Bursa Sustainable Energy and Climate Change Adaptation Plan 2017 (BUSECAP)

BURSA BÜYÜKŞEHİR BELEDİYESİ
ÇEVRE KORUMA ve KONTROL DAİRESİ BAŞKANLIĞI

BURSA METROPOLITAN MUNICIPALITY
SUSTAINABLE ENERGY and CLIMATE CHANGE ADAPTATION PLAN

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FOREWORD

Climate change is regarded as one of the biggest environmental problems on a global scale and it affects every phase of our lives, especially agriculture and food, clean water and health. Thus, makes it necessary for countries and cities to increase their solution efforts. In this context, local authorities in cities play an active role in tackling climate change and its adaptation.

Climate change studies are being conducted in two areas, "Preparation of Climate Change Action Plans" to reduce greenhouse gas emissions and "Developing Adaptation Strategies for Local Climate Change" to make our cities resistant by reducing the potential impacts of climate change. In this context, the Ministry of Environment and Urbanization also established the National Action Plan for Climate Change in 2011 and the National Climate Change Adaptation Strategy and Action Plan in 2012, defining national policies in the field of climate change and the role of cities.

In 2015, the Bursa Metropolitan Municipality Directorate of Environmental Protection and Control together with the cooperation with Demir Energy, based on the year 2014 and with the aim of contributing to the efforts carried out on a national and international scale to combat climate change, prepared the Bursa Greenhouse Gas Inventory and Climate Change Action Plan, in order to identify greenhouse gas emission sources in our city and to establish mitigation measures.

Within this period and with the parliamentary decision taken in July 2016, Bursa Metropolitan Municipality participated to the Covenant of Mayor which aims to increase support for local activities, provide a platform for greater engagement and networking by cities, and raise public awareness about adaptation and mitigation and the measures needed.

The Greenhouse Gas Inventory and the Climate Change Action Plan prepared in 2015 was revised according to the criteria of Covenant of Mayors and "Bursa Sustainable Energy and Climate Change Adaptation Plan" was prepared. According to the inventory results, the total carbon footprint Bursa province was determined to be over 13.2 million tons and the biggest share in the emission inventory was fuel and electricity consumption at 31%. This value was followed by residential and electricity consumption (22%) and urban transportation (19%). Bursa has a share of 2.7% in Turkey's total greenhouse gas emissions.

Greenhouse gas inventory prepared in 2015 has been revised within the framework of a participatory process in line with the data obtained from individual meetings and workshops with all the stakeholders in the city and our city has been evaluated under the headings such as; urban heat island, urban water areas, green areas, green corridors and biodiversity, public health, administrative organization and planning against the adverse effects of climate change. Climate change adaptation strategies have been developed to make our city more resilient to natural disasters such as hot weather fluctuations, drought, floods, and landslides due to climate change. In this framework, Bursa has been the first city to develop climate change adaptation strategies at a national scale.

We hope the greenhouse gas inventory of Bursa province, mitigation targets and strategies for adaptation to climate change will serve as a guide for other cities to create climate-friendly cities, and we would like to thank all persons and institutions that supported this study.

Bursa Metropolitan Municipality

Directorate of Environmental Protection and Control

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Abbreviations

Abbreviation	Explanation
BAU	Business As Usual
BMM	Bursa Metropolitan Municipality
BEBKA	Bursa Eskişehir Bilecik Development Agency
BİDEP	Bursa Climate Change Action Plan (completed in 2015)
UNFCCC	United Nations Framework Convention on Climate Change
BTSO	Bursa Chamber of Commerce and Industry
BUAP	Bursa Transportation Master Plan
BURFAŞ	Bursa Park Bahçe ve Kültürel Hizmetler Turizm Su ve Su Ürünleri, Sağlık İnşaat Enerji San. Tic. A.Ş.
BURULAŞ	Bursa Transportation Inc.
BUSECAP	Bursa Sustainable Energy and Climate Adaptation Plan
BUSKİ	Bursa Water and Sewerage Administration
CoM	Covenant of Mayors
MEU	Ministry of Environment and Urbanization
DSI	General Directorate of State Hydraulic Works
EMRA	Energy Market Regulatory Authority
ENVERDER	Energy Efficiency Association
MENR	Ministry of Energy and Natural Resources
IEAP	International Emission Analysis Report

