote monitoring should be introduced. All newly built sites must also be included in the scope of the system. The monitoring will allow the sustainable operation of the installations using renewable energy sources and the timely actions for maintenance and repair activities, so that inefficient operation of the installations or damages that require large financial resources and lead to long interruptions should be eliminated.

A platform for data collection and analysis will be created, and the process will be automated depending on the possibilities for centralized (by the energy and water suppliers) or on-site data collection. The platform will be designed on the basis of a geographic information system and will provide information not only on the current operational management of the buildings, but also on the analyses and development of programs and action plans, as well as on the strategic spatial planning at SM level.

To ensure high quality energy efficient street lighting, the monitoring system should gradually cover the outdoor lighting system. The monitoring will optimize the maintenance of the lighting system and will reduce the losses from technical problems in the network and from illegal inclusions.

**Scope:** All existing and new municipal buildings. The development of the system is phased, with priority connection of the buildings with high specific energy consumption.

**Responsible:** "Information Technologies" Directorate

Support units: "Public Construction" Division / District administrations / "CEA" Directorate

The role of SM: assignment / coordination / control / data analysis

C.1.5 – **C.3.5** – C.3.3 – C.3.4 –  
C4.1 – C 4.2

#### *Specific objectives of the plan:*

**Implementation of a fully functional information system for the purposes of reporting on the climate change mitigation measures and the future planning**

#### *Sectors concerned:*

**Municipal buildings**

#### *Expected effect by 2030:*

**Existence of a rich database for related to energy efficiency assessments and analyses of the use of energy from renewable sources and GHG emissions in the building sector**

**EE: 3 GWh/year  
RES: 0,5 GWh/year  
Emissions: 1,2 thousand tons CO2e/year**

#### *Budget required:*

**Gradual financing - initially BGN 60,000 for the system and the buildings in which installations already exist and in pilot buildings; BGN 2.4 million for the design of a platform for digitalization and monitoring of the buildings, envisaging a gradual expansion of the scope and the buildings that join the system**

#### *Potential sources:*

**SM Budget; NRRP; FMEEA**

#### *Deadline for implementation:*

**2022–2030**

## C.3 Investment measures to reduce the green gas emissions and/or to increase the share renewable energy used

### C.3.6

#### Implementation of pilot and demonstration projects for the construction of zero-energy and plus energy buildings

##### Description

The construction of zero-energy buildings and plus energy buildings requires the application of very different construction practices from the so far established. The development of pilot and demonstration projects for such buildings, the monitoring and dissemination of the results is very important to give an initial impetus to this new type of construction.

The measure includes the construction of one zero-energy municipal building and one municipal plus energy building for demonstration purposes. A detailed monitoring of the results will be carried out in the buildings and the achieved effect will be promoted in the community. The sites will be built in accordance with the needs of Sofia Municipality for construction of new sites. The most suitable types of buildings for pilot projects, from the point of view of attracting more public attention, are the accommodation facilities for vulnerable groups of people or children's institutions.

##### Scope

The whole territory of Sofia Municipality

##### Responsible

"Public Construction" Division

Support units: District administrations / "Climate, Energy and Air" Directorate

The role of SM: assignment / coordination / control / promotion

C.1.5 – C.1.8 – C.2.1 – C.2.2 –  
C.2.3 – **C.3.6** – C4.1 – C4.2

##### *Specific objectives of the plan:*

**Reduction of the greenhouse gas emissions by 40% per capita by 2030 compared to the 2007 levels**

**800 GWh reduction of the final annual energy consumption by 2030 compared to 2018**

**400 GWh final annual renewable energy consumption from RES by 2030**

##### *Sectors concerned:*

**Municipal buildings**

##### *Expected effect by 2030:*

**EE: 0,3 GWh/year**

**RES: 0,3 GWh/year**

**Emissions: 0.1 thousand tons CO<sub>2e</sub>/year**

##### *Budget required:*

**BGN 5 million**

##### *Potential sources:*

**RDP, Priority 1. Integrated Urban Development and co-financing by SM**

##### *Deadline for implementation:*

**2027–2030**

## C.3 Investment measures to reduce the green gas emissions and/or to increase the share renewable energy used

### C.3.7

#### Pilot areas development with zero-energy consumption and transition to plus energy consumption

C.1.9 – C.2.1 – C.2.2 – C.2.3 –  
**C.3.7** – C4.1 – C 4.2

#### Description

Encouraging the private and/or public-private projects (one or more development areas in Sofia with a total scope of about 1,000 residents) for the development of pilot areas with zero-energy consumption and transition to a positive energy balance, thanks to the integrated measures for energy efficiency, renewable energy production, intelligent electricity and heat networks, electricity and heat storage systems, energy cooperation, co-generation and others. Highlighting the neighborhoods as a model in the approach for creation of preconditions and direction of the energy behavior in the neighborhoods envisaged for future development or in the process of reconstruction and renovation. Demand management through the provision of more options for choice of local energy sources, ways of managing the energy use at the individual and collective level, as well as for the choice of ways of travelling (electric, bicycle and micro-mobility). Combination of the approach with the proposal in the Green City Action Plan (upgrading the measure in the Green City Action Plan (GCAP) U.01 Transit Oriented Development).

#### Scope

City of Sofia, territories envisaged for new development and/or reconstruction and renovation.

#### Responsible

“Architecture and Urban Planning” Division

Support units: “Climate, Energy and Air” Directorate

Stakeholders: Sofia Municipal Agency for Privatization and Investments / Bulgarian Investment Agency / private investors and construction contractors / companies for financial instruments management

The role of SM: assignment / coordination / control / promotion

#### *Specific objectives of the plan:*

**Reduction of the greenhouse gas emissions by 40% per capita by 2030 compared to the 2007 levels**

**800 GWh reduction of the final annual energy consumption by 2030 compared to 2018**

**400 GWh final annual renewable energy consumption by 2030**

#### *Sectors concerned:*

**Residential buildings  
Buildings of the tertiary sector**

#### *Expected effect by 2030:*

**EE: 12 GWh/year**

**RES: 4 GWh/year**

**Emissions: 3,1 thousand tons**

**CO<sub>2e</sub>/year**

#### *Budget required:*

**BGN 2 million for urban planning solutions, infrastructure design, development of incentive mechanisms and investment intermediation**

#### *Potential sources:*

**RDP, Priority 1. Integrated Urban development and co-financing by SM; EP, Priority 5; INVEST EU**

#### *Deadline for implementation:*

**2022-2030**

## C.3 Investment measures to reduce the green gas emissions and/or to increase the share renewable energy used

### C.3.8

#### Gradual replacement of the fleet of the interdepartmental transport with electric ones

C1.2 – **C.3.8** – C4.1 – C 4.2

#### Description

In case of need of replacement of an existing or purchase of a new light-duty vehicle for the interdepartmental transport, electric cars should be purchased as a priority. They should be charged with "green" electricity in accordance with the schedule, developed in measure C.1.2

With the implementation of this measure, apart from the GHG emissions reduction and the increase of the RE used, effect will be achieved in terms of clean air, as well as of operating and maintenance costs reduction. At least 60 vehicles are expected to be used as required by this measure by 2030.

#### Scope

The whole territory of Sofia Municipality

#### Responsible

"Transport and Urban Mobility" Division

Support units: District administrations / municipal enterprises / municipal companies / "Climate, Energy and Air" Directorate

The role of SM: assignment / coordination / control

#### *Specific objectives of the plan:*

**Reduction of the greenhouse gas emissions by 40% per capita by 2030 compared to the 2007 levels**

**800 GWh reduction of the final annual energy consumption by 2030 compared to 2018**

**400 GWh final annual renewable energy consumption by 2030**

#### *Sectors concerned:*

Transport

#### *Expected effect by 2030:*

**EE: 0,4 GWh/year**

**RES: See measure C.1.2**

**Emissions: 0,1 thousand tons CO<sub>2e</sub>/year**

#### *Budget required:*

**BGN 3 million**

#### *Potential sources:*

**Budget of SM**

#### *Deadline for implementation:*

**2021–2030**

## C.3 Investment measures to reduce the green gas emissions and/or to increase the share renewable energy used

### C.3.9

#### Gradual replacement of the street lighting fixtures with LED ones

C.3.9 – C.3.5 – C4.1 – C4.2

#### Description

By 2030, 90% of the existing street lighting fixtures in Sofia Municipality will be replaced with high-efficiency LED lighting sources. 102,506 lighting fixtures have been installed in the outdoor lighting system of Sofia Municipality by 2019 of which 12,158 or 11.86% are LED lighting fixtures. 80,000 lighting fixtures, using various light sources will be replaced with high-efficiency LED lighting fixtures by 2030. All new sections of the street lighting system will also be supplied with high-efficiency LED lighting fixtures. Funding for the measure activities implementation can be afforded through the National Recovery and Resilience Plan.

#### Scope

The whole territory of Sofia Municipality

#### Responsible

“Transport and Urban Mobility” Division

The role of SM: assignment / coordination / control

#### *Specific objectives of the plan:*

**Reduction of the greenhouse gas emissions by 40% per capita by 2030 compared to the 2007 levels**

**800 GWh reduction of the final annual energy consumption by 2030 compared to 2018**

#### *Sectors concerned:*

**Street lighting**

#### *Expected effect by 2030:*

**EE: 12 GWh/year**

**Emissions: 5,4 thousand tons CO<sub>2e</sub>/year**

#### *Budget required:*

**BGN 30 million**

#### *Potential sources:*

**Recovery and Resilience plan; RDP, Priority 1. Integrated Urban Development and co-financing from SM; FMEEA**

#### *Deadline for implementation:*

**2021-2030**

## C.3 Investment measures to reduce the green gas emissions and/or to increase the share renewable energy used

### C.3.10

#### Gradual replacement of the liquid fuel-fired boilers with heat pump or gas/pellets boilers

#### Description

Sofia Municipality has a large number of sites that are still heated by gas-oil boilers - mainly in the peripheral areas\*. In many cases, the comfort in the heated rooms is not maintained at good levels due to the high fuel costs. The operation of the boilers in non-optimal mode leads to overconsumption of fuel in some cases. Gradually, after the expiration of the technical life cycle of the existing boilers, they will be replaced by new boilers with higher performance, using natural gas, pellets or heat pumps. The management of the boilers and the installations will also be improved in order to reduce the energy consumption while maintaining good comfort in the buildings.

The replacement of the gas-oil boilers is a priority for SM in connection with the improvement of the air quality and the expected savings of energy and financial resources. It will be carried out after the assessment of the installations; and in case the life cycle of boilers has expired in the case they have been replaced in the last 5-10 years.

*\* The data collection template, that is completed by the district administrations of Sofia Municipality needs to be supplemented, as the information collected is not complete; it includes 56 sites that are indicated as using liquid fuel boilers. The sites are distributed by districts as follows: Novi Iskar - 13; Kremikovtsi - 12; Pancharevo - 9; Vazrajdana - 6; Poduene - 4, Slatina - 3; Vitosha - 2; Vrabnitsa - 2, Iskar - 2; Lyulin - 2; Ovcha Kupel - 1.*

#### Scope

The whole territory of Sofia Municipality

#### Responsible

“Public Construction” Division / “Climate, Energy and Air” Directorate

The role of SM: assignment / coordination / control

C.2.1. – C.3.4 – **C.3.10** –  
C4.1 – C4.2

#### *Specific objectives of the plan:*

**Reduction of the greenhouse gas emissions by 40% per capita by 2030 compared to the 2007 levels**

**800 GWh reduction of the final annual energy consumption by 2030 compared to 2018**

**400 GWh final annual renewable energy consumption by 2030**

#### *Sectors concerned:*

**Municipal buildings**

#### *Expected effect by 2030:*

**EE: 1.6 GWh/year**

**RES: 1.6 GWh/year**

**Emissions: 0.4 thousand tons CO<sub>2e</sub>/year**

#### *Budget required:*

**BGN 2 million**

#### *Potential sources:*

**Budget of SM; EERSF; NTEF; NRRP; FMEEA**

#### *Deadline for implementation:*

**2021-2030**



## C.3 Investment measures to reduce the green gas emissions and/or to increase the share renewable energy used

### C.3.11

#### Introduction of a system for separate collection of bio-waste form households

#### Description

In accordance with the provisions of the Waste Management Act and the Ordinance on the Separate Collection of Bio-waste and Treatment of Bio-degradable Waste, the mayors of the municipalities are obliged to gradually introduce the separate collection and utilization of the bio-waste. SM could develop Terms of reference and commission an external consultant to study and design a system for separate collection of bio-waste, and subsequently select a contractor for the purchase of the necessary containers and the phased implementation of the system, if found applicable. The separate collection of bio-waste and clean, recyclable waste by the households (unpolluted from organic waste, they are very easy to separate and recycle) will increase repeatedly their recovery rate and will reduce the generation of greenhouse gas emissions. The effect of the implementation of the measure is achieved together with the implementation of the C.1.11 measure.

*\* It should be kept in mind that the Waste Management Program of Sofia Municipality for 2021-2028 has not been developed yet, and the specific measures will be examined and developed in it.*

#### Scope

The whole territory of Sofia Municipality

#### Responsible

“Waste Management and Control Activities” Directorate

The role of SM: assignment / coordination / control / promotion

C1.11 – **C.3.11** – C4.1 – C4.2

#### *Specific objectives of the plan:*

**Reduction of the greenhouse gas emissions by 40% per capita by 2030 compared to the 2007 levels**

#### *Sectors concerned:*

**Waste**

#### *Expected effect by 2030*

**11 thousand tons CO<sub>2e</sub>/year**

#### *Budget required:*

**For the system design – BGN 200 thousand**

**For the system implementation (for 50 thousand households/year) – BGN 2.5 million/year**

#### *Potential sources:*

**EP, Priority 2. Wastes**

**SM budget**

#### *Deadline for implementation:*

**For the system design - 2023**

**For the system implementation – gradually as of 2024 until 2033**

## C.4 Establishment of a system for broad public involvement in the measures implementation

### C.4.1

#### Development of the communication strategy of Sofia Municipality regarding climate change

### C.4.1 – C.4.2

#### Description

The Communication Strategy will provide the framework for conducting activities to raise the public awareness, knowledge and attitudes on the climate issues in both their aspects - for mitigation and adaptation to climate change. The strategy will identify the main messages related to the SECAP, the specific communication objectives and will indicate the specific activities that will be implemented. It will also present the tools that will be used for each of the activities, as well as the implementation plan and the necessary budget for their implementation. The strategy will include special communication programs for the individual sectors to promote the implementation of the activities and for cooperation between the municipality, businesses, citizens' initiatives and citizens in support of the planned objectives achievement.

#### Scope

Settlements of Sofia Municipality

#### Responsible

"Climate, energy and air" Directorate

The role of SM: assignment / coordination / control / implementation

#### *Specific objectives of the plan:*

**Provision of a broad public support of the climate change mitigation policies, in order to build a positive attitude towards the policies of more than half of the population of the capital**

#### *Sectors concerned:*

**Everything in the "mitigation" and "adaptation" scope**

#### *Expected effect by 2030:*

**Specific systematic actions for communication with the stakeholders**

#### *Budget required:*

**BGN 14 thousand for the strategy development (part of the contract for SECAP development)**

#### *Deadline for implementation:*

**2021**

## C.4 Establishment of a system for broad public involvement in the measures implementation

### C.4.2

Implementation of communication activities to raise the public awareness, knowledge and attitudes regarding climate change mitigation

### C.4.1 – C.4.2

#### Description

Sofia Municipality will implement the envisaged communication activities in accordance with the plan and schedule of the communication strategy on climate change (measure C.4.1).

#### Scope

Settlements of Sofia Municipality

#### Responsible

“Climate, Energy and Air” Directorate

The role of SM: assignment / coordination / control / promotion

#### *Specific objectives of the plan:*

**Provision of a broad public support of the climate change mitigation policies, in order to build a positive attitude towards the policies of more than half of the population of the capital**

#### *Sectors concerned:*

**Everything in the "mitigation" range**

#### *Expected effect by 2030:*

**EE: 138,6 GWh/year  
RES: 50 GWh/year  
Emissions: 37,3 thousand tons CO<sub>2e</sub>/year**

#### *Budget required:*

**BGN 400 thousand/year**

#### *Potential sources:*

**Budget of SM; LIFE (a separate communication project or part of an integrated project, if proposed by the SM)**

#### *Deadline for implementation:*

**2021–2030**

#### 4.8. Expected effect of the selected measures and activities for climate change mitigation

The overall effect in terms of reducing the greenhouse gas emissions, final energy savings from and increase of renewable energy consumption, due to the implementation of all proposed in the SECAP measures, aimed at climate change "mitigation", is as follows:

- Reduction of the greenhouse gas emissions by 2030 compared to 2018 – 346.8 thousand tCO<sub>2e</sub>/year.
- Saved final energy to an annual amount of 836.7 GWh/year at 2030
- Annual renewable energy consumption at 2030 – 424.3 GWh/year.

The measures affecting the *Long-Term Program of Sofia Municipality for the Promotion of the Use of Renewable Energy and Bio-fuels, 2021-2030* and the *Long-Term Program for Energy Efficiency of Sofia Municipality, 2021-2030* are these in which a specific goal, related to reduction of energy consumption and/or use of renewable energy is indicated, but for the purposes of reporting on this program, only the effect achieved in the sites managed by Sofia Municipality is taken into account. The objectives related to the specific program are set out separately in the next chapter 4.9. and a list of measures is presented in *Annex 5*. The effect of the measures to be reported by 2030 is:

- Total annual final energy savings at 2030 – 50.5 GWh .
- Annual consumption of renewable energy at 2030 – 12.2 GWh/year.
- Reduction of the greenhouse gas emissions by 2030 compared to 2018 – 14.9 thousand tCO<sub>2e</sub>/year.

#### 4.9. Specific objectives for climate change mitigation

Climate change mitigation measures are aimed primarily at achieving the first strategic goal - *Sofia - Climate neutral city*, but also play important role in the achievement of the second strategic goal - *Sofia - Resource efficient city*. Through the measures implementation, along with the reduction of GHG emissions, improvement of the energy efficiency and renewable energy use in the individual sectors and in the SECAP scope as a whole, is achieved. In accordance with the set strategic goals, the evaluations of the implementation of the 2012-2020 SEAP, and the impact of the external for the municipality factors and the adopted municipal sectoral plans and programs valid after 2021, as well as the measures provided for in SECAP, Sofia Municipality has set the following specific goals for climate change mitigation related to the reduction of greenhouse gases:

- *Specific goal C1. Reduction of the green gas emissions per capita by 40% until 2030 compared to the 2007 levels.*

With the implementation of the measures provided for in the SECAP and without taking into account the influence of the external for the municipality factors and the adopted municipal sectoral plans and programs valid after 2021, Sofia Municipality sets the following additional specific goals:

- *Specific goal C2. Reduction of the final energy consumption by 800 GWh until 2030 compared to 2018.*
- *Specific goal C3. Achieving final annual renewable energy consumption of 700 GWh by 2030.*
- *Specific goal C4. Implementation of a fully functional information system for the purposes of reporting on the climate change mitigation measures and for the future planning.*

- *Specific goal C5. Provision of a broad public support of the climate change mitigation policies in order to build a positive attitude towards the policies in more than half of the population of the capital.*

For the long-term programs under Art. 10, para. 1 and para. 2 of the Renewable Energy Act and Art. 12 of the Energy Efficiency Act, Sofia Municipality sets the following specific goals:

- *Specific goal E1. Realization of total annual energy savings of 50 GWh by 2030 in the sectors managed by Sofia Municipality and included in the scope of the SECAP.*
- *Specific goal E2. Increase of the annual final energy consumption from renewable sources by 12 GWh by 2030 in the sectors managed by Sofia Municipality and included in the scope of the SECAP.*
- *Specific goal E3. Reduction of the annual greenhouse gas emissions by 2030 in the sectors managed by Sofia Municipality included in the scope of the SEAP by 14 thousands tCO<sub>2</sub>e compared to the levels of 2018.*
- *Specific goal E4. Implementation of a fully functional information system for the purposes of reporting on the renewable energy measures and the future planning.*

#### **4.9.1. Priority measures for climate change mitigation in accordance with the set objectives**

In line with the specific goals set for the climate change "mitigation", several of the envisaged measures stand out as particularly important. These are the measures C.3.1 and C.3.2 for the residential buildings renovation, with which the greatest effect will be achieved, both in terms of reduction of the greenhouse gas emissions and of the final energy consumption reduction; and the importance of the municipal buildings renovation (measure C.3.3) should not be ignored as well. The measures C.1.1, C.1.2, as well as the general action of the measures C.1.8, C.1.10, C.2.1 and C.2.2 are of great importance for the achievement of these goals, as well as for the increase of the share of renewable energy used. The measures C.1.3, C.1.4, C.1.5 and C.1.7 have a key role in the achievement of the higher results from the implementation of other measures. The introduction of a system for separate waste collection will also play an important role in the greenhouse gas emissions reduction (measure C.3.11).

The improvement of the information systems is of key importance for the effective management and reporting on the energy and climate activities. In this respect, the implementation of measures C.3.5 and C.1.6 will be of decisive importance, as well as of C.2.7, related to the accurate calculation of the greenhouse gas emissions from the waste sector. The implementation of measure C.2.3 will be very useful also.

As the support of the citizens and businesses is extremely important for the implementation of most of the planned measures, it is necessary to conduct active and targeted communication activities, to which measure C.4.2 will contribute.

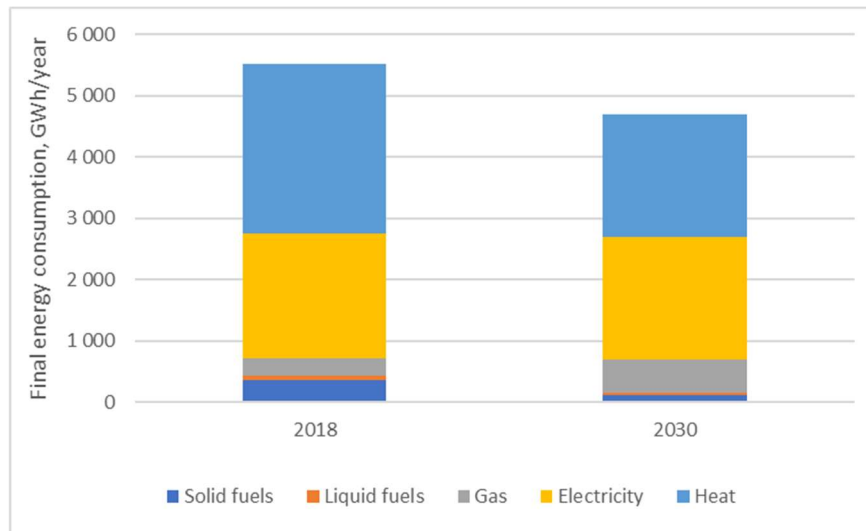
Measures C.3.3 and C.3.9 are of particular importance in terms of achieving the objectives of the *Energy efficiency program* and the *Long term program for promotion of the use of renewable energy and bio-fuels*, thanks to which the greatest reduction in energy consumption and greenhouse gas emissions will be realized. Of course, measure C.3.5 plays a key role for the efficient energy management in the municipal building stock.

## 4.10. Forecast scenario of development at the selected measures implementation

### 4.10.1. Energy consumption after the implementation of the measures

This forecast scenario takes into account both the effect of the factors, measures and projects outside the current plan, which are described in Chapter 4.5, and the effect of the proposed measures in the SECAP. The effect of the measures in the plan complements the expected "without measures" effect, taking into account the likelihood of some overlap between the two effects which is considered in the final result.

In line with the proposed measures, the largest reduction in the final energy consumption by 2030 compared to 2018 is expected in the „Residential buildings“ sector. The consumption in the sector is expected to decrease by more than 30.6% to 4366 GWh/year, not including the renewable energy produced in and around the buildings. The reduction of the final energy consumption is expected to cover the energy produced from all types of fossil fuels, with the exception of the energy produced from natural gas, which is expected to increase slightly compared to 2018. The sector will completely eliminate the energy produced from coal and liquid fuels. A comparison of the final energy consumption of the sector in 2018 and 2030, broken down by fuels, is presented in *Figure 30*.



*Figure 30. Comparison of the final energy consumption of the “Residential Buildings” sector in 2018 and 2030 after the implementation of the measures from the SECAP - distribution by fuel types*

Although the municipality cannot directly influence the **tertiary sector**, reduction in the final energy consumption is also expected in this sector. *Figure 31* shows a comparison of the results in 2018 and 2030. The total consumption of the sector is expected to decrease by about 11% to about 1550 GWh/year in 2030, and this value does not include the consumption of energy produced by RES on the sites. The sector will completely eliminate the use of energy from coal and liquid fuels.

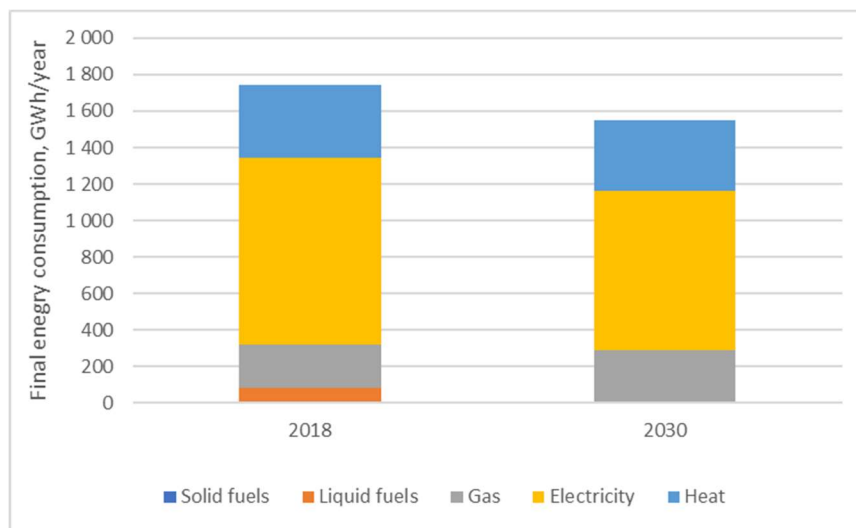


Figure 31. Comparison of the final energy consumption of the "Tertiary sector" in 2018 and 2030 after the implementation of the measures from the SECAP - distribution by fuel types

In the **industry** sector, the expectations are similar to those in the tertiary sector. By 2030, the final energy consumption will decrease compared to 2018 by about 9% to about 2732 GWh/year. The last value does not include the consumption of renewable energy produced on the sites. Coal energy will be completely eliminated in the sector, and energy from liquid fuels will be used for industrial needs only and not for heating.

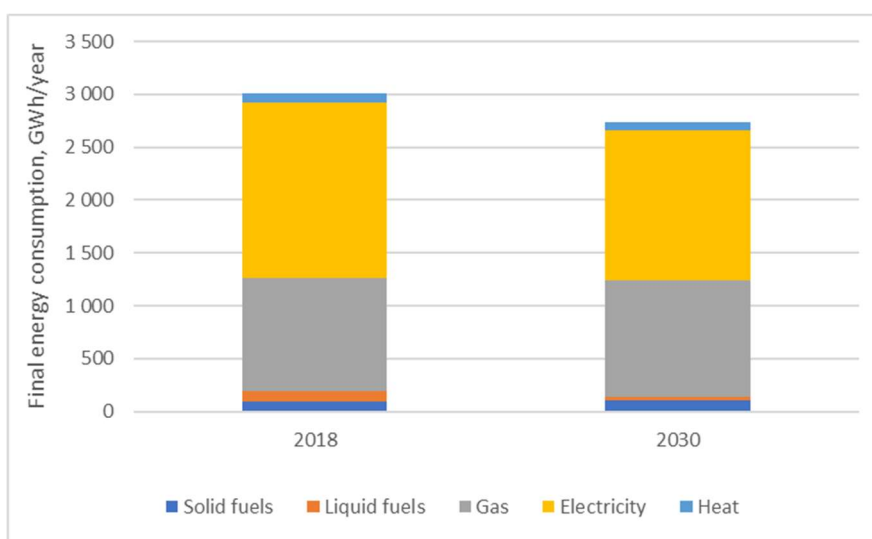


Figure 32. Comparison of the final energy consumption of the "Industry and Construction" sector in 2018 and 2030 after the implementation of the measures from the SECAP - distribution by fuel types

In the case of **municipal buildings**, the largest reduction of final energy consumption is expected, given the fact that the sites are entirely under the management of Sofia Municipality. By 2030, the implementation of the measures is expected to reduce the total energy consumption in the sector to only 71 GWh/year, which is a decrease of 57% compared to the consumption in 2018. In the specified final energy consumption for 2030 is indicated the energy from fossil fuels only. As of this year, the sector will not use energy from coal and liquid fuels.

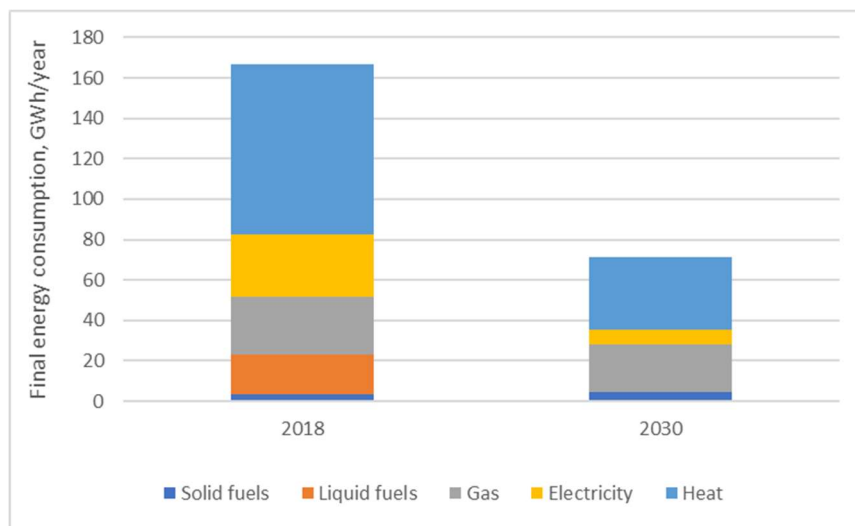


Figure 33. Comparison of the final energy consumption of the "Municipal Buildings" Sector in 2018 and 2030 after the implementation of the measures in the SECAP – distribution by fuel types

In the "Transport" sector, the current trend of declining growth of the energy consumption is expected to stop, and by 2030, after the implementation of the measures from the SUMP and the SECAP, the total energy consumption is expected to remain close to the 2018 levels, about 3600 GWh/year. The share of the electricity and the gaseous fuels is expected to increase, as well as the share of cycling and walking, which will contribute to the reduction of the share of liquid fuels in the total energy consumption in the transport sector although this will still remain the predominant type of fuel used. Especially thanks to the increasing number of electric car charging stations, that allow the charging with "green" electricity, by 2030 the "green" energy is expected to have a significant share in the transport total final energy consumption as well. In the **Public Transport** subsector, the use of traditional liquid fuels is expected to be almost completely eliminated by 2030, and the predominant share in the final energy consumption to become electricity. To reduce the greenhouse gas emissions, 75% of the electricity used in the "public transport" will be "green".

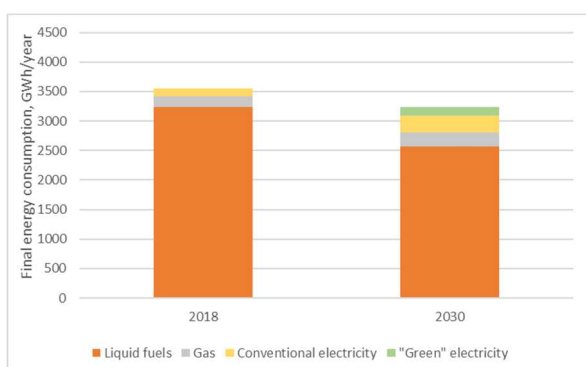


Figure 34. Comparison of the final energy consumption of the "Transport" sector in 2018 and 2030 after the implementation of the measures in the SECAP - distribution by fuel types

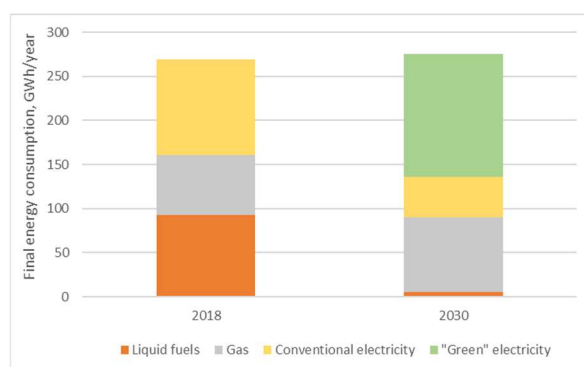


Figure 35. Comparison of the final energy consumption in the subsector "Public transport" in 2018 and 2030 after the implementation of the measures in the SECAP - distribution by fuel types

In the sector "**Outdoor public lighting**" the electricity consumption in 2030 is expected to decrease to 32 GWh/year compared to 44 GWh/year in 2018. The scenario envisages an increase of the lighting fixtures number comparable to that registered in 2010-2018, but nevertheless a reduction of the absolute electricity consumption of over 26%. (Figure 36) to be reached.



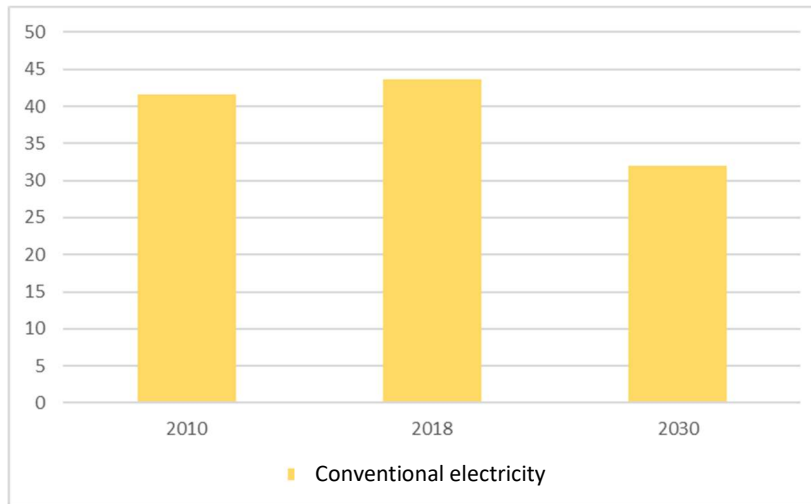


Figure 36. Comparison of the final energy consumption for "Outdoor Public Lighting" in 2010, 2018 and 2030 after the implementation of the measures from the SECAP

Figure 37 presents a comparison of the **total final energy consumption** in the sectors covered by the plan in 2018 compared to the expected energy consumption "without measures in the SECAP" in 2030 and the expected "with measures in the SECAP" in 2030, broken down by fuel types and energy. The total reduction of the energy consumption compared to 2018, given the combined action of the external factors and the implemented measures from the plan, is almost 14.5%. By 2030, after the implementation of the measures in the plan, the total annual energy consumption is expected to be 11,989 GWh/year compared to 14,029 GWh/year in 2018. The use of all types of energy from fossil fuels is expected to be reduced, except for the energy form natural gas, where a slight increase compared to 2018 is expected. The use of coal will be completely stopped, and the liquid fuels will be used for transport and industrial needs only. The graph does not include the energy from renewable sources produced on the sites, but only the purchased "green" electricity by the transport and for outdoor public lighting.

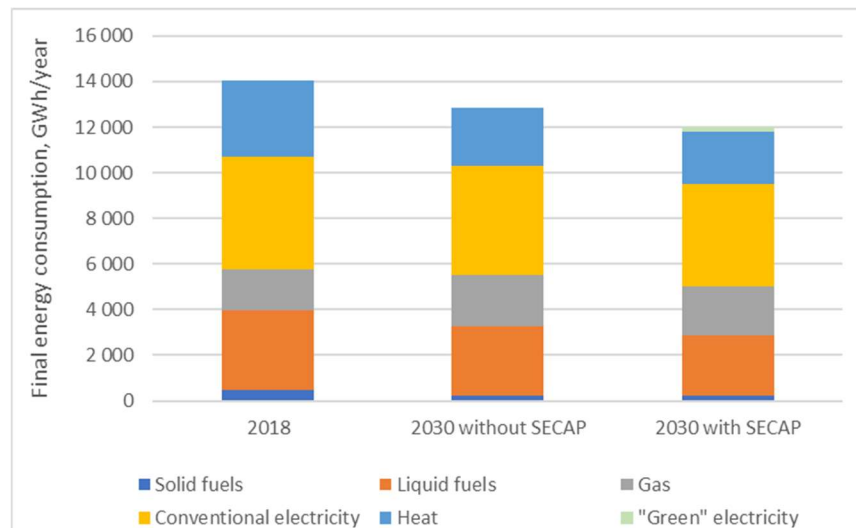


Figure 37. Comparison of the final energy consumption for the entire scope of the SECAP - 2018 compared to 2030 "without measures from the SECAP" and 2030 "with measures from the SEAP" scenarios – distribution by fuel types

The following Figure 38 shows a comparison of the **total final energy consumption** in 2018 for both scenarios by 2030, but by sectors. After the implementation of the SECAP measures, by 2030 the "Residential Buildings" sector (share of 36.4%) is expected to keep its first place as the sector with

the highest final energy consumption, but to almost reduce the gap with the second sector - "Transport" (27% of share). The "Municipal Buildings" and the "Outdoor Public Lighting" sectors together will have a share of less than 1% of the total final energy consumption of the sectors covered by the plan.

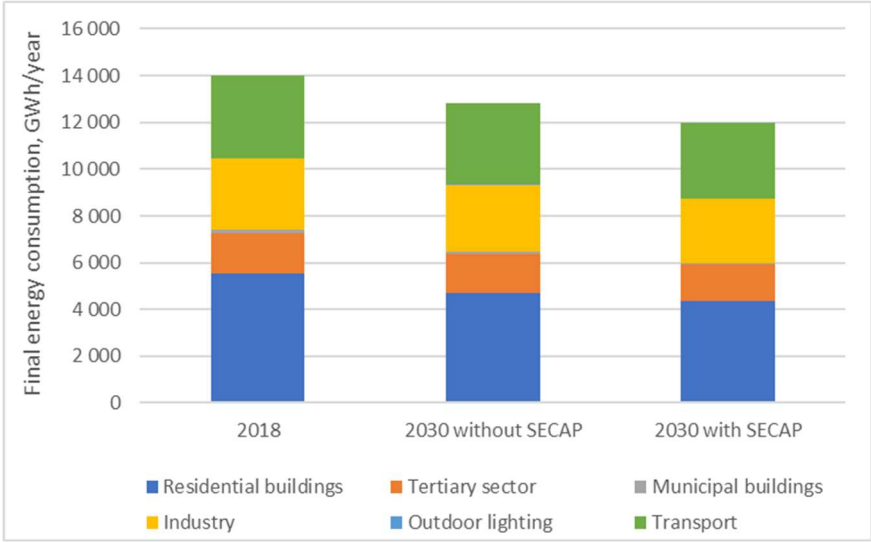


Figure 38. Comparison of the final energy consumption for the entire scope of the SECAP - 2018 compared to 2030 "without measures from the SECAP" and 2030 "with measures from the SECAP" scenarios – distribution by sectors

#### 4.10.2 Use of renewable energy after the implementation of the measures

After the implementation of the measures envisaged in item 4.6 and taking into account the scenario described in item 4.5, which reflects the expected effect of the external for the municipality factors and the implementation of the already adopted sectoral plans and programs, the total annual final energy consumption from RES is expected to be about 734 GWh/year by 2030. In determining this value, the probability of partial overlapping of the effect from the implementation of the measures from the SECAP with the effect of the scenario under item 4.5 was taken into account. The following Table 5 presents information on the expected final consumption of energy from renewable sources by sectors and by types of sources.

Table 16. Final annual energy consumption from renewable sources by 2030 after the implementation of the measures from the SECAP, GWh/year

Sector	Biomass	Electricity photovoltaics	Energy utilized by heat pumps	Heat energy – solar collectors	Purchased "green" electricity	Total
Residential buildings	123	19	72	15	0	229
Buildings of the tertiary sector	9	20	68	5	0	103
Municipal buildings	4	6	10	0	0	21
Industry	117	69	43	0	0	228
Transport	0	0	0	0	153	153
<b>TOTAL</b>	<b>253</b>	<b>114</b>	<b>194</b>	<b>21</b>	<b>153</b>	<b>734</b>

The data in Table 16 is presented graphically in Figure 39.

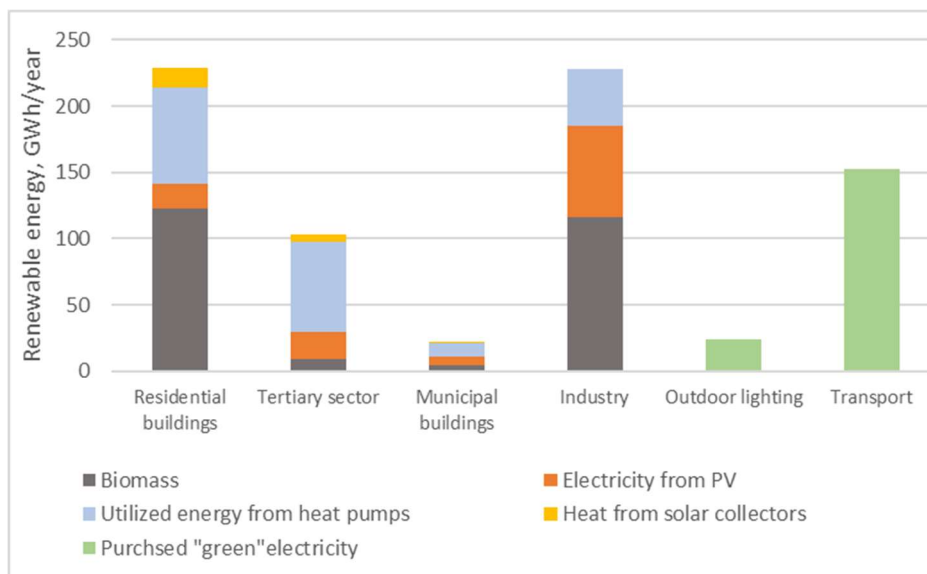


Figure 39. Final annual energy consumption from renewable sources by 2030 after the implementation of the measures from the SECAP, GWh/year

The share distribution of the expected final energy consumption of renewable energy sources in 2030 is presented in Figure 40. Although reduced, the highest share is still expected to be occupied by the biomass (34%), followed closely by the energy used by heat pumps (26%). The share of the purchased "green" electricity for transport needs is expected to be about 21% of the total final energy consumption from renewable sources.

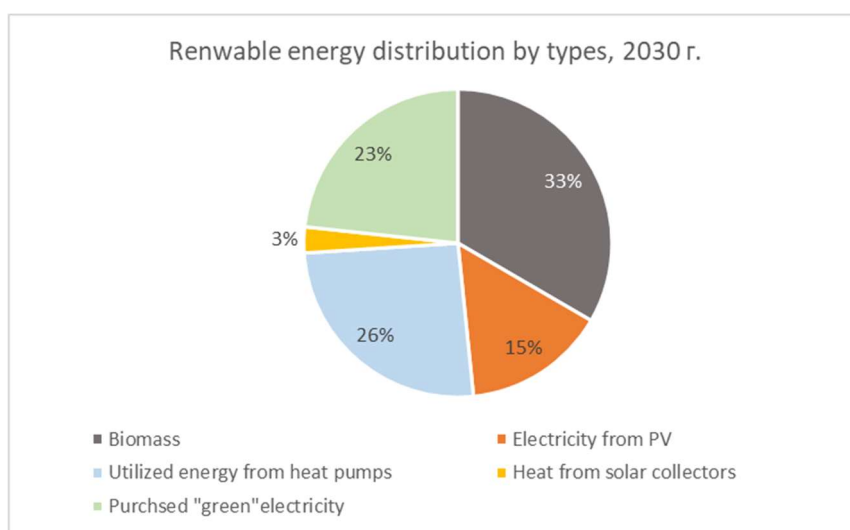


Figure 40. Share distribution of the energy consumption from renewable sources by 2030 after the implementation of the measures from the SECAP, GWh/year

#### 4.10.3. Greenhouse gas emissions after the implementation of the measures

As a result of the implementation of the planned climate change "mitigation" measures, it is expected that by 2030 the annual amount of greenhouse gas emissions, within the defined scope of the SECAP, will be reduced to 3,668.9 thousand tCO<sub>2e</sub>. The share distribution of the emissions by sectors will also change, with the emissions share from transport (23.1%) approaching the share of the

“Residential buildings” sector (35.8%) and displacing “Industry” from the second place which will have a slightly lower share (23.0%). The sectors managed entirely by the municipality - "Municipal Buildings" and "Outside Public Lighting" will be responsible for only 0.8% of the GHG emissions.

Table 17. Comparison of the annual quantities of greenhouse gas emissions during the base year, the year of the last emissions inventory and after the implementation of the two scenarios considered by 2030, thousand tCO<sub>2e</sub>

Sector	2007	2018	2030 without SECAP	2030 with SECAP	Savings at 2030
Residential buildings	2,270.1	1,722.8	1,445.1	1,312.0	46.0%
Tertiary sector	608.6	638.5	545.5	508.1	22.1%
Municipal buildings	69.4	45.5	29.8	16.2	78.2%
Industry	1,693.0	1,034.6	885.3	843.5	53.5%
Outdoor lighting	24.1	20.2	18.2	13.3	48.5%
Transport	815.9	959.1	954.2	849.2	2.8%
Waste	147.8	190.5	137.6	126.5	20.1%
<b>Total</b>	<b>5,629.0</b>	<b>4,611.3</b>	<b>4,015.7</b>	<b>3,668.9</b>	<b>39.1%</b>

The expected share distribution of the greenhouse gas emissions in 2030 after the implementation of the measures provided for in the SEECP is presented in Figure 41.

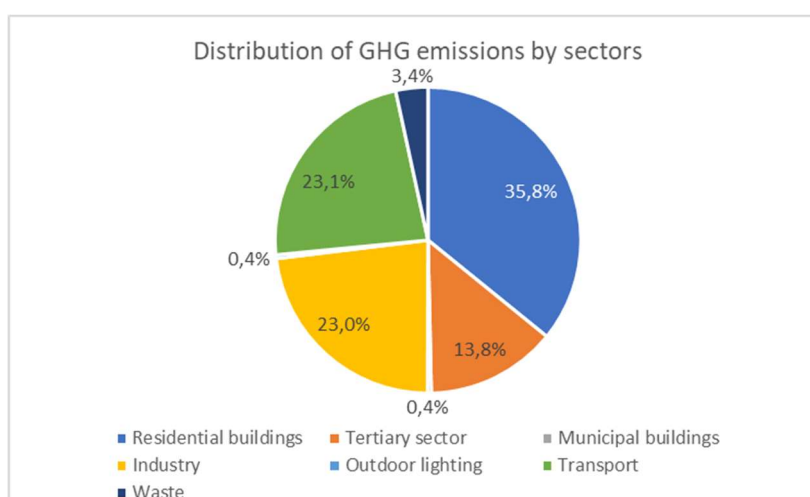


Figure 41. Distribution of the greenhouse gas emissions shares by sectors in 2030 after the implementation of the measures from the SECAP

As stated in Chapter 4.4.2, due to the sustainable trend of population growth of Sofia Municipality, the method of "per capita" was chosen for the assessment of the achieved GHG emissions reductions. Information on the number of the population in the 2007 base year and in 2019 has already been presented. NSI prepared forecasts for the change of the population number by regions for Sofia (capital) till 2080<sup>39</sup>, which coincides territorially with Sofia Municipality. The NSI forecast indicates that

<sup>39</sup> NSI, Population Forecast by Regions and Gender

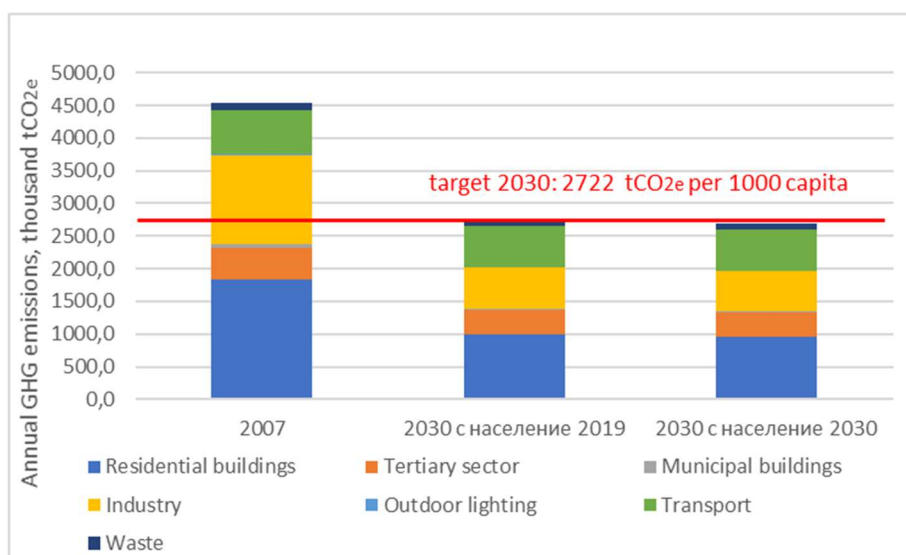
<https://www.nsi.bg/bg/content/2996/%D0%BF%D1%80%D0%BE%D0%B3%D0%BD%D0%BE%D0%B7%D0%B0-%D0%B7%D0%B0-%D0%BD%D0%B0%D1%81%D0%B5%D0%BB%D0%B5%D0%BD%D0%B8%D0%B5%D1%82%D0%BE->

in 2030 the population of Sofia Municipality will be 1,362,231, which is an increase of 9.79% compared to the base year. The following *Table 18* presents the quantities of GHG emissions per capita in 2007 and in 2030, as for the second year two options are presented - once the calculation is made for the population in 2019 and once towards the projected population for 2030.