Abbreviation	Explanation
UHI	Urban Heat Island Effect
ICLEI	International Council for Local Environmental Initiatives
CCAMCB	Climate Change and Air Management Coordination Board
IPARD	
IPCC	Intergovernmental Panel on Climate Change
İZODER	Association of Heat, Water, Sound and Fire Insulators
GHG	Greenhouse Gas
GWP	Global Warming Potantial
GDM	General Directorate of Meteorology
OIZ	Organized Industrial Zone
IPA	Important Plant Area
INA	Important Nature Area
SECAP	Sustainable Energy and Climate Adaptation Action Plan
TAKEP	
TEP	Tons of Oil Equivalent
TOKİ	Mass Housing Administration
TUBİTAK	The Scientific and Technological Research Council of Turkey
TurkStat	Turkish Statistical Institute
UEDAŞ	Uludağ Electricity Distribution Corporation
UKOME	Transportation Coordination Center
EIE	General Directorate of Renewable Energy

1 Introduction

1.1 Aim of the Study

Climate science is now able to precisely say that global warming has taken place because of human activities and carbon dioxide and equivalent greenhouse gases, especially from fossil fuels used in energy production. Maintaining the current production and consumption methods and habits of the communities will lead to serious climate change consequences, which are likely to result in major environmental destructions and possible mass casualties as well as human catastrophes associated with it. Since the industrial revolution, carbon dioxide emissions from human activities, especially due to fossil fuel consumption, have proven to increase faster than what the ocean and forest can absorb. This danger, which is revealed very clearly by climate science, has propelled the world to action.

However, while intergovernmental climate change negotiations progressed slowly, local governments which have a closer contact with society have increasingly been involved in this issue, which is a particular concern for people's quality of life and health. Since the beginning of the 2000s, local governments and their associations and coalitions have shown that they could start to play an important role in tackling climate change by setting further targets than their own governments. Today, coalitions formed by local governments have an increasing weight on climate negotiations.

The Metropolitan Municipality of Bursa prepared the Climate Change Action Plan in addition to the capacity building work on the determination of climate change strategies in 2014 and determined the flow of energy especially in the city and revealed the potential greenhouse gas mitigation in various areas.

With the signing of the Covenant of Mayors in the summer of 2016, commitments in line with the European Union's 2030 objectives were made. The Bursa Metropolitan Municipality BUSECAP report has been prepared in this context.

1.2 Methodology of the Study

Bursa Sustainable Energy Plan

While the Bursa Metropolitan Municipality's Sustainable Energy and Climate Change Adaptation Plan (BUSECAP) was being prepared, international GHG (Greenhouse gases) Protocol methods and standards adopted by the United Nations were applied.

Certain updates have been made to the greenhouse inventory prepared in 2015. First, the emission factors have been updated in accordance with the IPCC Fifth Assessment Report published in 2015. It also shows differences in the inventory prepared in 2014, as changes in the emission factors were made in order to comply with the inventory declaration of the Covenant of Mayors.

In addition, natural gas consumption in residential buildings has been revised considering the sales of other distribution companies.

The work carried out in 2014 was announced at a meeting held on May 24, 2017, with various units invited by the Waste Management Branch of the Directorate of Environment and Protection working with great devotion in the execution of Bursa Metropolitan Municipality works. In order to ensure continuity of the work related to the subject, the importance of forming a team with the support of top management and the employees from different disciplines was emphasized.