*Table 18. Greenhouse gas emissions per capita in the 2007 base year and in 2030 towards the population in 2019 and compared to the projected population for 2030, tCO<sub>2e</sub>/1000 inhabitants*

Sector	2007	2030 with the 2019 population	Decrease %	2030 with the 2030 population	Decrease %
Residential buildings	1,829.6	987.4	46.0%	963.2	47.4%
Buildings of the tertiary sector	490.5	382.4	22.0%	373.0	24.0%
Municipal buildings	55.9	12.2	78.2%	11.9	78.8%
Industry	1,364.5	634.8	53.5%	619.2	54.6%
Outdoor lighting	19.5	10.0	48.5%	9.8	49.7%
Transport	657.6	639.1	2.8%	623.4	5.2%
Waste	119.1	95.2	20.1%	92.9	22.0%
<b>Total</b>	<b>4,536.7</b>	<b>2,761.1</b>	<b>39.1%</b>	<b>2,693.3</b>	<b>40.6%</b>

The target of a 40% reduction in the greenhouse gas emissions per capita compared to 2007 assumes that their annual amount should not exceed 2,722 tCO<sub>2e</sub>/1000 inhabitants. When calculating the emissions per capita for 2030 compared to the NSI forecast, the expected emission reduction is 40.6%. A graphical comparison of the expected emission levels per capita in 2030 compared to 2007 is presented in *Figure 42*.



*Figure 42. Reduction of the greenhouse gas emissions by 2030 after the implementation of the measures from the SECAP, compared to the specific target set, thousand tCO<sub>2e</sub>*

[%D0%BF%D0%BE-%D0%BE%D0%B1%D0%BB%D0%B0%D1%81%D1%82%D0%B8-%D0%B8-%D0%BF%D0%BE%D0%BB](#)

## 5. Adaptation to climate change

The framework for the elaboration of the climate change adaptation part of the SECAP is defined in the SECAP development guide. Each municipality should present assessments of the adaptation capacity, the climate hazards, the vulnerability to these climate hazards and their impact on the individual sectors. Based on these assessments, the municipality must plan and implement appropriate adaptation measures. In addition to the assessments, measurable indicators for the vulnerability and the impact of climate change on the territory of Sofia Municipality must be presented, as well as for the municipality progress monitoring after the adaptation measures implementation.

Prior to the development of the current 2021-2030 SECAP, assessments of the vulnerability and climate change impact at the municipal level were not performed in Bulgaria, and in the guide of GCMCE specific methodology for these assessments was not included. For this reason, Sofia Municipality instructed the external experts, consulting the preparation of this plan, to perform a specialized analysis, a summary of which is presented in *Annex 6*. The document presents a specially developed methodology for vulnerability and impact assessment and identification of the climate risks, which is based on in-depth international practices study. A climate analysis was made and the main climatic hazards for Sofia Municipality were presented and described (see *Section 3.1.2* of the plan), after which the relevant assessments were performed according to the proposed methodology. The current plan, in its part for climate change adaptation, is based entirely on the results presented in the mentioned document.

### 5.1. Methodology for the adaptation capacity determination and assessment of the vulnerability and impact of climate change

The analysis in *Annex 6* is based on several key definitions of the main indicators for assessments related to the adaptation of a particular ecosystem to climate change - **climate hazards, exposure, sensitivity, vulnerability, impact and climate risk**. These definitions are presented below. The definitions used in the analysis are either specified by the *Intergovernmental Panel on Climate Change (IPCC)* or are specified in the template from the *SECAP Development Guide*.

By assessing each of the listed indicators and consistently tracking the total effect of the combined impact of the specified indicators, the climate risks for Sofia Municipality were finally determined. *Figure 43* shows the logical diagram of the climate risk assessment process.

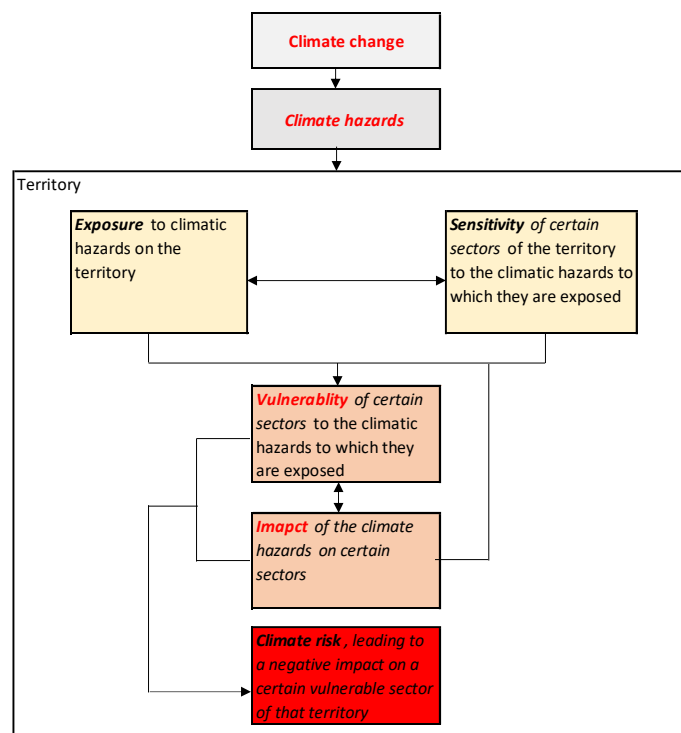


Figure 43. Logical diagram of the climate risk assessment process

**The adaptation capacity** is a combination of strong points, attributes and resources available to an individual, community, society or organization that can be used to prepare and take actions to reduce the adverse impacts or take advantage of the useful opportunities.

**Impacts** are the effects on life, livelihoods, health, ecosystems, economies, societies, cultures, services and infrastructure due to the interaction of climate change or dangerous climatic events that occur without actions for adaptation.

**Exposition** is the presence of people, subsistence, environmental services and resources, infrastructure or economic, social or cultural values in places that could be unfavorably affected.

**Climate hazard** is the potential occurrence of a natural or caused by humans physical event that could cause loss of life, injury or other health effects, as well as damage and loss of property, infrastructure, livelihoods, provision of services and environmental resources.

**Vulnerability** is the degree to which a system is vulnerable and unable to cope with the unfavorable effects of the climate change, including climate change and extreme phenomena.

**Sensitivity** is the degree to which a system can be affected by the climate change, e.g. the degree of change in the composition, structure and functioning of an ecosystem.

### Evaluation of adaptation capacity

The algorithm for the evaluation of the adaptation capacity is presented in the SECAP Development manual. The evaluation is performed on the basis of filling in a self-evaluation card by the municipal administration. The state of implementation of the important actions, related to the six main steps for the adaptation capacity building is assessed: 1) Preparation; 2) Assessment of the risks and vulnerabilities to climate change; 3) & 4) Identification, evaluation and selection of adaptation options; 5) Execution; 6) Monitoring and evaluation.

The evaluation is performed by a four-point scale, with "A" indicating the highest rating of the status - "Leading role" and "D" - the lowest rating "Not started or just starting". The score is presented graphically on a pentagonal scale with four pentagons placed one inside the other. The highest (the outer one) pentagon is represented by the highest scores of "A" and the smallest (the inner one) pentagon by the lowest scores of "D". Opposite the pentagon's vertices are the six steps, two of which (3 and 4) are placed together.

### Exposure and sensitivity evaluation

To assess the degree of **exposure** and the degree of **sensitivity**, a three-level color scale is used which is further upgraded with numerical values, as a large number of sectors are covered and in the summary at the municipal level it is necessary to prioritize the results that fell into the same color scale range (*Table 19*). The exposure assessment is uniform for the whole municipality, and the sensitivity assessment is performed by sectors, as with it is provided an opportunity to assess the "lack" of sensitivity for the cases when it is necessary to distinguish between the individual subsectors - some of them are sensitive to a certain climatic hazard, but others are not.

Table 19. Degrees for evaluation of the exposure and sensitivity to climatic hazards

Degree	Points	Definition for exposition	Definition for sensitivity
High	3	The objects of climate hazards impact are exposed to more than 50% hazards compared to their long-term average norm	Climate hazards can have a significant impact on the sites, processes, resources and products in the sector concerned
Moderate	2	The objects of climate hazards impact are exposed to more than 25-50% hazards compared to their long-term average norm	Climate hazards can have a moderate impact on the sites, processes, resources and products in the sector concerned
Low	1	The objects of climate hazards impact are exposed to less than 25% hazards compared to their long-term average norm	Climate hazards may have little impact on the sites, processes, resources and products in the sector concerned
Lacks	0	–	The sector is not sensitive (is not affected) to specific climate hazards

### Vulnerability assessment

The vulnerability assessment is performed at the sectoral level. The degree of vulnerability to climate change is defined as a function of two characteristics - exposure and sensitivity to climate hazards by the *Formula*:

$$V = S \times E \quad (1),$$

where: **V** is the vulnerability of the sector in question to the specific climate hazards, **S** is the degree of sensitivity for the sector concerned and **E** is the exposure to the basic climatic conditions/side effects.

In addition to the calculation according to *Formula (1)*, a tricolor matrix with the following color meanings is used: green - low, yellow - moderate, and red - high degree of vulnerability (*Table 20*). To adhere to the "one to three" scale, as used in the other assessments of this methodology, the estimates obtained by the formula are equated to the values shown in brackets.

Table 20. Color scale for the degree of vulnerability to climate hazards assessment

		Exposition		
		Low	Moderate	High
Sensitivity	Low	1 (1)	2 (2)	3 (2)
	Moderate	2 (2)	4 (2)	6 (3)
	High	3 (2)	6 (3)	9 (3)

### Impact assessment

The impact assessments are carried out again at the sectoral level, separately for each climate hazard for which the sector has been identified as vulnerable. The type of expected impact is described and the probability of occurrence and the expected level of impact are described and assessed on a similar three-level color scale, as in the other assessments, indicating also the period of time in which the impact can be expected. For the assessment of the expected level of impact, an assessment in figures has been added (*Table 21*).



Table 21. Scale for estimation of the occurrence probability and the impact level expected

Probability	Occurrence probability definition	Impact level	Rating	Impact level definition
Very likely	The impact will almost certainly appear in the specified period.	High	3	In the event of the described impact, large negative consequences can be expected on the affected persons or objects.
Probable	The impact can be expected in the specified period.	Moderate	2	In the event of the described impact, small negative consequences can be expected on the affected persons or objects
Unlikely	Rather, the impact is not expected to occur in the specified period, but it is not excluded.	Low	1	In the event of the described impact, insignificant negative consequences on the affected persons or objects can be expected.

The period of occurrence is classified as the "current moment" - until 2023, "short-term" - until 2030, "medium-term" - until 2050 or "long-term" - until 2100.

### Climate risk assessment

The climate risk is a function of the probability of an event occurrence causing damage and its consequences. The "probability" of an event occurrence that causes damages is expressed by the "degree of vulnerability", which is a function of the frequency of the climatic hazard occurrence and the sensitivity of the individual sectors to the relevant climatic hazard occurrence. The "consequence" is expressed by the assessment of the "degree of impact" caused by the climatic hazard in the vulnerable sector. Therefore, the formula for climate risk assessment is:

$$R = V \times I \quad (3),$$

where **R** is the climatic risk, **V** is the degree of vulnerability to the specific climatic hazard of the sector in question, and **I** is the degree of the specific climatic hazard impact.

The risk assessment is performed at the municipal level. After summarizing the types of "vulnerability" as described above and the assessments of the impact degree of each of them are taken into account, the degree of risk is calculated according to formula (3). The risk degree assessments of each climate hazard are summed up and the climate hazards in Sofia Municipality are ranked according to the significance of the risk.

## 5.2. Climate risks and vulnerabilities to climate change

### 5.2.1. Assessment of the sectors vulnerability to climate hazards

According to the estimates of the degree of vulnerability in the individual sectors, a total of 17 types of climate hazards identified in the exposure assessment of Sofia Municipality (see Table 1) have been identified to have sensitivity in at least one sector. The predominant estimates of the degree of vulnerability are for moderate levels, but a total of 33 vulnerabilities with a high degree of vulnerability have been identified in the various sectors studied. **The largest number of vulnerabilities was identified in the sectors "Human Health" and "Tourism" - a total of 17 types of climate hazards to which the territory of Sofia Municipality is exposed. The same two sectors have the highest number of high-level vulnerabilities as well – 7 each.** At the other pole, with the lowest number of vulnerabilities to climatic hazards to which the territory is exposed, is the "Water" sector with a total of 6 identified

vulnerabilities. The lowest number of high vulnerabilities was reported in the sectors "Water", "Buildings" and "Waste" – only one each.

The review of the degree of vulnerability ratings by type of climate hazards reveals that three types of climate hazards stand out, for which a high degree of vulnerability has been determined in the individual sectors – **intensive rains, storms and extreme temperatures**. The highest scores for vulnerability are related with the heavy rains - a total of 7 out of 9 sectors surveyed.

The **intensive rainfalls** are the climatic hazards to which absolutely all studied sectors have been identified as vulnerable. The same refers for the **heavy rains** and **floods**. However, high levels of vulnerability have been identified in the "Forestry and Agriculture" sector only, and as for floods - in none of the sectors.

The **changes in the precipitation quantities** are the climatic hazard to which vulnerability has been identified only in the "Water" sector, and those related to **snowfalls reduction** have been identified in two sectors only. On the other hand, in the "Tourism" sector, the degree of vulnerability to **snowfalls reduction** is defined as high. Table 22 summarizes all vulnerability degree assessments in the individual sectors.

Table 22. Summary of the sectoral vulnerabilities to climate threats

Climatic hazard	Waters	Forestry and agriculture	Urban planning	Environment and biodiversity	Waste	Buildings	Transport	Tourism	Human health
Extreme heat		Yellow	Red	Red	Yellow	Yellow	Red	Red	Red
Extreme cold		Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Red
Temperature changes	Yellow					Yellow		Yellow	Yellow
Heavy rains	Green	Yellow	Red	Yellow	Green	Yellow	Yellow	Green	Yellow
Intense rainfall	Red	Yellow	Red	Yellow	Red	Red	Red	Red	Red
Changes in precipitation	Yellow								
Reductions of snowfalls								Red	Yellow
Floods	Yellow	Green	Green	Green	Yellow	Yellow	Yellow	Yellow	Yellow
Drought	Yellow	Red	Yellow	Red				Red	Yellow
Storms		Red	Red	Red	Yellow	Red	Yellow	Yellow	Red
Hails		Yellow	Yellow	Yellow		Yellow	Yellow	Yellow	Yellow
Strong wind		Yellow	Red	Yellow	Green			Yellow	Yellow
Fogs							Yellow	Red	Red
Contrasting changes of weather			Red	Red		Yellow		Red	Red
Decreased bio-climatic comfort			Red					Red	Red
Land slides		Green	Green	Green		Yellow	Yellow	Green	Green
Fires (due to natural reasons)		Yellow	Green	Yellow		Yellow		Yellow	Yellow
Snowfall / Snow cover / Wet snowfall *		Yellow	Yellow	Yellow			Yellow		

\* The climatic hazard for Sofia Municipality caused by the climate change is the "Reduction of the snow cover". However, the "Transport", "Urban Planning", "Forestry and Agriculture" and "Environment and Biodiversity" sectors are moderately vulnerable to snowfall / snow cover / wet snowfall, which are climatic phenomenon but are not defined as consequence of the climate change.

Annex 6 of the report provides a summary description of all vulnerabilities to which a high degree of vulnerability has been identified in a given sector. The descriptions are summarized separately depending on the type of vulnerability – physical, socio-economic or environmental, as required by the template in the SECAP Development Manual. Table 23 presents a description of the vulnerabilities in the

individual sectors of Sofia Municipality in relation to the climatic hazards, to which all studied sectors are assessed as vulnerable – *intensive rainfall*.

Table 23. Description of the vulnerabilities to the climatic "Intensive rainfall" hazard in the individual sectors of Sofia Municipality

The "Water" sector is highly vulnerable to intensive rainfall due to the likelihood of exceeding the sewers hydraulic capacity and the occurrence of short-term, local floods, mainly affecting the street infrastructure and the buildings ground floors.

The "Urban Planning" sector is highly vulnerable to consumers and assets located in low and flat places near slopes and surfaces with rapid runoff of large amounts of surface water. This often leads to small-scale but numerous short-term pluvial floods, which cause a variety of, but generally significant, direct and indirect damages. Particularly vulnerable are the poorly developed neighborhoods or parts of them with deteriorating vertical planning, as well as those with a large share of sealed surfaces.

The "Waste" sector is highly vulnerable to intensive rainfalls due to the likelihood of an infiltrate increase in the landfills and a reduction of the water treatment efficiency of the WWTPs to the local landfills.

The "Buildings" sector is highly vulnerable to intensive rainfalls, involving large amounts of water entering the low and underground levels of the buildings located in the lower parts of the affected by the rain city areas and/or entering the attic spaces of the buildings.

The "Transport" sector is highly vulnerable to intensive rainfalls, which can cause damage to the underground transport infrastructure of the metro and subways and can lead to interruptions and delays in the public transport. Disorders in the power supply of the traffic control systems of the tram and trolleybus transport and the metro are also possible.

The "Tourism Sector" is highly vulnerable to intensive rainfalls, leading to: damages/destruction of the tourist infrastructure, of buildings, the transport infrastructure, sites of the CHH; need for higher insurance costs.

The "Human Health" sector is highly vulnerable to intensive rainfalls, which leads to flooding of the low and underground levels of the buildings located in the lower city areas and along the rivers, pollution of the water sources. There is a risk of injury, infectious diseases, allergies and dermatitis caused by floods and landslides.

### 5.2.2. Climate risks assessment

The sectoral analyzes show a total of 33 climate risks with a high level of impact related to a total of 13 of the climate hazards identified in Sofia Municipality's exposure assessment. The highest level of risk with a maximum score of 9, after the application of *formula (3)*, was identified in a total of 11 cases of the studied sectors. **The highest climate risks are identified in the "Human Health" sector** - a total of 7, and for 4 of them a maximum score has been set. Of the climatic hazards, **the extreme heat leads to high risk in most sectors** - a total of 6, and for 3 of them the assessment is maximal. The climate risks, identified as the least high, are in the "Buildings" sector - only one with a score of 6, for *storms*. A summary of the high climate risks for Sofia Municipality is presented in *Table 24*.

Table 24. Summary of the high climatic risks for Sofia Municipality

Climate hazard	Degree of exposure	Waters	Agriculture and forestry	Urban planning	Environment and biodiversity	Waste	Buildings	Transport	Tourism	Human health
Extreme heat	3		6	9	9			6	6	9
Extreme cold	2									9
Temperature changes	2									
Heavy rains	2			6						
Intensive rainfall	3	6		9		6		6		6
Changes in precipitation quantities	1								6	
Reductions in snowfall	2								9	
Floods	1	6				6		6		
Drought	2	6	9		9					
Storms	3		9		6		6			6
Hails	2									
Strong wind	2									
Fogs	3									6
Contrasting changes of weather	3			6	9					9
Reduced bio-climatic comfort	3			6						9
Landslides*	1							6		
Fires (for natural reasons)	2		6							

\* Although the climate risk for landslides has not been identified as high for the period of this plan, the tendency of heavy rainfalls increase can lead to landslides.

Section 6 of the report provides a summary description of all high climate risks, showing the climate risk, the sector that is vulnerable and the likely impact that may be caused. An excerpt from this summary description, which refers only to the climatic hazard that poses a risk in most sectors - extreme heat, is presented in Table 25.

Table 25. Excerpt from the ranking and description of the high climatic risks for Sofia Municipality related to the "Extreme heat" climatic danger

Sector	Degree of climatic risk	Description of the impact
Urban planning	9	Mortality, diseases, disability due to extreme heat and related phenomena; deformations due to overheating; drying due to overheating.
Environment and biodiversity	9	Net productivity reduction, and hence the water and biomass yields - food, wood, fiber, meat and the products from wild and domestic animals and plants. In the long run it is possible to the ecosystems to adapt, accompanied by change of the species composition. Increased demand and potentially lower supply of regulatory ecosystem services, especially critical within the ecological red lines for a heat island.
Human health	9	Deterioration of the temperature comfort, danger of body overheating, which can lead to rash, syncope, cramps, exhaustion and heat stroke.
Forestry and Agriculture	6	Starting and spreading fires, heat stress and damage of crops and tree plants.
Tourism	6	Reduction of the tourist demand in the middle of the summer season and reduction of the ski tourism demand in the winter. Increase of the energy consumption for cooling.
Transport	6	Damage of the road surface and increased risk of catastrophes and accidents. Deformation of the rail tracks. Increase of the passengers discomfort in the public transport. Increased need for personal cars cooling with air conditioners, which leads to higher than normal fuel consumption and the correspondingly higher emission values.

### 5.2.3. Vulnerability and impact monitoring indicators

All indicators for the defined climatic hazards are presented in *Annex 6* of the report. *Table 26* presents the indicators for monitoring the vulnerability to climatic hazards, typical for all studied sectors – namely *intensive rainfall*; the sectors where the vulnerability is assessed as high are included only.

*Table 26. Summary of the indicators for monitoring the high degree of vulnerability to the "Intensive rainfall" climate hazard*

Sector	Vulnerability indicator	Unit
<b>Waters</b>	Number of local floods due to exceeded sewerage capacity.	number of short-term floods/year
<b>Urban planning</b>	Residential/service/production/recreational, etc. areas in the scope of the flooded areas due to heavy or intensive rainfalls.	area
<b>Waste</b>	Number of cases of rains that have caused the closure of the LWWTP at the landfills.	number
<b>Buildings</b>	Number of cases of rain that have caused flooding of the buildings low levels.	number/year
<b>Transport</b>	Number of cases of heavy and intensive rainfalls that have caused flooding of metro stations and/or subways.	number/year
<b>Tourism</b>	Annual number of days with precipitation with an intensity of more than 30 l/(s.ha)	number/year
<b>Human health</b>	<ul style="list-style-type: none"> <li>Annual number of days with precipitation over 25 mm.</li> <li>Annual number of days with precipitation intensity over 0.18 mm/min.</li> </ul>	number/year

*Table 27* presents the indicators for monitoring the impact of the high climatic risks associated with the extreme heat climatic hazard.

*Table 27. Summary of the indicators for the high climate risks impact related to the "extreme heat" climate threat*

Sector	Vulnerability indicator	Unit
<b>Forestry and Agriculture</b>	Areas affected by stress and crop damage, fires due to extreme temperatures and forest fires.	ha/year
	Number of trees damaged by stress and perishing in the settlements due to extreme temperatures.	number/year
<b>Urban planning</b>	Percentage of occupants and users of (residential/public) buildings/spaces and green/blue/green areas affected by extreme heat, including: mortality, diseases, disability; overheating deformations; overheating.	%
<b>Environment and biodiversity</b>	<ul style="list-style-type: none"> <li>Reduction of the ecosystems area (Difference between the spatial coverage of the ecosystems in the baseline – 2017 mapping outside NATURA 2000 and Corine Landcover 2018 for NATURA 2000) and the new values determined in the monitoring of the same ecosystems).</li> </ul>	ha
	<ul style="list-style-type: none"> <li>Deterioration of the ecosystems: difference between the ecosystems state of in the baseline and the new values determined by monitoring the same ecosystems.</li> </ul>	Number of units according to the respective ecosystem rating scale
	<ul style="list-style-type: none"> <li>Reduction of the protected species populations (according to the NATURA 2000 reporting and the monitoring within the framework of the Vision for Sofia)</li> </ul>	Number of identified individuals

Sector	Vulnerability indicator	Unit
<b>Tourism</b>	<ul style="list-style-type: none"> <li>Number of tourists - total and by months</li> <li>Realized overnights – total and by nights</li> <li>Employment of the accommodation base by months.</li> <li>Average stay of visitors by months (days).</li> <li>Employment of the labor force in tourism (number and %).</li> <li>Revenues from tourism by months (BGN).</li> <li>Number, capacity (beds) and structure of PA and REE.</li> <li>Energy consumption per overnight compared to the total energy consumption per inhabitant per day (kWh).</li> <li>Number (share) of tourist enterprises that take actions to reduce the energy consumption - thermal insulation, windows, lighting, etc.</li> <li>Number (share) of tourist enterprises participating in climate change mitigation schemes, such as CO<sub>2</sub> offsets, low energy systems, etc., as well as in adaptation measures and actions.</li> <li>Annual amount of energy from renewable sources used (MWh) by type of RES and share in the total energy consumption (%).</li> <li>Structure of the hotel energy sources - by types and quantities.</li> <li>Number (share) of the hotels using renewable energy at building level.</li> <li>Number (share) of the hotels with an energy performance certificate and distribution according to the energy class category (energy performance certificates of the hotels in Sofia Municipality).</li> </ul>	Number of tourists (thou) Number of overnights (thou) % number of days % BGN (mln.) number of beds (thou) kWh % % % MWh (%) MWh (%) %
<b>Transport</b>	Number of registered cases of damages to the transport infrastructure due to climatic hazards.  Share of the relevant transport infrastructure (street network, railways, metro stations, subways, bridge facilities, traffic lights, contact cable network, etc.) damaged by extreme weather.	number/year  %
<b>Human health</b>	<ul style="list-style-type: none"> <li>Increase of the total mortality above the expected (average for the respective period) level during the periods with heat waves and up to three days after their pass away (due to the so-called delayed impact).</li> <li>Number of emergency calls.</li> <li>Number of accidents at work.</li> </ul>	%  number/year number/year

### 5.3. Assessment of the adaptation capacity

#### “Preparation” stage

Sofia Municipality has an active plan for the adaptation to climate change. The municipality has a team in charge of the energy and climate issues, but has not appointed a specific adaptation officer. The coordination of the activities on the horizontal and vertical levels is carried out by the “Climate, Energy and Air” Directorate. An expert “Energy and Climate” council has been established, including experts from the municipality and external institutions. A communication strategy for climate actions is in a process of development.

*Summary grade “C” - “Progress made”*

### “Risk and vulnerability assessment” stage

A specialized report for assessment of the climate risks and vulnerability was prepared during the development of the SECAP. The municipality has identified its priority sectors for adaptation actions. The vulnerability monitoring indicators and the impact are defined in the report necessary for the risk and vulnerability assessment carrying out. The plan envisages a measure to provide an opportunity for the systematic collection and analysis of the necessary information.

*Summary grade “A” – “Takes the lead”*

### “Identification of the opportunities” stage

As part of the SECAP, a number of measures have been developed and evaluated to reduce the vulnerability and limit the negative impacts of climate change. Actions are envisaged to include the adaptation in the existing normative documents and the future plans and projects.

*Summary grade “B” – “Keep going”*

### “Implementation” stage

Specific objectives for the adaptation and a schedule for the activities implementation have been set. The coordination of the mitigation and adaptation activities is performed by the “Climate, Energy and Air” Directorate. It is planned to develop a communication strategy for the stakeholder engagement, which will cover both aspects of the municipality's climate policy.

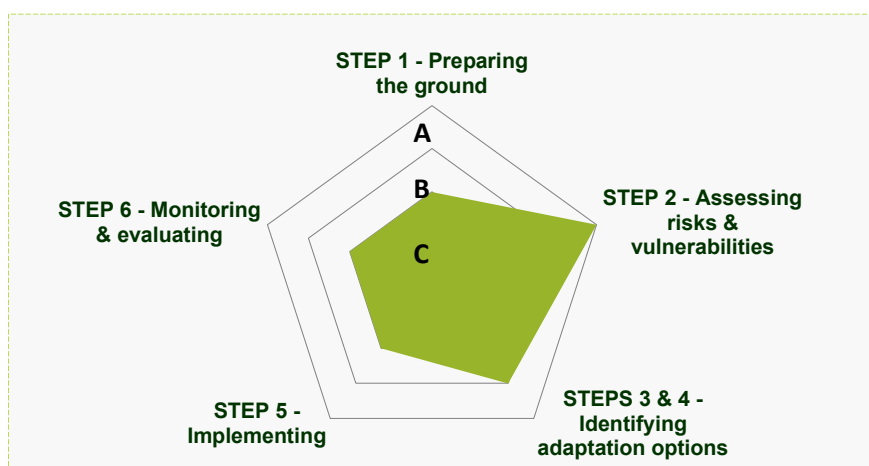
*Summary grade “C” – “Progress achieved”*

### “Monitoring and evaluation” stage

Indicators have been created to monitor the planned actions implementation. Development of an information system for the collection and monitoring of the indicators is also envisaged. Deadlines for the achieved results analyzes conducting are determined and a review of the need for identification of the actions for correction.

*Summary grade “C” – “Progress achieved”*

The current summary assessment of the adaptation capacity of Sofia Municipality is presented graphically in *Figure 44*.



*Figure 44. Evaluation of the adaptation capacity*

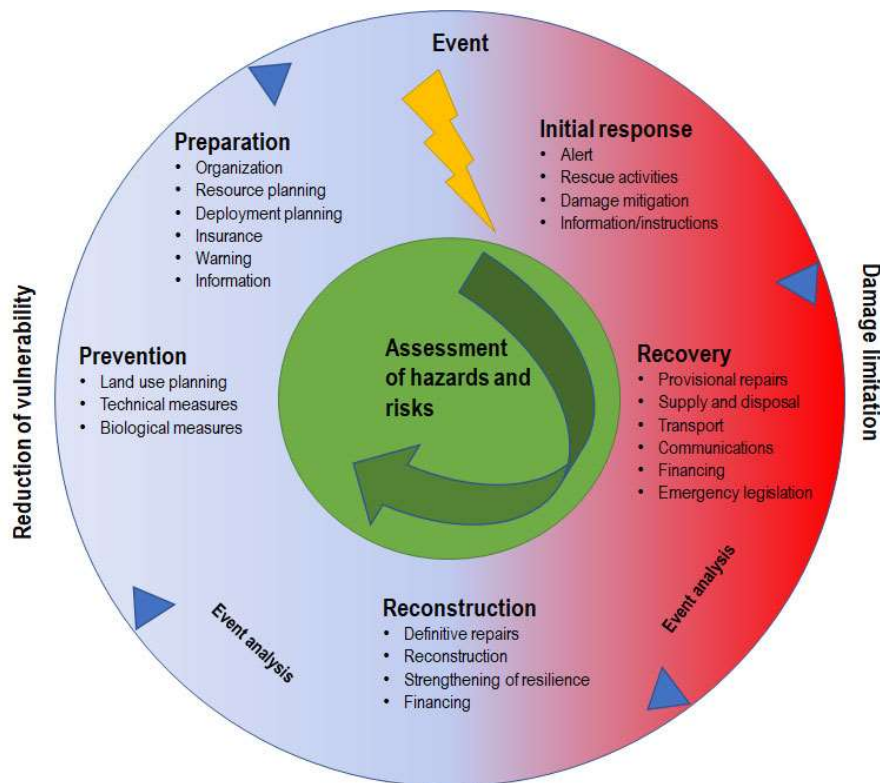
## 5.4. Selection of measures, activities and projects for climate change adaptation

The adaptation to climate change is a process in which a constant analysis of the potential threats and the consequences of certain climatic hazards is conducted and the appropriate actions in two main directions – on the one hand for reduction of the vulnerability in the individual sectors, and on the other – for limitation of their negative impact, are taken.

To **reduce the vulnerability** in the individual sectors, preventive measures are applied to limit the possible negative impact in the event of climatic hazard, and preparatory measures to enable the municipality to be ready for a timely and correct response in case climatic hazards occur. The reconstruction measures may also be aimed at vulnerability reduction, usually performed after the analysis of past events.

The other group of measures are those related to the **damages limitation** from the negative climatic events. Such are the measures for initial response when a phenomenon has occurred, such as alarm, information and instructions for action, rescue operations. Then the measures for recovery such as provision of interrupted supplies, communications and transport, land clearing and temporary repairs follow. Finally, come the measures related to reconstructions, major repairs, etc.

Diagram of the process related to the adaptation to climate change is presented on *Figure 45*.



*Figure 45. Diagram of the climate change adaptation process*

Source: Based on the example of the Integral Risk Management Cycle, Swiss Federal Office for Civil Protection (FOCP) 2019  
<https://www.babs.admin.ch/en/aufgabenbabs/gefaehrdrisiken.html>

The greater emphasis in the choice of measures for the adaptation to climate change in the current plan falls on the measures related to the individual sectors vulnerability reduction. The achievement of a lower level of vulnerability to climate hazards in the sectors will reduce the number of high climate risks, resulting in fewer cases where the impact of climate hazards will lead to significant damage of the affected sectors. This approach is in line with the strategic objectives of the plan. The activities in the *EU Strategy for Adaptation to Climate Change* are structured in the same way, where



the emphasis is related with the activities for prevention and preparation for negative climate events occurrence.

The measures developed are systematized in five sections depending on the field of their application:

1. **Legal-administrative and management framework for climate policy** - measures related to the legislative initiative and normative documents development.
2. **Upgrading the institutional, expert and financial capacity and the planning basis for the measures implementation** - measures related to the establishment of structural units, development of planning documents, activities management.
3. **Applied urban research and development activities** - measures related to conducting specialized research, cooperation and interactions, implementation of pilot projects.
4. **Investments in technical and green infrastructure, buildings and public works** - investment measures for intervention in the physical environment (urban and out-of-town).
5. **Development of a system for broad public involvement in the measures implementation** - measures related to communication with stakeholders, provision of information, upgrade of the education programs and development and conducting of thematic trainings.

The measures selection is consistent with the high climate risks described above, and assessed in the study presented in Annex 6. Figure 46 shows schematically how the individual measures affect the adaptation to climate change, leading to the occurrence of more significant climate risks.

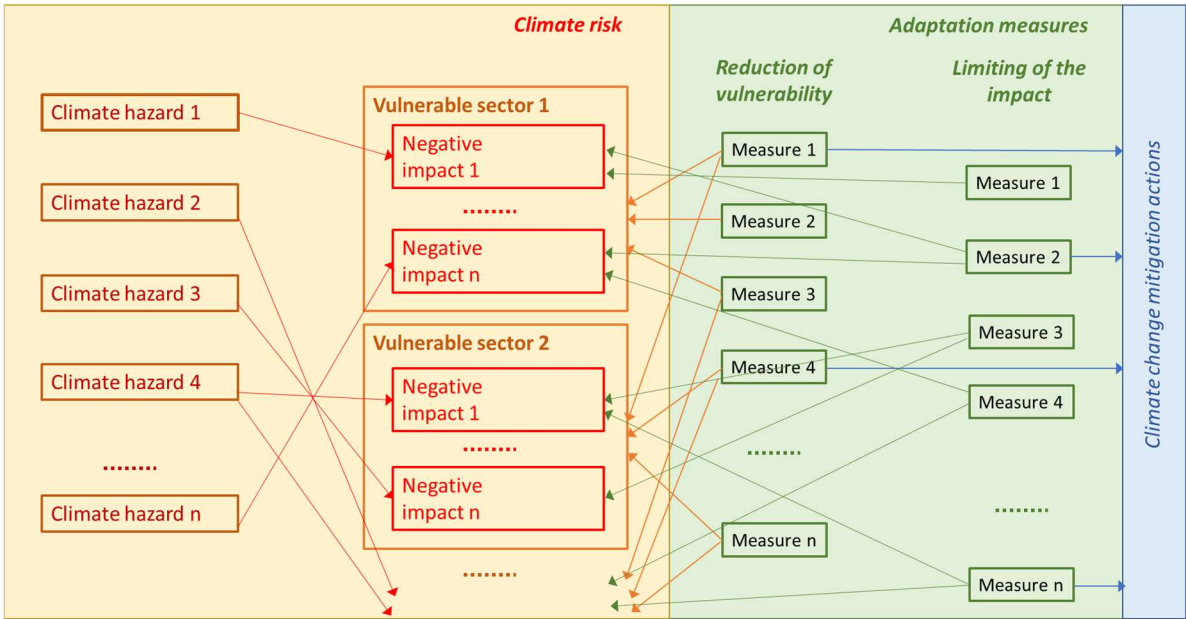


Figure 46. Focus of the activities for climate change adaptation

Each measure addresses one or more climatic hazards to which one or more sectors are vulnerable. The analysis of the sectoral vulnerabilities and the levels of impact have revealed that a high climate risk is present. The selected measures influence the reduction of the vulnerability in the targeted sectors, as well as the limitation of the potential damages in the event of negative climatic events. Many of the measures affect both aspects. Each measure may affect one or more vulnerable sectors and address one or more climate threats. Many of the measures are logically interlinked, which means that the achievement of an effect from one measure may be related to the implementation of another one or that the effect complements the result of other measures. Some of the measures have also a positive

effect on the "mitigation" of the climate change effects, and this is often achieved outside the "mitigation" scope of the current plan.

Each measure is described separately in the respective category, having its own identification number, which is consistent with the numbering of the categories. When presenting each measure, its most important characteristics are displayed in separate color fields. For each measure, a special field at the top right side of the sheet indicates whether the measure is aimed at "reducing vulnerability" or "limiting the damages" and the measures numbers, to which the measure described has logical links, are listed. Another field, on the right-hand side of the sheet, the specific adaptation objective targeted by the measure is indicated, the climate risks addressed, the vulnerable sectors affected, the budget needed for the measure implementation and the deadlines for the realization of the envisaged actions. The budget funds are calculated with VAT included. A description of the activities is included in the presentation of the measures - scope and benefits, as well as the responsible persons and the stakeholders.

The specific adaptation targets are derived in correspondence with the strategic objectives set and the measures developed and are presented in *Section 5.5*.

## A.I. Legal-administrative and management framework for climate policy

### A.1.1

#### Undertaking initiatives for legislative and regulatory normative changes for integrated adaptation to the climate changes affecting the territory of Sofia Municipality

#### Description

Development of an analytical report for identification of the legal and regulatory bases, as well as the gaps in the legal and regulatory system regarding the actions for adaptation to climate change. The report will be the basis for undertaking the necessary actions to ensure the legal and regulatory measures in the field of adaptation to climate change, where necessary, as well as the powers of Sofia Municipality to limit and promote essential activities on its territory.

Focus on the exploration of the possibilities for changes in the legislation concerning the implementation of the National Strategy for Adaptation to Climate Change and the introduction of additional integrated structural regimes, specific indicators and technical instructions related to the climate change adaptation and the challenges by developing proposals with options for amendment of the LLCC (from the Law on Limiting Climate Change to the Law on Limiting Climate Change and Adapting to Climate Change (LLCCACC)), SDA, LSBSM, CMA, EPL, (EPL, AAPA, ENPA), BDA, WA, WA, DPA, HL, LRWSSS and the related bylaws. General reform of the regulatory framework related to the Green Deal and the Mechanism for Recovery and Resilience (sustainability).

First level of integration between:

- LLCCACC (powers, integrated policies, cross-sectoral organization at the national, regional and local level) with SDA (territories with special territorial-structural protection and preventive structural protection, territories structures and land properties (build up parameters, location of buildings, development of green and afforested areas, etc.); LSBSM (types of territories, structural zones and independent terrains, rules and regulations, Ordinances on the green system (supplementing the Ordinance on the green system of Sofia Municipality and the Ordinance for elaboration of instructions for the perennial woody vegetation care, as well as for the long-term woody vegetation value estimates updating on the basis of the ecosystem services and compensatory payments in case of its injury or destruction; definition of green system, incl. green and blue infrastructure, elements of the ecological connectivity, artificial wetlands, communal gardens, etc.) and the Ordinance on the urban environment (urban planning requirements for ecological red lines, which will allow their use as public spaces while preserving their capacity for ecosystem services provision, urban planning requirements to reduce the sealing, optimal use of the rain and gray waters to maintain the green and blue infrastructure); CMA (common parts of condominium buildings, adjacent area);

- LLCCACC with WA (river basins and sub-basins, retention lowlands (natural water retention surfaces), areas with potential for water retention (natural floodplains), areas at risk and flood risk, Environmental Protection Act (introduction of the ecosystem approach in the National System for Environmental Monitoring in relation to all biotic and abiotic components – the monitoring of air, noise, water, waste and soil, biodiversity, forests will provide harmonized data on the capacity of the ecosystems to mitigate and adapt to climate change and the anthropogenic impacts on this capacity); BDA (protected areas and connections between them (landscape elements); nature-based solutions for mitigation and adaptation in urban and suburban environments; consistent application of the ecosystem approach, clarification of the relations ecosystem - habitat - species habitat ; based on these links regulation of the ecosystem-based solutions for the protected areas and zones with other green spaces connection, incl. parks in urban environments; introduction of ecosystem monitoring through the National System for Monitoring of the Biodiversity State so that it provides information for the territorial planning of the connectivity between the

#### Vulnerability reduction / damage reduction

A.1.1 – A.1.2, A.1.3, A.2.1, A.2.2, A.3.1, A.3.5, A.3.6, A.3.7, A.3.2, A.3.9 and all from A.4

#### Specific objectives of the plan:

**Creation of a normative, institutional and planning basis for the adaptation measures implementation**

#### Addressed risks:

**All major risks**

#### Vulnerable sectors affected:

**All**

#### Budget required:

**BGN 72 thousand**

#### Potential source:

**SM budget**

#### Deadline for implementation:

**Short-term priority – 2023**

**Repeatedly**

protected areas and zones; FA (zones for protection against the urbanization and the urban microclimate); LPAL (categorization of agricultural land, change of use, food security and ecosystem services related to the climate regulation); LOUAL (management and sustainable use in relation to the climate change adaptation measures, incl. microhabitats and ecological connectivity for increase of the agriculture adaptive capacity); MRA (mining waste, reclamation and extreme weather events); LOUAL (reduction of the water losses during the water supply systems operation and efficient and economical use of the supplied water quantities; regulation of the gray and rainwater harvestion and its use for the green system).

Second level of integration between LLCCACC and HL (climate change and healthy living conditions, health facilities, public facilities, resort resources and resorts); WA (climate change and tourist sites) and DPA (climate change and population, environment, property, disaster risks, critical infrastructure, collective and individual means of protection).

Third level of integration - LLCCACC and EPL (waters, soils, landscape and other components and factors of the environment whose condition affects the adaptive capacity); ZCA (areas with low emissions of harmful substances and reduced health vulnerabilities (e.g. from the combined effects of the air pollution and the contrasting weather changes and extreme cold, but also a potential contribution to climate change mitigation); ENPA (quiet areas and reduced health vulnerability (e.g. from the combined action of noise and heat waves) but also a potential contribution to the climate change mitigation); EPL (territories of the settlements intended for public use, sites for waste management and reduction of health vulnerabilities (e.g. from the combined action of misconduct related to waste disposal and the heat waves, heavy and intense rainfalls and floods).

### Scope

NA of the Republic of Bulgaria, CM, MoEW, NAMRB, municipalities, part of the Covenant of Mayors, Sofia Municipality, urbanized territories, Sofia city

### Benefits

Synchronized and integrated norms-making, which creates opportunities for better management, planning, design and implementation of the actions for adaptation to climate change

### Responsible

“Green System, Ecology and Land Use” Division

Supporting units: “Architecture and Urban Planning” Division / ME “Sofiaplan”

The role of SM: initiator, assignor, coordinator

## A.I. Legal-administrative and management framework for climate policy

### A.1.2

#### Creation of a municipal financial mechanism for climate change adaptation

#### Description

Exploration of the possibilities for use of the European and national funds and the ways of their provision, including the legislative, institutional, planning and technical requirements. Establishment of a local normative and institutional framework as a complementary municipal financial mechanism for timely implementation of the climate change adaptation measures related to the preparation, as well as response to, and recovery from extreme weather events in urban environments, taking into account the direct and side (external) costs as well as the ecosystem services benefits. Compliance with the European legislation (e.g. the Regulation on land use, the changes in land use and forestry) and the financial instruments (e.g. the Green Deal), the strategic and program documents of the Republic of Bulgaria for management of the European Union funds for the 2021-2027 programming period and the other funding sources related to the pandemic recovery and resilience, the integrated urban and territorial approach and investments, the conservation and restoration of the ecosystems and the biodiversity and other compatible approaches and priorities. Demarcation, combination and targeting of the funds oriented to the adaptation goals and the rest of the related goals and challenges, incl. of stakeholders involvement by balanced public-private financial mechanisms. Engagement of Sofia Municipality in the planning and spending of at least 30% of the funds for adaptation to climate change under various European programs.

#### Scope

Sofia Municipality, urbanized territories, the city of Sofia, focus territories for public use, municipal public and private property, public sites and common parts of buildings in condominium regimes, their adjacent area or regulated plots (RPs).

#### Benefits

A working framework to timely funding of climate change adaptation projects that affect the different sectors, common areas and need targeted resources that are not available or sufficient from other sources.

#### Responsible

“Green System, Ecology and Land Use” Division

Supporting unit: “Finance and Healthcare” Division

The role of SM: assignment, coordination and control

*Vulnerability reduction /  
damage reduction*

**A.1.2** – all measures for  
adaptation

#### *Specific objectives of the plan:*

**Creation of a normative,  
institutional and planning basis for  
the adaptation measures  
implementation**

#### *Addressed risks:*

**All major risks**

#### *Vulnerable sectors affected:*

**All**

#### *Budget required:*

**BGN 315 thousand**

#### *Potential source:*

**Financial instruments (loans  
supported by the European  
Structural and Investment Funds)**

#### *Deadline for implementation:*

**Short-term priority – 2023**

**Repeatedly**

## A.I. Legal-administrative and management framework for climate policy

### A.1.3

**Introduction and compliance with the spatial planning indicators for maximum percentage of ingestion and minimum percentage of permeability of the urban surfaces; complementation of the structural indicator for minimum obligatory landscaped yard area**

#### Description

Introduction of a structural indicator known in the structural practice as percentage of absorption, as well as a new structural indicator known, in the observation of the Earth, as a percentage of permeability of the earth's surfaces. Inclusion of the indicators in the Terms of Reference and the draft amendment of the GDP, in the accompanying amendment of the LSBSM, as well as bringing the DDPs in line with the provisions of the GDP after its amendment. Establishment of specific values for all structural zones and terrains and with attention to each regulated plot (RP).

Further clarification of the approach for calculation and compliance with the percentage of landscaping in the Terms of Reference and the draft amendment to the GDP, in the accompanying amendment of the LSBSM and the Ordinance of the Sofia Municipal Council for Development, Maintenance and Protection of the Green System of Sofia Municipality (OSMCDMPGSSM); bringing of the DDPs in line with the current GDP, issuing projects for design visas, placement schemes and sketches indicating the placement method, subsequent coordination of the investment projects, issuing building permits, construction sites organization, commissioning and follow-up control.

Specification of the approach for surveying and calculation of the sealed surfaces, the minimum mandatory landscaped yard area and the respective role of the remote survey sampling, calculation and production of high resolution plant indices, including height and volume of the tree crowns and shrub vegetation; and the biophysical parameters (biomass, leafs area, species diversity and assessment of the overall condition), together with the established geodetic survey and expert assessment of the woody, shrubby and grassy vegetation. Purchase of equipment and assignment of the services for the sustainable baseline and subsequent indicator monitoring. Clarification of the correction factors according to the presence of low, medium and high vegetation, primary and compensatory landscaping, roof, vertical and interior landscaping.

Coefficient, related to the indicators monitoring, when calculating the real estate tax.

#### Scope

Sofia Municipality, all groups of structural zones, territories and separate terrains, as well as the individual RPs.

#### Benefits

Ensuring the systematic presence of landscaping and limiting the overall vulnerability of the territory of SM

#### Responsible

“Architecture and Urban Planning” Division / Supporting unit: ME “Sofiaplan”

The role of SM: assignment, coordination and control

#### Vulnerability reduction

**A.1.3** – A.1.1, A.1.2, A.2.1, A.2.2, A.2.3, A.3.1, A.3.5, A.3.6, A.3.7, A.3.2, A.3.9, A.4.1, A.4.2, A.4.3

#### Specific objectives of the plan:

**Creation of a normative, institutional and planning basis for the adaptation measures implementation**

#### Addressed risks:

**Extreme heat, heavy and intense rainfall, etc.**

#### Vulnerable sectors affected:

**All**

#### Budget required:

**BGN 425 thousands**

#### Potential source:

**SM budget**

**ME “Sofiaplan” budget**

**Research Fund (SM as a partner of the scientific organizations)**

#### Deadline for implementation:

**Short-term and long-term priorities – 2023 and 2030**

**Once and repeatedly**

## A.2 Upgrading of the institutional, expert and financial capacity and the planning basis for the measures implementation

### A.2.1

**Establishment of an applied-research network for study, analysis and simulation of the microclimate-related characteristics of the urban environment and for preparation for extreme weather events**

#### Description

A network of specialists, working on the basis of a cloud parametric platform, developed around modelling, based on agents and artificial intelligence for research, analysis and simulation of volumetric-spatial characteristics of the building-up and landscaping, the behavior of the environment and the people in it, including variable parameters regarding: sun exposure and shading; wind load and ventilation; external thermal comfort; surface water drainage; backup power supply and heating; evacuation and rescue of residents and visitors; state of the green system and urban biodiversity. The basis of the platform-related modular software application will be the creation of a digital duplicate of the city of Sofia in an open access model and laboratory equipment funded by the GATE project, under conditions set in the agreement between the project and Sofia Municipality, the future conditions for the laboratory equipment use will be specified further.

Pilot and actual implementation aiming to reduce the combined effects of the climate change in the framework of the expert and policy decisions in the detailed development plans coordination (with emphasis on the work development plans). Determination of reference values for daylight, acceleration and permeability of the air currents, external thermal comfort, volume of retention and velocity of the surface waters, degree of autonomy and reserve capacity of electricity supply and heating, safe withdrawal and stay of the vulnerable groups and visitors, phyto-sanitary status of large vegetation and biodiversity index. Potential introduction of a requirement for combined simulations in LSBSM, together with the transport ones in Art. 16d.

#### Scope

Sofia Municipality, city of Sofia - Detailed spatial plans (including DDP) for one or for a group of neighborhoods with an area of more than 1 ha; for neighborhoods with connected medium-height construction and for high-rise properties; zero, first and second category consumers according to Section III of the Ordinance No 3 of 9.06.2004 on the design of electrical installations and power lines.

#### Benefits

Operational implementation of a tool for common use to support the informed decision-making.

#### Responsible

“Architecture and Urban Planning” Division / Supporting unit: ME “Sofiaplan” / scientific, professional and non-governmental organizations

The role of SM: support and partnership

#### *Vulnerability reduction / damage reduction*

A.2.1 – A.1.1, A.1.2, A.1.3, A.2.2, A.3.1, A.3.6, A.3.3, A.3.10, A.4.1-5, A.4.7

#### *Specific objective:*

**Creation of a normative, institutional and planning basis for the adaptation measures implementation**

#### *Addressed risks:*

**Extreme heat, heavy and intense rainfall, etc.**

#### *Vulnerable sectors affected:*

**All**

#### *Budget required:*

**BGN 800 thousand**

#### *Potential source:*

**In partnership with scientific organizations:**

**PE – Priority 4. Risk and climate change**

**PIC – Priority 1. Innovations and growth**

**LIFE**

**URBACT**

**Horizon 2020 – GATE project – will provide the appropriate equipment and laboratory (SM is partner of the Sofia University)**

#### *Deadline for implementation:*

**Medium and long-term priority – 2025 and 2030**

**Once and repeatedly, constantly**

## A.2 Upgrading of the institutional, expert and financial capacity and the planning basis for the measures implementation

### A.2.2

**Strategic spatial planning of new and reconstruction of existing elements of the green and blue systems and infrastructure of Sofia Municipality and the city of Sofia**

#### Description

Development of a concept, spatial planning and pre-investment study, as well as action plans for the development and formation of the overall green system and infrastructure of parks, gardens, green and water elements. Ensuring their development through the Terms of Reference and the draft GDP, adoption of the amendments, coordination of the detailed development plans and the steps for substantive and administrative-procedural steps for actual creation of new ones, as well as reconstruction of the existing ones in the following spatial entities with emphasis on the adaptation to climate change:

- Green wedges (radial and tangential) – regulating the microclimate of the intensively built-up urban macrostructures. Development of a clear action plan for the completion of the green wedges system in Sofia with identification of the obstacles and the ways to solve them;

- Green belt around the city of Sofia and green connections (territories north of the city of Sofia and the Iskar River and its tributaries) to and along the Iskar River – regulation of surface water runoff, allowing innovative forms of sustainable land use;

- Green collar (contact area with Vitosha Nature Park, panoramic and Ring Road) - reconstruction of the contact areas of the established green links, allowing better and continuous access to greenery and the related ecosystem services in extreme heat;

- Green stripes (dismantled railway lines, river valleys and terraces) - reconstruction of the gray into green connections, allowing the binding of the green wedges crossing intensively the built-up urban macrostructures;

- Green pockets (a great number of small inner district and district parks, gardens and landscaping) - improving the state of the variety of material, regulatory and cultural ecosystem services, incl. through green areas and volumes improving the microclimate;

- Green Heart (The Green Memory of Sofia and the individual centuries-old trees) - a specific reconstruction for the protection of the centuries-old trees and those in old age phase, as well as improving the condition of the soils in places with intensive use and trampling.

General planning of ecological corridors for the protected areas and zones connection with each other and with the urban environment parks, as well as for the valuable ecosystems restoration, together with the landowners and users (agricultural owners and producers, forest holdings and forest owners, hunting and fishing companies, NGOs and other stakeholders). Ecological corridors can also be planned as places with permanent crops (e.g. landmarks planted with local rosehip varieties) or other types of steppe-shrubs, forest or aquatic ecosystems providing material ecosystem services. The ecological corridors and restored ecosystems should be included in the ecological red lines system and should be developed with priority through targeted applications for funding, e.g. green agricultural subsidies, funds for recovery, funds for implementation of the

*Vulnerability reduction / damage reduction*

A.2.2 – A.1.1, A.1.2, A.1.3, A.3.1, A.3.6, A3.9-10, A.3.12, A.3.8, A.3.7, A.4.1-4

*Specific objective:*

**Creation of a normative, institutional and planning basis for the adaptation measures implementation**

*Addressed risks:*

**Extreme heat, heavy and intense rainfall, etc.**

*Vulnerable sectors affected:*

**All sectors considered**

*Budget required:*

**BGN 1.6 million**

*Potential source:*

**SM budget**

**ME “Sofiaplan” budget**

**PE – Priority 4. Risk and climate change**

*Deadline for implementation:*

**Short, medium and long-term priority – 2023 creation; 2025 - first concepts and their implementation; by 2030 – approved center for urban planning adaptation services**

**Once and repeatedly, constantly**



ecosystem approach, funds for support of the eco- and rural tourism, voluntary donations for patronage of endangered species and/or payments for ecosystem services (including for compensation of the biodiversity losses), etc. Sustainable use of groundwater resources should also be envisaged through the construction of infrastructure of water extraction facilities (drilling) for irrigation purposes in parks and gardens, for street washing and air refreshment in hot periods.

The activity upgrades the projections of the current GDP of the Municipality, as well as the Green City Action Plan (Green Wedges Project). Sofia Municipality has started actions for the development of Terms of Reference for the activities implementation described in the measure.

### **Scope**

Sofia Municipality, city of Sofia, elements of the existing and of the green system potential structure, provided in the current Master Plan.

### **Benefits**

Utilization of regulating and cultural ecosystem services around and between the so-called ecological red and blue lines, incl.:

- regulation of the microclimate, capture and storage of carbon dioxide, purification of the air from fine dust and other harmful substances, improvement of the water and other biochemical cycles, improvement of the plant pollination, creation and restoration of various habitats;
- recreation and observation of nature, green offices and classrooms for physically distant work and learning in nature, ecological training in nature and forest schools, sports and games in green natural areas, therapeutic activities in nature, urban (including cooperative) agriculture based on permacultural design and other outdoor creative activities.

At the same time, the measure addresses actions related to the climate change mitigation. The addition of a large amount of perennial green plants has a significant effect on the absorption and storage of carbon dioxide.

### **Responsible**

“Architecture and Urban Planning” Division

Supporting unit: ME “Sofiaplan”

The role of SM: planning and coordination with the stakeholders

## A.2 Upgrading of the institutional, expert and financial capacity and the planning basis for the measures implementation

### A.2.3

#### Development of a roadmap for the use of buildings roof areas for climate-related activities

#### Description

The roofs of many buildings may be suitable for implementing measures related to both climate change mitigation and adaptation. On the one hand, the roofs may be suitable for the construction of installations for production of renewable energy for own needs, but they can also be used for landscaping, or to be covered with special reflective coating to increase the albedo and reduce the heat-absorption capacity, thus decreasing the effect of the urban heat island. In accordance with the research dedicated to this effect and after studying the construction characteristics of the roofs, areas in the city should be determined, in which the application of a specific type of technology or combination of technologies should be prioritized.

#### Scope

City of Sofia

#### Benefits

Efficient use of significant part of urban areas that could have a positive impact on the climate change mitigation and adaptation.

#### Responsible

“Architecture and Urban Planning” Division

Supporting unit: ME “Sofiaplan”

The role of SM: assignment, coordination, control

#### Vulnerability reduction / damage reduction

**A.2.3** – C.3.2, C.1.3, A.1.1, A.1.2, A.1.3, A.2.1, A.2.2, A.3.9, A.4.1, A.4.2

#### Specific objective:

**Creation of a normative, institutional and planning basis for the adaptation measures implementation**

#### Addressed risks:

**Extreme heat, heavy and intense rainfall**

#### Vulnerable sectors affected::

**Urban planning, Buildings, Environment and biodiversity, Human health**

#### Budget required:

**BGN 120 thousand**

#### Potential source:

**SM budget**

**European Climate Initiative (with NGO partners)**

#### Deadline for implementation:

**2024**

## A.2 Upgrading of the institutional, expert and financial capacity and the planning basis for the measures implementation

### A.2.4

**Action plan development and implementation for the population protection of Sofia Municipality in case of heat waves**

*Vulnerability reduction / damage reduction*

**A.2.4** – A.2.1, A.3.1, A.3.7, A.3.9, A.3.4, A.4.2, A.4.3

#### Description

The population protection action plan at hot waves includes the implementation of a set of measures for the periods before and during the summer season. The efficient prevention of morbidity and mortality due to hot weather requires the functioning of the meteorological systems for early warning provision, the timely dissemination of recommendations for preventive and protective measures, the vulnerable groups social protection, the improvement of the urban planning and housing construction and ensuring the health system's readiness. The plan can be an independent document or can complement the existing Sofia Municipality Disaster Protection Plan.

The population protection action plan in case of hot waves will be developed as part of the Plan for population protection in case of disasters and accidents.

#### Scope

Sofia Municipality

#### Benefits

Protection of the health and life of the population of Sofia Municipality and especially of the vulnerable groups from the negative impact of extremely hot weather

#### Responsible

"Emergency Aid and Prevention" Directorate

Supporting units: "Finance and Healthcare" Division

Stakeholders: GD "Fire Safety and Population Protection" / NCPHA / NIHM / UACEG / NIGGG-BAS / BRC / WHO – Bulgaria office

The role of SM: initiator, assignor, coordinator / partner

#### *Specific objective:*

**Creation of a normative, institutional and planning basis for the adaptation measures implementation**

#### *Addressed risks:*

**Extreme heat**

#### *Vulnerable sectors affected::*

**Human health**

#### *Budget required:*

**BGN 1 million**

#### *Potential source:*

**LIFE**

**SM budget**

#### *Deadline for implementation:*

**2023 – development of the plan**

**2030 – implementation of the plan**

## A.2 Upgrading of the institutional, expert and financial capacity and the planning basis for the measures implementation

### A.2.5

Development of general guidelines for the inclusion of climate change adaptation when assigning transport infrastructure projects

*Vulnerability reduction /  
damage reduction*

**A.2.5** – A.1.1, A.1.2, A.2.1, A.3.9,  
A.4.2, A.3.14, A.4.6

#### Description

Review of the existing practices and improvement of the procedures for the transport infrastructure projects development. In order to achieve the gradual adaptation of the transport infrastructure to the expected climate change, general instructions for awarding transport infrastructure projects by Sofia Municipality or the municipal companies for the adaptation to climate change reporting in the project preparation process.

#### Scope

Sofia Municipality

#### Benefits

The inclusion of an environmental impact analysis, taking into account the needs for climate change adaptation and disaster resilience in the project preparation process, will ensure the implementation of sustainable transport projects.

#### Responsible

"Public Construction" Division

Supporting unit: "Climate, Energy and Air" Directorate

The role of SM: assignment, coordination, control

#### *Specific objective:*

**Creation of a normative,  
institutional and planning basis for  
the adaptation measures  
implementation**

#### *Addressed risks:*

**All climate risks**

#### *Vulnerable sectors affected::*

**Transport**

#### *Budget required:*

**BGN 20 thousand**

#### *Potential source:*

**SM budget**

#### *Deadline for implementation:*

**2022**

## A.3 Applied urban R&D activities

### A.3.1

#### Elaboration of a concept and municipal information system development for the processes related to the activities for adaptation to climate change management

#### Description

The concept should consider:

- Data collection from global, European, national and own sources, scientific circles and national scientific infrastructures.
- Management of the available data or the data in a process of acquisition.
- Quality control organization, creation and maintenance of the metadata, back-up systems, provision of secure access, security and sharing policies for the municipality's own data, compliance with the international, European and national standards regarding the data infrastructure (incl. the INSPIRE directive and the SDAA), as well as other standard classifications, incl. the sustainable development goals, the sectoral standards, nomenclatures, etc., e.g. for forests and other ecosystems - classifications of species and habitats by taxonomic nomenclatures, annexes to directives, IUCN nomenclatures, CICES ecosystem services nomenclature, etc.
- Hardware and software, incl. geo-data bases and other appropriate applications which provide software for the generation of interactive automated information reports.
- Standard data processing, modelling and analysis.
- Development of interactive automated dashboards/reports for all indicators related to the monitoring of the vulnerability and the impact of climate change in the sectors covered by the plan, for which high climate risks have been identified, incl.:
  - specialized, permanent, high-resolution meteorological monitoring in Sofia Municipality's own meteorological network and through scientific infrastructures (see measures A 2.1, A 4.5);
  - municipal carbon budget with integrated data on the emissions by sources, as well as greenhouse gas capture/reduction of emissions due to economic, social activities and environmental processes;
  - geo-spatial report on the floods on the territory of Sofia Municipality - location, main causes, affected population and damage assessment in order to more effectively plan the flood protection measures;
  - geo-spatial reports on:
    - mapping and analysis of the long-term vegetation in the GIS environment (used tree, shrub and grass species, basic biometric indicators, plant),
    - identification and mapping of the missing long-term trees and other vegetation positions in the urban street landscaping, places with insufficient climate-sustainable green infrastructure and the planning and implementation of landscaping, incl. species suitable for the expected future climatic conditions,
    - identification and mapping of crops vulnerable to climate change due to their species composition and condition,
    - ecosystems affected by natural disturbances by type (forest, agro-ecosystems, grass, steppe-shrubs, etc.) and the loss of ecosystem services caused by their impact (wood biomass, climate regulation, protection against erosion, floods, etc.) and the related emission changes due to the reduced carbon sequestration from the ecosystems,

#### Vulnerability reduction / damage reduction

A.1, A.2., A.3, C.2; C.1.6, C.2.1, A.4.4 – A.3.1; measures from group C.3, A.4, A.5 – feedback to A.3.1

#### Specific objective:

**Implementation of a system for information and analytical security regarding the adaptation**

#### Addressed risks:

**All major**

#### Vulnerable sectors affected::

**All**

#### Budget required:

**BGN 1 million for development and BGN100 thousand for maintenance**

#### Potential source:

**In partnerships with scientific organizations:**

**PE – Priority 4. Risk and climate change**

**LIFE**

**PIC – Priority 1. Innovations and growth**

#### Deadline for implementation:

**Short-term priority – 2025**

**Repeatedly**

- areas subject to reclamation with a proposal for their use in order to utilize renewable energy sources - fast-growing biomass, solar energy, etc.,
    - interactive information data base for the so-called "Cold spots" in the city, where one can look for coolness in extremely hot weather.
  - sectoral knowledge base on the impact of climate change on the tourism development and other sectors affected;
  - report on the number, size and type of fires on the territory of Sofia Municipality, the methods of extinguishing and estimation of the carbon emissions in case of extreme CO<sub>2</sub> load related to the fires;
  - Register of the occurred negative impacts caused by climatic hazards, incl.:
    - road transport accidents caused by fog, snow, hail, icing of bridges and viaducts, heavy and intensive rainfalls,
    - damages to land and underground transport infrastructure - street network, railway, metro stations, subways, bridge facilities, traffic lights, contact cable network, bus shelters and other public transport infrastructure,
    - interruptions and delays in the public transport services related to the damages on the transport infrastructure, disturbances in the activities of the zones for hourly paid parking and closed streets/road sections,
    - significant damage and loss of perennial woody vegetation.
  - municipal ecosystem bills with assessment of the ecosystem services, incl. the monetary value of the pilot activities under the bidirectional cost recovery and schemes balancing in selected neighborhoods (measure A.3.6);
  - municipal carbon bills for estimation and monitoring of the amount of greenhouse gases captured by the ecosystems in Sofia Municipality that should be included in the future emission inventories. Such accounts may be developed jointly with the LTER-BG scientific network as a scientific product using the results of the cooperation in the frames of the European LTER network;<sup>40</sup>.
- Development of other interactive automated information reports/dashboards at the suggestion of the competence center (measure A.2.1), e.g.:
  - for the purposes of other policies of SM competence that may be affected by climate change;
  - for external users, incl. state and municipal authorities, climate volunteers, etc.;
  - sharing of good practices (see measure A 3.7.);
  - publication of expert lists for the vegetation types (measure A.3.13);
  - information publication on the voluntary initiatives, incl. eco labels, etc.

The concept should define the necessary types of interoperability with other information systems at the national, European and global levels (such as national monitoring data, the European climate data and products system, Copernicus environmental data, European and national institutions field data, European and national research infrastructures, products with open access from remote observations of other space nations - USA, Japan, Russia, China, etc.), to create a unified data model that would allow the inclusion of information from the SECAP studies and others thematic studies/analyses, as well as to identify the needs for additional data to provide information support for the above-described reports (dashboards). This analysis will be used to define the parameters of scientific and applied products for climate change adaptation and mitigation and the potential socio-ecological site of LTER-BG. In addition to the primary data storing in the information system, it should be possible to generate and update dynamic specialized reports in a user-friendly way. They should be provided automatically for the creation of applied and scientific products, for the needs of the above analyses and for making informed policy decisions and taking measures related to the climate change adaptation, as well as to calculate, monitor and forecast the values of individual vulnerability and impact indicators.

The concept will also create a science-based toolkit showing the steps, approaches, space-time, monitoring and other parameters for the building of a network of weather stations in Sofia Municipality and a relevant database of specialized climate data.

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<sup>40</sup> Research on the challenges "Biogeochemical controls of ecosystem functions" and "Climate-water-food relationship", details at <https://www.lter-europe.net/projects/PLUS>

The information system should realize the concept in terms of software and hardware, interface with other systems; to create the necessary organization for the maximum automated collection (ingestion), data processing, storage and data archiving of the results obtained and their presentation to the stakeholders.

### Scope

- Territorial scope: The whole territory of Sofia Municipality and, if necessary, parts of other municipalities, covering the ecosystems of importance for Sofia Municipality.
- Thematic scope: all sectors affected by climate change.
- Time range: the longest possible time series of data depending on their availability. If necessary, digitalization of the old data and analysis repetition can be planned at a next stage.

### Benefits

- Interoperability for better data sharing and reuse.
- Creation of a continuous workflow adapted to the challenges of the “Large amount of data?” processing.
- Significant simplification of the process of reports generation and analyzes for informed implementation of the mitigation and adaptation policies. Such system has been adopted by the European Environment Agency in its catalog of publicly available data, analyzes and info-graphics at: <https://www.eea.europa.eu/data-and-maps>

### Responsible

ME “Sofiaplan”

Supporting units: “Green System, Ecology and Land Use” Division / “Digitalization, Innovation and Economic Development” Division

Stakeholders: The institutions and universities of the LTER-BG network / state and municipal authorities on Sofia Municipality territory, who collect, maintain data and provide them to SM under a normative act, other academic partners/volunteers collecting data, incl. businesses, NGOs, citizens and their organizations.

The role of SM: assignor and coordinator of the concept development, support and partnership, user

## A.3 Applied urban R&D activities

### A.3.2

**Study of the city of Sofia microclimate and development of a meso-model and platform for micro simulations for management, planning and development purposes**

#### Description

Study of the general and specific microclimatic conditions dynamics of the urban environment of Sofia on the basis of a dense network of measurements, detailed mapping of topographic, morphological, surface, plant and energy characteristics, as well as meso-model development using a system for improvement by meteorological data repeated analysis and a platform for micro-simulations using artificial intelligence and with a focus on climate comfort and the impact of the extreme weather events for the purposes of the of spatial planning, investment design, traffic organization, disaster protection and health prevention (upgrading the measure from CCAP O-3; D-1 Mapping of urban microclimate; CCAP O-3; D-2 Mapping of the street and inter-block landscaping; AQP 71-Sf-i-St Development of an expanded information base for analysis of the influence of urban structure and local time and climate on the AQP).

#### Scope

Sofia Municipality, city of Sofia, meso-model with horizontal resolution up to 1 km and micro simulations with horizontal resolution less than 10 m.

#### Benefits

Great benefits from the creation of a basic climate model for Sofia Municipality, which will be essential for the other applications and systems and will support the planning and decision-making.

#### Responsible

ME "Sofiaplan"

Stakeholders: scientific organizations

The role of SM: assignment, coordination, control

*Vulnerability reduction /  
damage reduction*

**A.3.2** – A.1.1-3, A.2.1-5, A.3.3, A.3.4,  
A.3.5, A.3.7, A.3.9, A.4.1-4

*Specific objective:*

**Implementation of a system for information and analytical security regarding the adaptation**

*Addressed risks:*

**All major**

*Vulnerable sectors affected::*

**All**

*Budget required:*

**BGN 1,25 million**

*Potential source:*

**In partnership with scientific organizations:**

**LIFE**

**PIC– Priority 1. Innovations and growth**

**Horizon 2020 – GATE project – will provide the appropriate equipment and laboratory (Sofia is a partner of the Sofia University)**

*Deadline for implementation:*

**Short, medium and long-term priority – 2023, 2027 and 2030**

**Once and repeatedly**



## A.3 Applied urban R&D activities

### A.3.3

**Complex evaluation of Sofia Municipality climate in micro- and meso-climatic terms, as a factor for air pollution**

#### Description

Climate is important for the air pollution degree, respectively for its self-purification. Depending on the local climatic conditions, when harmful substances, with the same properties and in the same quantities enter the atmosphere, the pollution over localities with different climatic characteristics, or in the same locality, but in periods with different meteorological conditions, can significantly differ. The climate parameters determine the atmosphere degree of resistance to the emissions impacts, showing the potential, climatically determined possibility of the air basin to be susceptible to pollution, and its ability to self-clean. This action provides an assessment of the possible pollution/self-cleaning of the air basin through a relevant complex climatic indicator. It is a set of climatic parameters that determine the potential for impurities dissipation in the atmosphere by points.

The presence of significant local differentiation of the climate on the territory of SM requires the measure's implementation in meso- and even in micro-climate terms, in contrast to its more general presentation in the sectoral analysis report to the SECAP. This will allow detailed approaches of the reciprocal actions at the local level and by municipal districts.

#### Scope

Borderline layer of the atmosphere; Sofia Municipality

#### Benefits

The values of the climatic potential for self-cleaning of the atmosphere are taken into account when construction of industrial facilities and operation of industrial sites is planned; when designing living and working areas, recreational and tourist sites and agricultural lands; when forecasting the air pollution, etc.

#### Responsible

"Climate, Energy and Air" Directorate

The role of SM: assignment, coordination and control

*Vulnerability reduction*

**A.3.3** – A.2.2; A.2.3; A.2.5;  
A.3.1; A.3.2; A.3.4;

*Specific objective:*

**Implementation of a system for information and analytical security regarding the adaptation**

*Addressed risks:*

**Pollution of the air basin**

*Vulnerable sectors affected:*

**Human health (Outdoor work; Sports); Tourism; Transport**

*Budget required:*

**BGN 20 thousand**

*Potential source:*

**SM budget**

*Deadline for implementation:*

**2022**

## A.3 Applied urban R&D activities

### A.3.4

**Development/upgrade of an early warning system for meteorological situations with dangerous impacts on the various economic areas and sectors of Sofia Municipality, incl. on air quality**

#### Description

The activity envisages the creation of a mechanism for assessment and preliminary disclosure of the dangerous meteorological situations in relation to various spheres of the human economic activities. The mechanism requires ongoing, operational analysis and assessment of the weather conditions in order to identify their transition through certain critical thresholds. In addition, a logistical organization is needed to notify definite institutions, organizations and individuals, as well as the general population, for taking preventive measures against the relevant dangerous meteorological event. The scope of such events includes all those that have adverse sector effects, incl. and those that provoke the pollutants retention in the air basin of the municipality and/or accelerate their negative effect - windlessness, inverse state, conditions for the occurrence of photochemical smog, etc.

The need to implement this measure follows from the following considerations:

1. The current forecasting system in SM is based on a meteorological monitoring network and does not comply with the specialized rules and requirements for meteorological monitoring development. In this regard, the correctness of the generated meteorological values and the databases accumulated may give rise to doubts.
2. The current system is aimed mainly for the AQP purposes.
3. The A.3.5. measure envisages upgrade of the existing meteorological monitoring system to include evaluation indicators related to the different sectors. The application of this approach is imperative, because if at a certain moment the weather is appropriate for one type of business, it may not be appropriate for another one. In this way, the forecasts will become more focused and significantly more practical for the purposes and real needs of each individual sector.

#### Scope

All dangerous meteorological/climatic phenomena on the territory of Sofia Municipality

#### Benefits

Protection of the populations' health and the normal status of all other areas, sensitive to the relevant hazardous weather events.

#### Responsible

"Climate, Energy and Air" Directorate

Supporting unit: "Digitalization, Innovations and Economic Development" Division

The role of SM: assignor, consumer

*Vulnerability reduction /  
damage reduction*

**A.3.4** – A.2.2; A.2.4; A.3.1; A.3.2;  
A.4.2; A.4.5; A.4.6

*Specific objective:*

**Implementation of a system for information and analytical security regarding the adaptation**

*Addressed risks:*

**All climatic phenomena with unfavorable effects on the economic sectors of the municipality**

*Vulnerable sectors affected::*

**Buildings and Urban planning, Transport, Human health, Civil Protection, Waters, Forestry and Agriculture, Tourism, Environment and Biodiversity**

*Budget required:*

**- BGN 80 thousand – for the initial system development of the system;**

**- BGN 20 thousand – for the maintenance in permanent operational status**

*Potential source:*

**PIC – Priority 1. Innovations and growth**

**SM budget**

*Deadline for implementation:*

**2023**

**Annually**

## A.3 Applied urban R&D activities

### A.3.5

#### Study of the eco-system services and pilot introduction of two-way bidirectional cost recovery schemes and benefits balancing

#### Description

Study of the ecosystem services and their benefits for the city of Sofia and the suburbs with emphasis on the regulatory services; design and pilot implementation and evaluation of payment schemes for benefits from ecosystem services in selected neighborhoods (in the green wedges contact areas, the Vitosha Nature Park and the other potential green belts (e.g. the Iskar Hydropark), linking the local taxes schemes and fees and the activities for development, protection and maintenance of the green infrastructure.

The study of the ecosystem services and their benefits is under development, both nationally and locally within Sofia Municipality. A common methodological framework for the mapping and assessing the state of the ecosystem services at the national level has been established; the approaches to identification of the potential benefits are in a process of further development. At the local level, within Sofia Municipality, ME "Sofiaplan" carries out the activities related to the development of a concept and methodology for more accurate mapping and assessment of the services and their benefits aiming at the integration of the ecosystem approach and ecosystem services into the policies and instruments for spatial urban planning. At the same time, a mechanism for priority expropriation of the private properties, within the borders of the planned green areas for wide public use, is under development.

Bidirectional reimbursement and balancing of the benefits is achievable through payment schemes for the benefits from the ecosystem services, the implementation of which depends on the changes in the national and local regulations following the implementation and evaluation of the pilot schemes to specify the payment levels readiness and the forms for communication between the parties, the transactions and the financial technologies between Sofia Municipality, the owners and the investors.

The schemes allow for the appropriate distribution of revenues from local taxes and fees (on real estates, on inheritance and at remunerative acquisition of property, on building permits) from neighborhoods located or under development close to already built elements of the green system (e.g. in intervals of pedestrian accessibility of 400, 800, 1200 m and beyond, as well as with certain levels of plant index, coefficients and values of the ecosystem services related to a defined buffer zone of the property). Such revenues will provide the necessary funds for the implementation of the five-year medium-term and one-year short-term programs for planning and development of the new green areas as part of the phased plan-programs for the implementation of the GDP. The schemes can be applied also as a transitional solution in the process of private property expropriation, falling in the scope of the green areas for public use (upgrading the measure of CCAP 0-3; *D-8 Study of the opportunities and barriers to the green wedges development in Sofia Municipality*; the study carried out in step 3 of the *Vision for Sofia* "Study of the possibilities for the implementation of green wedges in Sofia Municipality" and the project "Mapping and assessment of the ecosystem services" of ME "Sofiaplan").

#### Vulnerability reduction / damage reduction

A.3.5 – A.1.1-3, A.2.2, A.2.3, A.3.1, A.3.2, A.3.3, A.3.6, A.3.7, A.3.8, A.4.2-4

#### Specific objective:

**Implementation of a system for information and analytical security regarding the adaptation**

#### Addressed risks:

**All major**

#### Vulnerable sectors affected::

**All**

#### Budget required:

**BGN 2 million**

#### Potential source:

**In partnership with scientific organizations:**

**LIFE**

**Horizon Europe**

#### Deadline for implementation:

**Short and medium-term priority – 2023 and 2025**

**Once and repeatedly**

## **Scope**

Sofia Municipality, ME “Sofiaplan”, urbanized territories, city of Sofia (contact territories of green wedges and belts), suburban territories (“Vitosha” National Park, Iskar River, Vladayska, Suhodolska and Kakach Rivers).

## **Benefits**

Finding an innovative solution to ensure the implementation of green areas for public use and green infrastructure based on a direct and indirect costs and benefits approach, taking into account the balancing of private and public interests.

## **Responsible**

“Architecture and Urban Planning” Division

Supporting unit: ME “Sofiaplan”

The role of SM: support and partnership, implementation

## A.3 Applied urban R&D activities

### A.3.6

**Food security study, creation of conditions and capacity development for urban and suburban agriculture, food reserve and crisis management of the agro-food chain**

#### Description

Food security study and creation of additional management and planning conditions for safe and rapidly developing opportunities for production through urban and suburban agriculture and storage of the basic and supplementary food reserves, as well as crisis management in the agro-food chain within Sofia Municipality. Spatial, health, environmental and social research supporting the planning of an operating network of shared vegetable gardens. Assessment of the material ecosystem services and benefits that can be provided from potential terrains for urban and suburban agriculture, as well as assessment of the wider range of socio-cultural benefits of a related range of activities. Operational maintenance of up-to-date maps with terrain assessments and determination of municipal terrains for shared perma-culture, vegetable, fruit and mixed (multicultural, forest, forest-pasture) gardens for temporary and long-term use. Development, adoption and implementation of a municipal program for development of the urban agriculture in SM, management and technical support and establishment of a basic network of shared gardens and related social and solidarity enterprises with inclusion of the climate, energy and food vulnerable groups. Supplement to the regulatory framework (LSBSM, municipal ordinances, etc.) and development of a contractual framework for the purpose of normative regulation of the urban agriculture and the food reserves for efficient and fair use of the land and services; upgrading the measure from CCAP 0-3; D-9 Study of the possibilities for promotion and support of the urban agriculture at municipal level and implementation of a pilot project; the "Remote methods for soil research" project of the ME "Sofiaplan"; and the "Development of Urban Agriculture" project of the *Initiative for Development of Urban Agriculture* and the ME "Sofiaplan".

#### Scope

Sofia Municipality and neighboring municipalities of Sofia district; urbanized territories, city, suburban territories, terrains acting as or suitable for warehouses.

#### Benefits

Establishment of systematic food provision and overall capacity for reaction and response at extreme weather events.

#### Responsible

ME "Sofiaplan"

Supporting units: "Green System" Directorate / District administrations

Stakeholders: MAF

The role of SM: assignment / coordination / partnership

#### *Vulnerability reduction / damage reduction*

**A.3.6** – A.1.1-3, A.2.1-4, A.3.1, A.3.4-5, A.3.7, A.3.9, A.3.11-12, A.4.4

#### *Specific objective:*

**Implementation of a system for information and analytical security regarding the adaptation**

#### *Addressed risks:*

**All major**

#### *Vulnerable sectors affected::*

**All**

#### *Budget required:*

**BGN 1.125 million**

#### *Potential source:*

**"Food" Program – technical assistance**

**LIFE**

#### *Deadline for implementation:*

**Short, medium and long-term priority – 2023, 2025 and 2030**

**Once and repeatedly**

## A.3 Applied urban R&D activities

### A.3.7

#### Climate vulnerability study among the socio-demographic groups on the territory of Sofia Municipality and the city of Sofia and action plan development

#### Description

Study of the comparative climatic vulnerability of the socio-spatial groups living in different parts of Sofia Municipality and the city of Sofia. Determination of the territorial location of the potentially most vulnerable groups in terms of the risks for their life, health and property. Spatial-oriented health and epidemiological studies linking the mortality and morbidity with the extreme weather events (extreme heat and cold, heavy and intense rainfalls, contrasting weather changes, etc.)

Development of an action plan for vulnerability overcoming and prevention of the potential risks through external support and a system for promoting independent actions (upgrade of the measure in CCAP 0-3; D-3 Epidemiological analysis of the mortality related to the ambient temperature).

#### Scope

Sofia Municipality, separate settlements and settlement formations, urban planning units with concentration of inhabitants and users in disadvantaged ecological and environmental, demographic and social, material and economic living conditions.

#### Benefits

Deepening of the knowledge about the climate vulnerability social side on the territory of Sofia Municipality, the individual settlements and parts of them where the vulnerable groups are concentrated or scattered.

#### Responsible

“Climate, Energy and Air” Directorate

Supporting units: “Social activities and integration of people with disabilities” Division / ME “Sofiaplan” / “Finance and Healthcare” Division

Stakeholders: Agency for People with Disabilities / Agency for Social Assistance / Employment Agency

The role of SM: assignment, coordination / partnership

#### Vulnerability reduction / damage reduction

A.3.7 – A.1.1, A.1.2, A.1.3, all in A.2, A.3.1, A.3.5, A.3.6, A.3.9, A.3.4, A.3.8, A.4.1-4, A.4.5, A.4.6, A.4.7

#### Specific objective:

**Implementation of a system for information and analytical security regarding the adaptation**

#### Addressed risks:

**All major**

#### Vulnerable sectors affected::

**All**

#### Budget required:

**BGN 625 thousand**

#### Potential source:

**“Food” Program – technical assistance (probably together with A.3.7 as a common project)**

**LIFE**

#### Deadline for implementation:

**Short, medium and long-term priority – 2023, 2027 and 2030**

**Once and repeatedly**

## A.3 Applied urban R&D activities

### A.3.8

#### Study of the relationship between the heat waves and the cardiovascular diseases mortality in the city of Sofia

*Vulnerability reduction /  
damage reduction*

**A.3.8** – A.2.5, A.3.4

#### Description

The aim of the study of the relationship between the hot waves and the mortality from cardiovascular diseases (heart attacks and strokes) is to determine the temperature threshold above which the deaths from hot waves increase sharply. This threshold, specific to a particular geographical area, will serve as a signal to activate the early warning system in case of heat waves. The study could also be conducted using the general mortality database.

The study can be carried out by external organizations, which can apply for funding from a third party on the basis of the study inclusion in the plan and with the support of SM.

#### Scope

Settlements in Sofia Municipality

#### Benefits

Optimization and better management of the resources invested in the early warning systems; protection of public health.

#### Responsible

"Climate, Energy and Air" Directorate

Stakeholders: NIMH / NCPHA / WHO – Bulgaria office

The role of SM: support

#### *Specific objective:*

**Implementation of a system for information and analytical security regarding the adaptation**

#### *Addressed risks:*

**Extreme heat**

#### *Vulnerable sectors affected::*

**Human health**

#### *Budget required:*

**External financing**

#### *Potential source:*

**Not applicable**

#### *Deadline for implementation:*

**2023**

## A.3 Applied urban R&D activities

### A.3.9

**Summary of the best practices, technologies and solutions for adaptation to climate change and development of a digital catalogue with guidelines for households and businesses**

#### Description

Summary of the best practices and technologies, as well as of the combined solutions (incl. nature-based) for adaptation to climate change, which can be applied by households and enterprises in individual (individual sites, land and property) and collective manner (e.g. multifamily buildings, office and buildings and terrains with mixed use, production and storage buildings and terrains in the neighborhood, co-ownership, condominium). Development of a digital catalogue with guidelines for the application of practices, technologies and solutions in various spatial, structural, morphological and economic situations in Sofia Municipality. Content, related to the general principle guidelines and such aimed at the specific users, through a chatbot consultant. Development and/or connection to sample procedural pathways, development and investment prototypes, certification schemes, technical standards, specifications and dictionaries, product and service categories. Interactivity of the catalogue with voluntary contribution through crowdsourcing, as well as virtual exhibition and market (upgrading the measure from CCAP 0-3; E-19 Study of good practices for heat islands).

#### Scope

Sofia Municipality, settlements and settlement formations (urbanized territories), different types of spatial, structural, morphological and economic situations.

#### Benefits

Maximum expansion of the access to knowledge and related skills on the ways of adaptation in individual, collective and general terms.

#### Responsible

Association for Sofia development

Stakeholders: NGOs for public and private benefit, with appropriate activities goal, related to the climate change adaptation solutions

The role of SM: summarizing / support and partnership / promotion

#### *Vulnerability reduction / damage reduction*

**A.3.9** – A.1.1-3, A.2.1, A.2.2, A.2.4, A.2.6, A.3.2, A.3.6-7, A.3-10, A.3.15, A.4.1, A.4.2, A.5.3, A.5.5

#### *Specific objective:*

**Implementation of a system for information and analytical security regarding the adaptation**

#### *Addressed risks:*

**All major**

#### *Vulnerable sectors affected:*

**All**

#### *Budget required:*

**BGN 625 thousand**

#### *Potential source:*

**European Climate Initiative**

**PIC – Priority 1. Innovations and growth**

**Climate-KIC (partially)**

**Support by partnerships and business model**

#### *Deadline for implementation:*

**Short and long-term priority – 2023 and 2030**

**Repeatedly and constantly**



## A.3 Applied urban R&D activities

### A.3.10

#### Ongoing specialized training for experts and administrators

#### Description

Ongoing specialized training of experts and administration officers on the topics related to climate change mitigation and adaptation. The implementation of the measure will support the management of the actions related to the implementation of the municipal climate policies. The trainings will be held annually and will include experts from different administrative levels of the municipality.

#### Scope

Central and regional administrations of Sofia Municipality and the district town halls.

#### Benefits

Efficient management, organization and quality control over the implementation of the climate change adaptation activities envisaged in the plan. Increase of the municipal administration capacity in relation to the relatively new and unknown topic and provision of shared knowledge, common understanding of the concepts and processes and succession of the planned activities coordination.

#### Responsible

"Climate, Energy and Air" Directorate

Stakeholders: universities / Bulgarian Academy of Sciences / NGOs

The role of SM: support and partnership

*Vulnerability reduction /  
damage reduction*

**A.3.10** – all adaptation and  
mitigation measures

*Specific objective:*

**Implementation of a system for  
information and analytical security  
regarding the adaptation**

*Addressed risks:*

**All major**

*Vulnerable sectors affected:*

**All**

*Budget required:*

**BGN 10 thousand annually for  
trainings conducting**

*Potential source:*

**SM budget**

*Deadline for implementation:*

**2022-2030**

## A.3 Applied urban R&D activities

### A.3.11

Creation of a plan supporting the long-term tree vegetation and other green areas watering in conditions of prolonged summer and autumn droughts

#### Description

Operational planning of the needs of long-term woody vegetation and green areas watering in the conditions of prolonged summer and autumn droughts. Sofia Municipality has started actions for the elaboration of Terms of Reference for the activities described in the measure.

#### Scope

City of Sofia and settlements in Sofia Municipality.

#### Benefits

Provision of the trees and shrubs watering in critical phases of their development in unfavorable climatic conditions - severe and prolonged droughts. This will reduce the risk of deterioration of their condition and loss of lasting tree vegetation.

#### Responsible

"Green System, Ecology and Land Use" Division

The role of SM: assignment / coordination / control

*Vulnerability reduction /  
damage reduction*

**A.3.11** – A.3.1, A.4.1-3

#### *Specific objective:*

**Implementation of a system for information and analytical security regarding the adaptation**

#### *Addressed risks:*

**Droughts (loss of perennial vegetation due to drought)**

#### *Vulnerable sectors affected:*

**Forestry and Agriculture,  
Environment and Biodiversity**

#### *Budget required:*

**BGN 20 thousand**

#### *Potential source:*

**SM budget**

**European Climate Initiative (in partnership with NGOs; measures A3.15 and A3.16 can be combined in one project)**

#### *Deadline for implementation:*

**2022**

## A.3 Applied urban R&D activities

### A.3.12

Development of expert catalogues of trees and other plant species suitable for urban landscaping and agricultural crops and varieties suitable for use in agriculture given the expected future climatic conditions

#### Description

Elaboration of expert catalogues of suitable plant species and varieties taking into account the soil specifics and the expected climatic conditions in Sofia Municipality. The municipality has already assigned the development of recommendations and prescriptions for the maintenance and use of suitable tree species for street landscaping that can adapt to environmental changes.

#### Scope

Settlements and agricultural lands in Sofia Municipality.

#### Benefits

Availability of prepared by experts catalogues, with appropriate varieties according to the environmental conditions; expected future changes and other factors such as specific conditions of the urban environment (presence or absence of shading by tall buildings, street or park landscaping, presence or absence of irrigation systems, levels of groundwater, potential effects causing allergies, etc.).

#### Responsible

"Green System, Ecology and Land Use" Division

Supporting unit: ME "Parks and City Gardens"

The role of SM: assignment / coordination / control

*Vulnerability reduction / damage reduction*

**A.3.12** – A.2.4, A.2.3, A.2.2, A.4.1-3

#### *Specific objective:*

**Implementation of a system for information and analytical security regarding the adaptation**

#### *Addressed risks:*

**Droughts (loss of perennial vegetation due to drought)**

#### *Vulnerable sectors affected:*

**Forestry and Agriculture, Environment and Biodiversity, Waters**

#### *Budget required:*

**BGN 40 thousand**

#### *Potential source:*

**SM budget**

**European Climate Initiative (in partnership with NGOs; measures A3.15 and A3.16 can be combined in one project)**

#### *Deadline for implementation:*

**2022**

## A.3 Applied urban R&D activities

### A.3.13

Transport systems capacity assessment related to climate change

*Vulnerability reduction /  
damage reduction*

**A.3.13 – A.3.1**

#### Description

The in-depth study of the adaptation capacity of all entities of the transport sector on the territory of Sofia Municipality should include:

- review of the existing internal rules and practices for data collection related to the transport infrastructure operated by them and the availability of documents and guidelines related to the climate change adaptation;
- availability of staff and guidelines to address the effects of climate change;
- availability of registers (detailed statistics) on the effects of climate change such as:
  - o damages to the infrastructure (frequency, costs, territorial distribution) and,
  - o interruption of services (reasons, duration, territorial distribution).

#### Scope

Sofia Municipality

#### Benefits

The improvement of the transport sector adaptation capacity to climate change will lead to a more adequate response to the climate change in the sector and to better coordination, information and communication between those responsible.

#### Responsible

"Transport and Urban Mobility" Division

Supporting unit: "Climate, Energy and Air" Directorate

The role of SM: assignment / coordination / control

*Specific objective:*

**Implementation of a system for information and analytical security regarding the adaptation**

*Addressed risks:*

**All climate risks to which the transport sector is vulnerable**

*Vulnerable sectors affected:*

**Transport**

*Budget required:*

**BGN 50 thousand**

*Potential source:*

**SM budget**

*Deadline for implementation:*

**2022**

## A.3 Applied urban R&D activities

### A.3.14

**Study on the activities for the transport infrastructure conditions improvement related to the specific climate risks**

*Vulnerability reduction /  
damage reduction*

A.2.5 – **A.3.14** – A.4.6

#### Description

During the rehabilitation and modernization of the street lanes and pavements, railways, sidewalks, bicycle infrastructure, subways, bridges, connections, shafts, drainage facilities, adjacent terrains, activities should be performed taking into account the climatic risks in order to adapt to the expected climate change. To this end, specialized studies should be prepared to assess the specific risks and vulnerabilities of the activities for rehabilitation and modernization of the different types of transport infrastructure. Attention should be paid to the elements of the green system, especially of the cycling and walking infrastructure. Apart from being a temperature regulator, the street landscaping has a beneficial effect on the retention and drainage of rainwater, the sound insulation and dust retention. In the design of street landscaping, species with appropriate root system type should be offered, as well as count on the use of root-regulating equipment.

#### Scope

Populated places in Sofia Municipality

#### Benefits

Taking into account the climate risks, in order to adapt to the expected climate changes, will contribute to less damages to the transport infrastructure, less risk of catastrophes and accidents, as well as fewer interruptions and delays in the public transport services.

#### Responsible

"Public Construction" Division

Supporting unit: "Climate, Energy and Air" Directorate

The role of SM: assignment / coordination / control

#### *Specific objective:*

**Improvement of the impact indicators assessment related to the high climate risks in each sector at the end of the planning period**

#### *Addressed risks:*

**All climate risks to which the transport infrastructure is vulnerable**

#### *Vulnerable sectors affected:*

**Transport**

#### *Budget required:*

**BGN 30 thousand**

#### *Potential source:*

**SM budget**

#### *Deadline for implementation:*

**2022**

**Constantly**

## A.3 Applied urban R&D activities

### A.3.15

#### Introduction of eco-label for the tourist companies in Sofia

#### Vulnerability reduction

**A.3.15** – A.3.1, A.3.9, C.1.3., C.1.5, C.1.9

#### Description

The activity includes research of the existing eco-certification systems in the field of tourism in Europe and initiation of a new or introduction of an internationally recognized system for awarding eco-labels to tourist enterprises in Sofia. In this way, incentives are created for the tourism enterprises to introduce measures to mitigate and/or adapt to climate change. As a result of the introduction of the system, an increase in the share of tourist enterprises, with responsible behavior in terms of resource use and adaptation to climate change, can be expected.

#### Scope

The activity is focused mainly on the tourist enterprises of the accommodation sector in Sofia and in particular on the hotels, but some certification systems cover other sectors of tourism as well - mediation, tourist attractions, etc. Development of rules and criteria for awarding the eco-label is envisaged also.

#### Benefits

The introduction of eco-label (s) will help for the promotion of Sofia as a tourist destination that seeks to develop tourism in an environmentally friendly way. Tourist companies will gain a marketing advantage on the highly competitive tourist market by advertising with an eco-label to attract the attention, to reduce the cost of basic natural resources and adapt the product to climate change. The benefits for the local community are the harmful emissions reduction, preservation of the natural environment and improvement of the living conditions.

#### Responsible

ME „Tourism“

The role of SM: assignment / coordination / control

#### *Specific objective:*

**Implementation of a system for information and analytical security regarding the adaptation**

#### *Addressed risks:*

**Extreme heat, changes in precipitation**

#### *Vulnerable sectors affected:*

**Tourism**

#### *Budget required:*

**BGN 20 thousands**

#### *Potential source:*

**Budget of the ME “Tourism”**

#### *Deadline for implementation:*

**2022**

## A.3 Applied urban R&D activities

### A.3.16

#### Study and assessment of the landslide processes current state

#### Vulnerability reduction

#### A.3.16 – A.3.1

#### Description

The trend of climate change in Sofia Municipality shows intensity increase of the precipitations. This is a risk factor for landslides and landslips.

The measure includes research and assessment of the current state of the landsliding processes on the territory of the municipality and their classification according to the parameters of their current and forecasted status. Based on this, development of an action plan for the gradual strengthening of the landsliding sites, depending on their danger degree for activation, is planned. Carrying out fortification actions in accordance with the plan developed.

#### Scope

Manifested and registered 74 landslide areas on the territory of Sofia Municipality.

#### Benefits

Development of a detailed action plan for identification of the necessary means and activities to fortify the landslides and prevent major future damages.

#### Responsible

“Architecture and Urban Planning” Division

The role of SM: assignment / coordination / control

#### *Specific objective:*

**Implementation of a system for information and analytical security regarding the adaptation**

#### *Addressed risks:*

**Landslides**

#### *Vulnerable sectors affected:*

**Environment, Forestry and Agriculture, Tourism**

#### *Budget required:*

**BGN 100 thousand**

#### *Potential source:*

**Budget of the SM**

#### *Deadline for implementation:*

**2025**

## A.4 Investments in technical and green infrastructure, buildings and public works

### A.4.1

#### Protection of the tall buildings facades from overheating

#### Vulnerability reduction / damage reduction

A.4.1 – A.1.1, A.1.2, A.1.3, A.2.2, A.2.4,  
A.3.1, A.3.3, A.3.4, A.3.6, C.3.6, C.3.7

#### Description

Protection of the tall public and multifamily residential buildings facades with the help of technological facades and roof improvements (specific details, coatings) before, together with or after the energy efficiency renovations, in the absence of measures in this direction. Combination with qualitative tall (large size) woody vegetation near the southern and western facades, vertical and roof landscaping (intensive and extensive) on the adjacent surfaces, restoration of the green areas, and improvement with permeable pavements (e.g. tiles on grass joints and other solutions).

In this regard, Sofia Municipality has already commissioned the elaboration of scientific and applied works aimed at reducing the negative effects of the "heat islands".

(Upgrading the measures from CCAP 0-3; D-17 Shading in the building sector (kindergartens, hospitals, schools, municipal buildings) - study and implementation of a pilot project; CCAP G-1; D-1 Reconstruction and improvement of the inter-block spaces).

#### Scope

The city of Sofia, public and multi-family residential buildings over 15 m high and southwestern expositions, together with the adjacent spaces with a high share and significant in scope sealed areas, with rare, large-scale woody vegetation and within the heat islands with the greatest temperature difference and intensity (a separate appendix with indicative scope).

#### Benefits

Reduction of the negative effects on the thermal comfort of the occupants of poorly protected, high-rise buildings in close to and extreme heat and unfavorable position against excessive heating.

#### Responsible

"Architecture and Urban Planning" Division

Supporting units: "Green System, Ecology and Land Use" Division

Stakeholders: Condominium associations (for privately owned multifamily residential buildings)

The role of SM: assignment, coordination and control, promotion

#### Specific objective:

**Improvement of the impact indicators assessment related to the high climate risks in each sector at the end of the planning period**

#### Addressed risks:

**Extreme heat**

#### Vulnerable sectors affected:

**Urban planning, Buildings, Human health, Environment, Forestry and Agriculture**

#### Budget required:

**BGN 50 million**

#### Potential source:

**PE – Priority 4. Risk and climate change and own funds of the municipality**

**National Decarbonization Fund (in case of residential buildings renovation, if admissible)**

**Financial instruments (loans supported by the European Structural and Investment Funds)**

#### Deadline for implementation:

**Medium and long-term priority – 2023-2030**

**Repeatedly**



## A.4 Investments in technical and green infrastructure, buildings and public works

### A.4.2

#### Transport hubs protection in central urban areas and secondary service centers from overheating

#### Description

Protection of secondary service centers, formed by public spaces with a high share and significant in scope sealed areas and with a concentration of public transport stops for passenger transport. Application of bio-airconditioned territorial and nature based technological solutions. General bioclimatic urban design for spatial reconstruction based on a detailed geo-spatial analysis or microclimatic modelling, including a mosaic of small green areas and pots, large woody vegetation, movable objects and bus shelters allowing the maintenance of climbing and other vegetation resistant to heat and drought, air pollution and dust. Avoiding flowering-leaf ornamental plant forms in street and alley landscaping in the range of such nodes and central places and use of sustainable species with longer life expectancy in urban environments. Additional use of devices, materials and technologies that reduce the direct sunlight, the intense solar energy retention and reflection as well as capturing the surface and air moisture for storage, irrigation and sprinkling during prolonged drought and extreme heat. Equipment of the public transport stops, located in places far from commercial sites, with vending machines for mineral water (measure in hot weather) (upgrade of the measure in 0-3 CCAP; D-10 Exploration of possibilities and pilot construction of sprinkler systems (foggers) in the areas of public transport stops and other public spaces).

#### Scope

City of Sofia, public spaces with a high share and significant in scope sealed areas, with concentration of public transport stops for passenger transport within the heat islands with the largest temperature difference and intensity (separate appendix with specified scope).

#### Benefits

Reduction of the negative effects on the thermal comfort of person staying in poorly protected open urban spaces at close to the extreme heat and unsuitable cover against excessive heating.

#### Responsible

“Architecture and Urban Planning” Division

Supporting units: Transport and Urban Mobility”” Division / Public Construction”” Division / “Green System, Ecology and Land Use” Division

The role of SM: assignment, coordination and control

#### Vulnerability reduction / damage reduction

A.4.2 – A.1.1-3, A.2.1, A.2.2, A.2.4-6, A.3.1, A.3.3, A.3.4, A.3.6, C.3.7

#### Specific objective:

**Improvement of the impact indicators assessment related to the high climate risks in each sector at the end of the planning period**

#### Addressed risks:

**Extreme heat**

#### Vulnerable sectors affected:

**Urban planning, Buildings, Human health, Environment, Forestry and Agriculture**

#### Budget required:

**BGN 5 million**

#### Potential source:

**PE – Priority 4. Risk and climate change and own funds of the municipality**

#### Deadline for implementation:

**Short and medium-term priority – 2022-2023 and 2027**

**Repeatedly**

## A.4 Investments in technical and green infrastructure, buildings and public works

### A.4.3

#### Creation of "blue-green" arches for coolness in urban environment and blue and green acupuncture

#### Description

Identification, development and implementation of small-scale solutions (urban acupuncture) with great effect on the urban environments adaptation.

Creation of inclusive integrated spaces with active presence of water and greenery in the conditional form of arches built in areas for wide public use (public spaces and green areas) within the thermal islands. Adaptation of the arches by a methodology for habitats creation and detailed analysis and assessment of the surrounding urban environment, the ways of its use and microclimatic characteristics. (Upgrading of the measures from G-1 CCAP; D-3 Afforestation activities in urban environment; G-1; D-5 Restoration and maintenance of existing water areas; G-1; D-6 Restoration and maintenance of urban and extra-urban water taps; G-1; D-4 Construction of fountains).

Green acupuncture of gray areas and unsealing of the unnecessary ones. Small-scale interventions related to the use of various nature based solutions with the suitable vegetation in forms of cultivation suitable for different places (upgrading the measure in 0-3 CCAP; D-18 Study of the potential for increasing the permeable areas on the territory of Sofia).

Blue acupuncture of gray and green areas, bringing and reusing the water to the neighboring green areas and balancing the groundwater level. Micro-retaining and distributing the water runoff ditches, catchments and wells (upgrading of the 0-3 measure in CCAP; D-12 Study of the possibility of rainwater utilization; the measure of the Green City Action Plan (GCAP) BG.03 Management of the surface waters).

Sofia Municipality has started actions to develop Terms of Reference for the activities described in the measure.

#### Scope

City of Sofia (separate appendix with specified scope):

- For blue-green arches - open public spaces with a high degree of sealed surfaces with less common tall woody vegetation and lack of conditions for such, as well as lack of water points such as fountains.
- For green acupuncture on gray areas - medium (between 1-2 ha and over 90% sealing) and large (over 2 ha and over 80% impermeability) sealed and densely built-up areas in medium-intensity heat islands.
- For blue acupuncture on gray and green areas - large (over 10 ha and over 60% impermeability) sealed areas and green areas with soil drought nearby).

#### Benefits

Increasing the positive effects from public places reconstruction with improved thermal comfort and suitable conditions for living in poorly protected open urban areas with close to extreme heat and unsuitable cover against excessive heating.

#### Vulnerability reduction / damage reduction

A.4.3 – A.1.1-3, A.2.1, A.2.2, A.3.1, A.3.2, A.3.3, A.3.4, C.3.7

#### Specific objective:

**Improvement of the impact indicators assessment related to the high climate risks in each sector at the end of the planning period**

#### Addressed risks:

**Extreme heat, heavy and intense rainfalls**

#### Vulnerable sectors affected:

**Urban planning, Waters, Environment and Biodiversity, Tourism, Human health, Civil Protection, Transport, etc.**

#### Budget required:

**BGN 5 million**

#### Potential source:

**PE – Priority 4. Risk and climate change and own funds of the municipality**

**Recovery and Resilience Plan, "Integration of the ecosystem approach and implementation of nature-based solutions for the conservation of the "Natura 2000" protected areas" - for sites with ecological connectivity to Vitosha mountain and other areas of the "Natura 2000" ecological network in Sofia Municipality**

**Financial instruments (loans supported by the European Structural and Investment Funds)**

#### Deadline for implementation:

**Short and medium-term priority – 2022-2023 and 2027**

**Repeatedly**

Wider range of small-scale changes with a relatively large effect on the microclimate and urban surfaces in the living places of high public importance in the city.

**Responsible**

“Transport and Urban Mobility” Division

Supporting unit: “Public Construction” Division / “Green System, Ecology and Land Use” Division

Role of the municipality: assignment, coordination and control

## A.4 Investments in technical and green infrastructure, buildings and public works

### A.4.4

#### Landscape measures to accelerate trees growth

#### Description

Landscape measures to increase the productivity and accelerate the growth of the large-scale vegetation crowns in the range of the urban land areas with southwestern and other exposures and shallow man-made soils, mainly in areas with plans for the development of green areas for public use or other public purposes, but also additional voluntary inclusion of private lands. Study of the combined benefits from the ecosystem services of the individual massifs, groups and separate trees, including the possibility for increase of the carbon sequestration potential of the urban greenery. Activities implementation with the help of interdisciplinary surveys and reconstructions and the joint participation of landscape architects, dendrologists and arborists after large-scale phyto-sanitary and environmental assessments of the urban environment trees. Improvement of the soils mechanical composition, composting, natural (green) fertilization, landscaping of the terrains and the wood massifs structure and the accompanying grass and bush vegetation, as well as other supporting activities.

Sofia Municipality has started actions to develop Terms of Reference for the activities described in the measure.

#### Scope

The City of Sofia, the green areas on the southwestern slopes with shallow man-made soils (separate application with sample scope specified).

#### Benefits

Increase of the contribution of urban greenery to the formation of a favorable microclimate of the city of Sofia and improved resilience of trees in extreme heat and drought, as well as greater contribution of the green areas in the carbon capture.

#### Responsible

“Green System, Ecology and Land Use” Division

Supporting unit: “Architecture and Urban Planning” Division

Role of the municipality: assignment, coordination and control

#### *Vulnerability reduction / damage reduction*

**A.4.4** – A.1.1, A.1.2, A.1.3, A.2.1, A.2.2, A.3.1, A.3.2, A.3.3, A.3.4, C.3.7

#### *Specific objective:*

**Improvement of the impact indicators assessment related to the high climate risks in each sector at the end of the planning period**

#### *Addressed risks:*

**Extreme heat, droughts**

#### *Vulnerable sectors affected:*

**Urban planning, Waters, Forests and Agriculture, Environment and Biodiversity**

#### *Budget required:*

**BGN 11 million**

#### *Potential source:*

**Budget of SM – operational activities**

**PE – Priority 3. Biodiversity and SM's own resources**

#### *Deadline for implementation:*

**Medium and long-term priority – 2023-2030**

**Repeatedly**

## A.4 Investments in technical and green infrastructure, buildings and public works

### A.4.5

**Improvement of the technical equipment needed for rapid response in case of fires in forest, agricultural and urban areas**

*Vulnerability reduction /  
damage reduction*

**A.4.5 – A.3.11**

#### Description

Provision of sufficient number and quality equipment units for response in case of large fires, including significant and massive damages to trees and other street infrastructure.

#### Scope

The whole territory of Sofia Municipality

#### Benefits

Improvement of the capacity to deal with large fires as the risk of serious damages increases due to the constant development of construction activities near the forest areas (Wildland-Urban Interface, WUI). Fires in similar situations have caused the death of many people in Greece and Portugal over the past decade.

Improvement of the opportunities for faster crisis management and restoration of the normal rhythm of life. Rescue response time will be improved and the likelihood of loss of life will be reduced.

#### Responsible

“Emergency Aid and Prevention” Directorate

The role of SM: assignment, coordination and control

#### *Specific objective:*

**Improvement of the impact indicators assessment related to the high climate risks in each sector at the end of the planning period**

#### *Addressed risks:*

**Fires (significant fires in agricultural and forest areas that may affect the settlements, as well as damage of the street landscaping components**

#### *Vulnerable sectors affected:*

**Civil protection, Forestry and Agriculture**

#### *Budget required:*

**BGN 1.5 million**

#### *Potential source:*

**Budget of SM**

**PE – Priority 4. Risk and climate change**

#### *Deadline for implementation:*

**2023**

## A.4 Investments in technical and green infrastructure, buildings and public works

### A.4.6

Socio-demographic groups adaptive capacity increase by improving the public transport system accessibility and provision of air conditioning in the vehicles

*Vulnerability reduction / damage reduction*

**A.4.6 – A.2.5 – A.3.7**

#### Description

Adaptation/adjustment to climatic hazards (extreme heat/extreme cold) when using public transport by providing air conditioning in the public transport vehicles. By 2030, all buses and trolleybuses from the capital's public transport should be air-conditioned; the share of the air-conditioned trams and metro trains should increase also.

The accessibility and connectivity of the city is important for the adaptation to climate change of the different social groups. The public transport plays an important role for the social inclusion support of the economically vulnerable groups, given their lower adaptive capacity. However, not all land public transport vehicles are still low-floor. There is need to improve the accessibility of the stations and the metro stations also.

In the SUMP are provided funds for replacement of the public transport rolling stock. It is necessary to include requirements for accessibility and air conditioning when ordering the vehicles.

#### Scope

Sofia Municipality

#### Benefits

The improvement of the accessibility of the public transport system will help for the increase of the public transport travels and for reduction of the dependence on car use.

Improvement of the comfort and quality of public transport travel.

#### Responsible

“Transport and Urban Mobility” Division

The role of SM: According to SUMP

#### *Specific objective:*

**Improvement of the impact indicators assessment related to the high climate risks in each sector at the end of the planning period**

#### *Addressed risks:*

**Extreme heat**

#### *Vulnerable sectors affected:*

**Transport, Human health**

#### *Budget required:*

**No additional funds are required other than those provided for in the SUMP for the renewal of the rolling stock and the reconstruction of the pedestrian and public spaces, the street network and accessible environment creation.**

#### *Potential source:*

**RDP, Priority 1. Integrated urban development and own funds of SM**

#### *Deadline for implementation:*

**2021–2030**

**Repeatedly**

## A.4 Investments in technical and green infrastructure, buildings and public works

### A.4.7

#### Increase of the intensity of public places maintenance

*Vulnerability reduction /  
damage reduction*

**A.4.7 – A.2.4**

#### Description

In conditions of extremely high temperatures, on hot and dry days, it is advisable to carry out intensive irrigation and washing of the streets and public places. This will provide secondary moisture to the ground layer and reduce the secondary dust and air pollution. In this sense, the determination of the planned annual municipal waste tax, the costs for cleaning public places should be increased in order to ensure the greater intensity of the services for the streets and public places automatic sweeping, washing and sprinkling in the summer season. This requirement should also be included in the contracts with the performers for maintaining the cleanliness of the public places of Sofia Municipality. Depending on the category and use intensity, the frequency of services should be increased; for instance, requirements for daily automatic sweeping and sprinkling and weekly washing of the central part of the city and the main city arteries can be laid down in the contracts. It is necessary to estimate the costs of services for the different scenarios based on the scope and multiplicity of services, in order to specify the costs increase, which will reflect on the amount of municipal waste tax paid by citizens and companies.

#### Scope

City of Sofia

#### Benefits

Such measure would contribute to the humidity increase in the ground layer, reduction of the dust emissions and for prevention of population's health problems, as well as provision of additional moisture for the green urban systems.

#### Responsible

"Waste Management and Control Activities" Directorate

The role of SM: In accordance with the practice for public places cleaning.

#### *Specific objective:*

**Improvement of the impact indicators assessment related to the high climate risks in each sector at the end of the planning period**

#### *Addressed risks:*

**Extreme heat**

#### *Vulnerable sectors affected:*

**Human health**

#### *Budget required:*

**BGN 4.5 million**

#### *Potential source:*

**Budget of SM – operational activities**

**EP – Priority 4. Risk and climate change and own funds of the municipality**

#### *Deadline for implementation:*

**2021-2030**

**Annually, during the summer season**

## A.5 Development of a system for wide public involvement in the measures implementation

### A.5.1

Communication activities implementation to raise public awareness, knowledge and attitudes regarding climate change mitigation

*Vulnerability reduction /  
damage reduction*

A.5.1 – C.4.1, C.4.2

#### Description

Sofia Municipality will implement the planned communication activities in accordance with the plan and schedule of the climate change communication strategy (measure C.5.1).

#### Scope

Settlements of Sofia Municipality

#### Benefits

Improvement of the awareness and understanding, building a positive attitude and public support for the policies to adapt to climate change. Active participation of the citizens in the respective planned activities. Attraction of private investments in appropriate activities, related to the technical and green infrastructure, buildings and public works.

#### Responsible

"Climate, Energy and Air" Directorate

The role of SM: coordination and control / implementation

#### *Specific objective:*

**Raising the public awareness and knowledge about the adaptation and creation of a positive attitude towards the key measures related to it**

#### *Addressed risks:*

**All climate risks**

#### *Vulnerable sectors affected:*

**All sectors**

#### *Budget required:*

**BGN 100 thousand/year**

#### *Potential source:*

**Budget of SM**

**LIFE – a separate communication project or part of an integrated project, if proposed by the SM**

**DEAR**

#### *Deadline for implementation:*

**2021–2030**



## A.5 Development of a system for wide public involvement in the measures implementation

### A.5.2

Develop a concept and initiate actions for introduction of the climate change topic as part of the civil, health, environmental and intercultural education, as well as of the STEM training

*Vulnerability reduction /  
damage reduction*

A.5.2 – C.4.1, A.5.1, A.5.4

#### Description

The action envisages to propose to MES to launch an initiative for introduction of programs related to climate change (mitigation and adaptation); for activities by interests of the children and students of pre-school and school education in the schools of Sofia Municipality; for early building and strengthening of the climate change issues understanding and consciousness of responsible climate-friendly personal and social conduct.

#### Scope

All municipal school in Sofia Municipality

#### Benefits

Creation of a favorable environment and attitudes among the adolescents in SM for further broad support, understanding, assistance and actions for mitigation and adaptation to climate change.

#### Responsible

"Culture, Education, Sports and Youth Activities" Division

Supporting units: "Climate, Energy and Air" Directorate

Stakeholders: MES / RDE-Sofia City

The role of SM: coordination and control

#### *Specific objective:*

**Raising the public awareness and knowledge about the adaptation and creation of a positive attitude towards the key measures related to it**

#### *Addressed risks:*

**All climate risks**

#### *Vulnerable sectors affected:*

**All sectors**

#### *Budget required:*

**BGN 70 thousand**

#### *Potential source:*

**Budget of SM**

**European Climate Initiative (in partnership with NGO, can be a previous project follow-up, led by the NTEF)**

**LIFE – a separate communication project or part of an integrated project, if proposed by SM**

#### *Deadline for implementation:*

**2022 – concept**

**2024 – introduction of the topic**

## A.5 Development of a system for wide public involvement in the measures implementation

### A.5.3

Development of a sectoral program for short-term training on climate change and adaptation measures in the field of tourism

*Vulnerability reduction /  
damage reduction*

A.3.1, A.3.6, A.3.9, A.3.11,  
A.3.13, C.1.9, C.4.2

#### Description

Development of a program by tourism sectors - suppliers, intermediaries, etc. for short-term training on climate change and adaptation measures. The program should include a set of topics revealing the climate change factors, the main climate risks to tourism and the consequences overcoming, the possible adaptation measures and technological solutions, as well as the sources of funding. The trainings will increase the knowledge about climate change and the need to adapt to them in the tourism sector by planning and implementing specific measures which will increase the adaptive capacity of the tourist enterprises and organizations.

#### Scope

Tourist companies from different sectors of tourism - hotels and other accommodations, restaurants and entertainment establishments, travel agencies, tourist attractions, etc.

#### Benefits

Raising the awareness of the tourist enterprises representatives and their organizations in Sofia Municipality related to the climate changes, as well as of the possible measures for their mitigation and adaptation. The adaptation capacity of the tourist sector will increase.

#### Responsible

ME „Tourism“

The role of SM: Support

#### *Specific objective:*

**Raising public awareness and knowledge about the adaptation and creation of a positive attitude towards the key measures related to it**

#### *Addressed risks:*

**Extreme heat, changes in precipitation**

#### *Vulnerable sectors affected:*

**Tourism**

#### *Budget required:*

**BGN 15 thousand**

#### *Potential source:*

**Budget of the ME “Tourism” – communication programs**

**LIFE – as part of an integrated communication project**

**INTERREG / Transnational cooperation programs**

#### *Deadline for implementation:*

**2022**

## A.5 Development of a system for wide public involvement in the measures implementation

### A.5.4

Initiation, development and introduction of modules dedicated to climate change for the existing curricula and disciplines of the universities

*Vulnerability reduction /  
damage reduction*

**A.5.4** – C.4.1, A.5.1, A.5.2

#### Description

Initiation of discussions with the MES and the universities managements on the territory of Sofia Municipality to develop and introduce modules on climate change in the curriculums, their impact on the sectors and good practices for the changes mitigation and adaptation. Upon successful implementation of the activity, newcomers to work young people will have knowledge on the topic and will be prepared to seek additional information, to participate in the planning and implementation of measures for mitigation and adaptation to climate change. The activity will not lead to changes in the curricula, but only to changes in the curricula of selected disciplines. In some cases, the introduction of specialized master's programs could be considered.

#### Scope

Specialized schools and universities teaching in the areas covered by the plan, pupils and students in specialties related to climate changes and the need to adapt to them.

#### Benefits

Acquisition and application of the knowledge on climate change; building of expert capacity in various sectors. Willingness to tackle the problems arising in the different sectors as a result of climate change through adequate planning and prevention.

#### Responsible

“Culture, Education, Sports and Youth Activities” Division

Supporting units: “Climate, Energy and Air” Directorate

Stakeholders: MES / Universities / BAS / ME “Tourism” / NGO

The role of SM: initiator and coordinator

#### *Specific objective:*

**Raising the public awareness and knowledge about the adaptation and creation of a positive attitude towards the key measures related to it**

#### *Addressed risks:*

**All climate risks**

#### *Vulnerable sectors affected:*

**All sectors**

#### *Budget required:*

**Not applicable**

#### *Potential source:*

**European Climate Initiative**

**LIFE – as part of an integrated project**

**To the implementation of similar measures in NAPCC**

**To the implementation of similar measures in the National Strategy for Adaptation to Climate Change**

#### *Deadline for implementation:*

**2023**

## A.5 Development of a system for wide public involvement in the measures implementation

### A.5.5

#### Emphasis on the tourist sector climate change adaptation in the work of the Tourism Advisory Board

#### Description

The activity is aimed at improving the coordination and exchange of information between Sofia Municipality and representative organizations of the tourist sector within the Tourism Advisory Board, regarding the adaptation of the sector to climate change by discussing and planning measures for the development of new tourism products. This will help for the building of an adaptive capacity of tourist enterprises and organizations to modify and diversify Sofia's tourism product under the pressure of climate change. The efforts of the stakeholders will be turned in the same direction to achieve the common goals in relation to climate change adaptation – creation of new products, adaptation of the existing climate changes, risks avoidance, etc., as well as to ensure the safety and thermal comfort of the tourist flows in the urban spaces.

#### Scope

Representatives of the municipal administration and ME "Tourism", representatives of the tourist organizations participating in the work of the Tourism Advisory Board to the Mayor of Sofia Municipality, external experts.

#### Benefits

Timely discussions and planning of the measures for climate change adaptation for neutralization of the negative impacts and utilization of the new opportunities for year-round offering of the municipality's tourist product.

#### Responsible

ME "Tourism"

Stakeholders: External parties, participants in the Tourism Advisory Board

The role of SM: support

#### *Vulnerability reduction / damage reduction*

A.2.2, A.3.1, A.3.6, A.3.9, A.3.13, C.4.1, A.5.2

#### *Specific objective:*

**Raising the public awareness and knowledge about the adaptation and creation of a positive attitude towards the key measures related to it**

#### *Addressed risks:*

**Extreme heat, changes in precipitation quantities, heavy rainfalls, lower bio-climatic comfort**

#### *Vulnerable sectors affected:*

**Tourism**

#### *Budget required:*

**The activity is organizational, no additional budget is needed**

#### *Deadline for implementation:*

**2022-2030**

## 5.5. Specific objectives for adaptation to climate change

The adaptation measures are aimed mainly at achieving the third strategic goal "*Sofia – an adaptive city*", but also play a major role in achieving the second strategic goal "*Sofia – resource efficient city*". The implementation of the adaptation measures should lead to an increase in the overall assessment of the adaptation capacity of Sofia Municipality, which means that significant progress must be made in the stages of "preparation", "implementation" and "monitoring and evaluation". According to the set strategic goals, the performed assessments of the climatic risks and the vulnerability and the measures identified, Sofia Municipality sets the following specific goals for adaptation:

- *Specific goal A1. Creation of a normative, institutional and planning basis for the adaptation measures implementation.*
- *Specific goal A2. Implementation of an information and analytical security system regarding the adaptation.*
- *Specific goal A3. Improvement of the assessment of the impact indicators related to the high climate risks in each sector at the end of the planning period.*
- *Specific goal A4. Raising public awareness and knowledge about the adaptation and creation of a positive attitude towards the key measures related to it.*

### 5.5.1. Priority measures for adaptation to climate change in accordance with the set goals

Unlike the climate change “mitigation” activities, those for the climate change “adaptation” have so far rarely been used. That is why all measures that build the foundations for the sustainable overlapping of the topics in the future policies and in practice are especially important. These are all measures of the first two categories related to the creation of the normative, institutional and planning basis for the implementation of the adaptation related activities, as well as the A.3.1 very important measure, which is connected with the development of an information system and the monitoring and analysis of the "adaptation" indicators. The provision of the data itself is particularly important also, and the analyses will be incomplete without the full set of climate data that can be provided through the implementation of A.3.5 and A.4.1 measures. The measures related to the different groups knowledge raising on the climate change issues - A.3.11, A.5.2 and A.5.4 can, be defined as basic for the sustainable overlapping of the topics in practice.

The third category covers the measures that complement the important areas analytical security that are affected by the assessed as high climate risks. All studies and research are important and cover different topics, which makes it difficult to identify those with higher priority than the others. Of course, not less important are the measures in the fourth category related to the urban environment improvements to reduce the negative effects of the unfavorable climatic events. Among them the measures A.4.3, A.4.4 and A.4.5 can be identified as particularly important for the two highest climatic risks - extreme heat and heavy rainfalls.

## 6. Organization of the implementation

The plan envisages the implementation of a total of 65 measures in the period 2021-2030, 29 of which are related to the climate change "mitigation" and 36 - to the climate change "adaptation".

The general coordination of the activities implementation under the plan will be performed by the “Climate, Energy and Air” Directorate. The Directorate will be responsible for all implementation activities for monitoring and control described in Section 7 of the plan, for the preparation of reports related to the overall implementation of the plan, the interim overall results analyses, the analyses and

proposals for corrective actions, the changes in the planned measures, their scope and deadlines, the convention and management of the interdepartmental expert council for climate and energy activities. The Directorate prepares instructions and sets deadlines for reporting on the implementation of the measures in the plan to the relevant responsible.

The implementation management of all measures, incl. organization, preparatory activities, procedures for contractors selection, contracting, work with the contractors, control over the implementation, payment of the contractors, reporting on the implementation, etc. is carried out by the appointed for each measure officials, incl. the "Climate, Energy and Air" Directorate for the measures that are its responsibility.

All responsible units plan the implementation of the relevant measures in their annual action plans in accordance with the schedules below. During the periods in which they are engaged in managing the implementation of the measures under this plan, the units shall submit to the "Climate, Energy and Air" Directorate annual reports on the implementation of the measures, following the instructions and deadlines set by the coordinating directorate. Upon request, the responsible units shall also provide the coordinator with interim reports on the implementation of the measures.

*Table 28. Schedule for the implementation of the activities for climate change "mitigation" and distribution of financial resources, thousands of BGN.*

Mitigation	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total, thou. BGN
C.1.1		4	8								12
C.1.2											0
C.1.3											0
C.1.4											0
C.1.5											0
C.1.6											0
C.1.7											0
C.1.8		2	6								8
C.1.9		50									50
C.1.10		18									18
C.1.11		20									20
C.2.1		15	35								50
C.2.2					30						30
C.2.3		30									30
C.2.4			15	35							50
C.2.5				30		30		30		30	120
C.3.1		16 000	32 000	32 000	32 000	32 000					144 000
C.3.2					100 000	100 000	100 000	100 000	100 000	100 000	600 000
C.3.3		6 000	7 000	7 000	7 000	7 000	7 000	7 000	6 000	6 000	60 000
C.3.4		120	110	110	110	110	110	110	110	110	1 000
C.3.5		60	415	900	1 000	5	5	5	5	5	2 400
C.3.6							750	750	1 750	1 750	5 000
C.3.7		50	100	250	100	300	300	300	300	300	2 000
C.3.8		100	150	200	250	300	350	500	500	650	3 000
C.3.9		5 000	10 000	5 000	2 000	2 000	2 000	2 000	2 000		30 000
C.3.10		220	220	220	220	220	225	225	225	225	2 000
C.3.11		50	150	2 500	2 500	2 500	2 500	2 500	2 500	2 500	17 700
C.4.1	14										14
C.4.2		400	400	400	400	400	400	400	400	400	3 600
<b>Total, thou. BGN</b>	<b>14</b>	<b>28 139</b>	<b>50 609</b>	<b>48 645</b>	<b>145 610</b>	<b>144 865</b>	<b>113 640</b>	<b>113 820</b>	<b>113 790</b>	<b>111 970</b>	<b>871 102</b>

The total amount of funds required for the implementation of the plan is about BGN 961.45 million, incl. VAT for the entire period, including the activities on the plan reporting until 2032. Most of the funds are intended for the implementation of the measures related to the climate change "mitigation". The total value required for the implementation of these measures is BGN 871.1 million with VAT, of which the basic amount – BGN 744 million with VAT are for the implementation of the key measures for achieving the C.3.1 and C.3.2. objectives related to the residential buildings renovation. The schedule for the implementation of the activities aimed at climate change "mitigation" is presented in *Table 28*, which includes the funds distribution by year in thousands of BGN.

A total of BGN 90.26 million with VAT for the entire period is provided for the implementation of the planned measures for climate change "adaptation". The schedule for the implementation of the activities aimed at climate change "adaptation" and the distribution of the necessary financial resources by years in thousands of BGN is presented in *Table 29*.

*Table 29. Schedule for the implementation of the activities for climate change "adaptation" and the distribution of the financial resources, thousands of BGN with VAT*

Adaptation	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total, thou. BGN
A.1.1		20	52								72
A.1.2		75	240								315
A.1.3		50	155					50	50	120	425
A.2.1		80	80	80	120	80	80	80	80	120	800
A.2.2		100	140	70	500	70	70	70	80	500	1 600
A.2.3		20	20	80							120
A.2.4		60	120	117	117	117	117	117	117	118	1 000
A.2.5	5	15									20
A.3.1		300	700	100	100	100	100	100	100	100	1 700
A.3.2		100	350		50	50	300	50	50	300	1 250
A.3.3		20									20
A.3.4		30	50	20	20	20	20	20	20	20	220
A.3.5		200	800	200	800						2 000
A.3.6		50	300	50	300			50	75	300	1 125
A.3.7		50	175		25	25	150	25	25	150	625
A.3.8											0
A.3.9		80	230					20	60	235	625
A.3.10	5	10	10	10	10	10	10	10	10	10	95
A.3.11		20									20
A.3.12		40									40
A.3.13	10	40									50
A.3.14		30									30
A.3.15		20									20
A.3.16				30	70						100
A.4.1		2 000	10 000	10 000	10 000	10 000	8 000				50 000
A.4.2		1 000	4 000								5 000
A.4.3		650	2 350	500	500	500	500				5 000
A.4.4		250	1 500	1 500	1 500	1 500	250	1 500	1 500	1 500	11 000
A.4.5		500	1 000								1 500
A.4.6											0
A.4.7		500	500	500	500	500	500	500	500	500	4 500
A.5.1	5	100	100	100	100	100	100	100	100	100	905
A.5.2	5	50	5	10							70
A.5.3	3	12									15
A.5.4											0
A.5.5											0
<b>Total, thou. BGN</b>	<b>33</b>	<b>6 472</b>	<b>22 877</b>	<b>13 367</b>	<b>14 712</b>	<b>13 072</b>	<b>10 197</b>	<b>2 692</b>	<b>2 767</b>	<b>4 073</b>	<b>90 262</b>

In both graphs the years in which the respective activity is performed, but without final result, are marked with a lighter color - organization, preparation, selection of contractors, contracting, current implementation, etc. The years in which the final result of the respective activity must be ready are marked in a darker color.

The total costs for the implementation of the plan, broken down by years, are presented in *Table 30*. The account includes the funds necessary for the plan implementation reporting activities described in *Section 7*.

*Table 30. Total distribution of the financial resources by years, thousands of BGN with VAT*

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total
Mitigation	14	28 139	50 609	48 645	145 610	144 865	113 640	113 820	113 790	111 970	0	0	871 102
Adaptation	33	6 472	22 877	13 367	14 712	13 072	10 197	2 692	2 767	4 073	0	0	90 262
Reporting	0	0	0	0	30	0	0	30	0	0	0	30	90
<b>Total</b>	<b>47</b>	<b>34 611</b>	<b>73 486</b>	<b>62 012</b>	<b>160 352</b>	<b>157 937</b>	<b>123 837</b>	<b>116 542</b>	<b>116 557</b>	<b>116 043</b>	<b>0</b>	<b>30</b>	<b>961 454</b>

## 7. Monitoring and control of the plan implementation

The monitoring and control of the plan implementation is a particularly important activity for the successful realization of the planned activities and the achievement of the set goals. The term "monitoring" summarizes the activities of observation, data collection, analysis and the results evaluation.

The basis for the development and reporting of each quality plan is the availability of accurate and reliable data. They are necessary for the performance of analyses, forecasts and evaluations, on the basis of which the measurable goals and indicators for evaluation and success of the planned policies, measures and activities are determined. In the 2020-2022 PPUREB, Sofia Municipality has planned activities on the creation and implementation of a model for data collection for the greenhouse gas emissions inventory covered by the SECAP, both for the use of energy from renewable sources and for the generation of automatic reports. The adherence to the model will provide an opportunity for better management of the data collection process and will facilitate the analyses preparation and accurate reporting documents.

The SECAP foresees a number of measures that will improve the information support needed for the analyses and reports preparation and will provide important data that are not available at the time of the plan preparation. The measures A.3.1, A.4.1, C.2.3, C.1.6, C.2.5 are particularly important in this aspect, but all measures in A3 category of the "adaptation" section have a similar focus, as well as the C.1.8, C.2.1 and C.2.2 measures, whose implementation would also be of great importance for more accurate reporting.

According to the rules of GCMCE, described in the *SECAP Development Manual*, the monitoring and reporting carrying out are mandatory and very important elements of the local authorities commitments. Two types of reports are required - "Activity Report" and "Full Report".

The "**Activities Report**" should provide quantitative information on the implementation of the activities envisaged in the SECAP mainly, incl. the status of the individual activities implementation and analysis of the possible barriers to their implementation. This type of reports should be submitted at least every two years after the adoption of the plan, but it is recommended to be done annually by collecting and analyzing the data from the data collection model developed under the SECAP. This will allow the timely monitoring of the progress on the main objectives of the "mitigation" and the municipality to be able to take corrective action when necessary. After the development of the information database according to A.3.1 measure and the beginning of the relevant data collection, it will be possible to make annual analyses of the vulnerability and impact indicators related to the "adaptation".

In the "**Full Report**", in addition to the information from the "Activity Report", an interim inventory of the greenhouse gas emissions must be performed. The complete reports must be submitted every 4 years at least. Sofia Municipality considers that within the period of the SECAP implementation until 2030 the preparation of two full reports is most appropriate.

In accordance with the information presented so far, Sofia Municipality adopts the following schedule for monitoring and control of the plan implementation (*Table 31*).



Table 31. Schedule of the monitoring and control activities

Activity	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Submission of SECAP to GCMCE	P 31 Dec.											
Data collection and analysis in the model for data collection to PPUREBF, 2020-2022 r.												
Preparation of reports on the implementation of EE program and on the Long-term PPUREBF	R 1 march	R 1 march	R 1 march	R 1 march	R 1 march	R 1 march	R 1 march	R 1 march	R 1 march	R 1 march	R 1 march	
Preparation of information on the implementation of the program to promote the use of renewable energy	I 1 march	I 1 march	I 1 march	I 1 march	I 1 march	I 1 march	I 1 march	I 1 march	I 1 march	I 1 march	I 1 march	
Preparation of "Activities Report" for submission to GCMCE			R 31 Dec.				R 31 Dec.			R 31 Dec.		
Preparation of interim inventories of GHG emissions for 2024 and 2027					IInv 31 Dec.			IInv 31 Dec.				
Preparation of a "Complete Report on Activities" for submission to GCMCE					R 31 Dec.			R 31 Dec.				
Preparation of a final inventory of GHG emissions for 2030												FInv 31 Dec.
Preparation of a "Final Report" for submission to GCMCE												R 31 Dec.

Legend: P - plan; R - report; I - information; IInv - intermediate inventory of greenhouse gases; FInv - final inventory of greenhouse gases

According to Art. 12, para. 5 of EEA Sofia Municipality annually, **no later than March 1**, must submit to SEDA an *Annual Report on the implementation of the energy efficiency programs under Art. 12 of the EEA and for the energy efficiency management according to Art. 63 of the EEA*. According to Art. 10, para. 3, item 5 of REA Sofia Municipality must submit annually to SEDA *Information on the implementation of a municipal program to promote the use of renewable energy and bio-fuels*. The two report documents should be prepared according to a standard form, which is available on the SEDA website in the "Documents" section. **Each department should submit its report** which is required by both laws to be summarized by the **"Climate, Energy and Air" Directorate one month before the legal deadline** for the reports submission.

## 8. Development of a communication strategy

### *„Sofia – a city of clean energy and sustainable growth“*

As part of the measures, the SECAP envisages the implementation of a special communication strategy of Sofia Municipality to promote the actions for the municipal climate policy implementation and the engagement of the broad public for this policy support.

The communication strategy of Sofia Municipality in the field of energy efficiency and renewable energy is subordinated to the vision of the city as a prosperous economic and administrative center with a high quality of life for the citizens. Within the overall goal of positioning the capital as a dynamic city of young people and sustainable development, its strategic goal is to create and establish an image of **Sofia as a center of clean energy and sustainable growth**, positioning it as an excellent field for investments in high-tech industries in the energy sector and an attractive place to live and work, with a preserved and sustainable urban environment.

The strategy for communication with the public, which has been developed in support of the implementation of the SECAP, will be linked to the goals set in the strategic scope of the activities for sustainable energy development of the municipality. The specific objective of the communication strategy is to raise the awareness of the identified target groups on key issues related to the global and local challenges of climate change and the role of the municipality, of the business and the civil society, as the activities planned in the program are directly related to the main objectives of the SECAP. The main focus of the proposed measures is to strengthen the investment attitudes and support for the investment intentions implementation in the field of industry and buildings of the tertiary sector, which are beyond the direct influence of the Municipality and for which the awareness raising and

development of knowledge and skills in the field of energy efficiency and renewable energy are of particular importance. Thus, in accordance with the adopted vision and the set strategic goal of the communication strategy, the communication program sets specific traceable goals in the following areas:

- 1) Public support for the implementation of the activities of the municipality in the field of efficient utilization of the available resources.
- 2) Dissemination of information on the improvement of the quality of services provided by the municipality.
- 3) Support for the investment intentions of the public and private organizations with significant impact on the carbon emissions reduction and the urban ecosystems improvement.
- 4) Imposing a vision of Sofia as a natural center and leader in the introduction of the circular economy principles for the achievement of sustainable growth in all sectors.

## 9. Conclusions

The Sofia Municipality *Sustainable Energy and Climate Action Plan (SECAP)* for the period 2021-2030 has been developed in accordance with the commitments of the municipality with its accession to the international climate initiative "*Global Covenant of Mayors for Climate and Energy*". The document was developed as an integrated plan and includes a *Long-term program for the use of renewable energy and bio-fuels* and a *Long-term program for energy efficiency* of Sofia Municipality for the same period. The plan is compliant simultaneously with the rules set out in the guidelines for the development of the SECAP of the GCMCE and with the recommendations of the *Sustainable Energy Development Agency (SEDA)* presented in the instructions of the Agency under Art. 10, para. 1 and para. 2 of the Renewable Energy Act and Art. 12 of the Energy Efficiency Act.

Following the objectives of the main strategic document for the development of Sofia Municipality "*Vision for Sofia*" and the objectives of GCMCE, the long-term strategic objectives of the SECAP are:

*Strategic goal 1:*

***Sofia Municipality - climate neutral***

*Transforming Sofia Municipality into carbon neutral until 2050 by applying the highest standards in terms of energy efficiency and transformation of the energy mix to the use energy from renewable sources with an emphasis on the shared energy production and consumption at the local level.*

*Strategic goal 2:*

***Sofia Municipality - resource efficient***

*Development of Sofia Municipality according to the circular economy principles with an emphasis on the environment and bio-diversity protection and the creation of comfortable and healthy living conditions and professional realization of the citizens.*

*Strategic goal 3:*

***Sofia Municipality - adaptive***

*Increasing the adaptation capacity of Sofia Municipality to deal with the caused by climate change negative impacts through the development of regulatory framework and institutional capacity, attracting the public and business attention, implementing environmentally friendly adaptation solutions and increasing the*

*prevention opportunities and improving the preparedness and reaction to the occurrence of extreme weather events.*

To meet these strategic goals, 29 measures related to climate change mitigation and 36 measures for adaptation to climate change are envisaged. In line with the strategic objectives and the potential effect of the prescribed measures, specific objectives for "mitigation" and "adaptation" have been set. The specific target for "mitigation", related to the reduction of the greenhouse gas emissions by 2030, which takes into account the expected effect of the external for the municipality factors influence and the adopted municipal sectoral plans and programs valid after 2021 is the following:

- *Specific goal C1. Reduction of greenhouse gas emissions per capita by 40% by 2030 compared to the 2007 levels.*

With the implementation of the measures provided for in the SECAP and without taking into account the influence of the external for the municipality factors and the adopted municipal sectoral plans and programs valid after 2021, Sofia Municipality sets the following additional specific objectives for "mitigation" as well:

- *Specific goal C2. Reduction of the final energy consumption by 800 GWh until 2030 compared to 2018.*
- Specific goal C3. Achieving final annual renewable energy consumption of 700 GWh by 2030.*
- *Specific goal C4. Implementation of a fully functional information system for the purposes of reporting on the climate change mitigation measures and the future planning.*
- *Specific goal C5. Provision of a broad public support of the climate change mitigation policies, in order to build a positive attitude towards the policies of more than half of the population of the capital.*

With regard to the adaptation to climate change, the plan sets the following specific goals for 2030:

- *Specific goal A1. Creation of a normative, institutional and planning basis for the adaptation measures implementation.*
- *Specific goal A2. Implementation of an information and analytical system to support the adaptation.*
- *Specific goal A3. Improvement of the assessment of the impact indicators related to the high climate risks in each sector at the end of the planning period.*
- *Specific goal A4. Raising the public awareness and knowledge about the adaptation and creation of positive attitude towards the key measures related to it.*

For the long-term programs for promotion of the use of energy from renewable sources and bio-fuels and for energy efficiency, Sofia Municipality sets the following specific goals:

- *Specific goal E1. Realization of total annual energy savings of 50 GWh by 2030 in the sectors managed by Sofia Municipality and included in the scope of the SECAP.*
- *Specific goal E2. Increase of the annual final consumption of energy from renewable sources by 12 GWh until 2030 in the sectors managed by Sofia Municipality and included in the scope of the SECAP.*

- *Specific goal E3. Reduction of the annual greenhouse gas emissions by 2030 in the sectors managed by Sofia Municipality included in the scope of the SEAP by 14 thousands tCO<sub>2e</sub> compared to the levels of 2018.*
- *Specific goal E4. Implementation of a fully functional information system for the purposes of reporting on the renewable energy measures and the future planning.*

The achievement of the set high goals for 2030 will be reached thanks to the results already achieved by 2020 and the overall effect of the measures included in the SECAP; of the measures in the already adopted by Sofia Municipality other sectoral plans and programs which may also contribute to the achievement of the objectives of this plan; and the external factors influencing the achievement of the objectives, such as the national policies.

By 2030, the greenhouse gas emissions are expected to decrease by 40.6% per capita compared to the base year. The reduction of the annual final energy consumption in 2030 compared to 2018 as a result of the measures in the SECAP alone is expected to be 837 GWh. The expected annual energy consumption of renewable energy sources from the implemented measures in the SECAP is expected to be 424 GWh (with the influence of other factors expected to reach 734 GWh by 2030). In the sectors managed by the municipality, through the implementation of the measures in the plan, total annual energy savings of 50.5 GWh are expected to be realized by 2030; the annual energy consumption of renewable energy to reach 12.2 GWh in 2030; and the annual greenhouse gas emissions are expected to decrease by 14 thousand tCO<sub>2e</sub> compared to 2018.

The implementation of the measures will significantly increase the adaptation capacity of Sofia Municipality. The regulatory framework, the planning framework, the information and analytical systems on the "adaptation" problems will be greatly improved. A number of improvements in the physical environment will be implemented, addressing the main climate risks, and especially the most expressed, related to the extreme heats and heavy rainfall.

The total value of the investments for the plan implementation is about BGN 961,454 million, most of which should be provided by external financing.

The plan envisages annual collection of reporting data and GHG emissions inventories conducting for 2024, 2027 and 2030, which is the requirement of GCMCE as well. In accordance with the results of the inventories, a periodic analysis of the implementation of the plan will be performed and, if necessary, corrective actions will be taken to achieve the set goals.

GCMCE sets a GHG emissions reduction target of 40% to the associated local authorities and is adopted by Sofia Municipality. It has been defined in line with the European Union's energy and climate policies. In the second half of 2020, the European Commission adopted a new target for 55% reduction of the greenhouse gas emissions by 2030. It is likely that the governing body of GCMCE will also adjust the target to those local authorities that have joined the covenant. In order to be able to achieve even greater GHG emissions reduction in Sofia Municipality, solutions must be sought, especially such related to the development of hydrogen technologies and their application in the energy sector and the private transport; increase of the electric cars in the private transport in combination with the implementation of more ambitious national policies to change the electricity mix and significant reduction of the electricity national emission factor; further acceleration of the pace of the building stock deep renovations; implementation of the highest standards in terms of new buildings energy performance; and even greater involvement of the industrial sector in the improvement of the energy efficiency and the production and use of renewable energy.