Within the scope of the Bursa Sustainable Energy and Climate Adaptation Action Plan (SECAP) activities in 2017, the process of determining the measures to reduce direct urban greenhouse gas emissions started. At the beginning of this process, a workshop with the participation of all urban stakeholders was organized.
In the workshop "Bursa is Planning its Sustainable Future" held on May 24, 2017, the outcomes of the carbon footprint inventory were shared and relevant public institutions, non-governmental organizations, local governmental units and all related individuals and groups were included in the topics that were closely related the future of the city. After informative presentations about the project, the participants from different stakeholder groups realized Group Work under the following 6 main themes.

1. Physical Development of the City-Built Environment,
2. Industry and Services,
3. Renewable Energy,
4. Transportation,
5. Waste and Wastewater Management,
6. Agriculture-Animal and Forestry

Group work was carried out in 2 stages.

In the first phase, each sub-group focused on plans and scenarios related to the development of the city towards the year 2030, looking for answers to the questions identified above.

Photograph 1: May 24, 2017 Training for Municipality Units

Photograph 2: Images from the "Climate Change Action Plan" Workshop dated May 24, 2017

In the second phase, each group was asked to form project proposals to be evaluated in action plans and to prioritize these proposals. They were asked to elaborate the top 5 strategic recommendations from each theme group. Details about the proposals included, responsible institutions/organizations, financing needs, risks, implementation steps and time schedules, energy intensities or possible effects on the greenhouse gas emissions. After about four hours of work, each group presented their own suggestions and group presentations were opened for discussion.

Climate Change Adaptation Plan

With the organization of Bursa Metropolitan Municipality Directorate of Environmental Protection Waste Management Department, essentially about climate change followed by vulnerability and fragility evaluation of Bursa province was carried out by interviewing important units and institutions provided below. As a result of these interviews and literature studies, the priority areas regarding Bursa's compliance with climate change were identified in the following headings and an attempt was made to collect compliance indicators that should be filled under the Covenant of Mayors.

- Urban Heat Island Effect
- Water Management
- Public Health
- Green Areas, Biodiversity, Corridors
- and determined as Administrative Organization.

Later, "Climate Change Adaptation Workshop" was held on October 12, 2017 with the participation of the universities, the municipal units and other stakeholders of the city, which also had studies specific to the province of Bursa. The results of this workshop will be detailed in the relevant sections of the report.

During the workshop, each participant scored the self-assessment forms given to each thematic group in advance, and in this form, the present situation of Bursa in terms of climate adaptation strategies was presented. Afterward, answers were sought by the moderators at the tables. Following the discussions on the outcomes, solutions were suggested and recommendations were made and prioritized. The organizations that have participated in the workshop are listed below.

Bursa Metropolitan Municipality Departments

- Directorate of Environmental Protection
- Civil Works Department
- Directorate of Transport
- Bursa Water and Sewerage Administration (BUSKI)

Universities

- Uludağ University
- Bursa Technical University
- İzmir Institute of Technology
- Gazi University

Moderators

- Gazi University Assoc. Prof. Dr. Nilgün Görer Tamer (Green Areas Desk with Oya Tabanoğlu)
- Bursa Technical University - Assoc. Prof. Dr. Gül Atanur (Urban Waters and Streams Desk
- Uludağ University - Assoc. Prof. Dr. Alpaslan Türkkann (Public Health Desk
- İzmir Institute of Technology – Assoc. Prof. Dr Koray Velibeyoğlu (Administrative Organization and Planning Desk Demir Energy- Dr. Baha Kuban (Heat Island Effect Desk)

Other Institutions

- Provincial Directorate of Environmental Urbanization
- DSİ Zone 1 Directorate
- Provincial Directorate of Food, Agriculture and Livestock
- Bursa City Council
- Chamber of Mechanical Engineers
- Uludağ Organized Industrial Zone Directorate
- Bursa Organized Industrial Zone
- ENVERDER (Energy Efficiency Association)
- Bursa Chamber of Commerce and Industry
- UKOME (Transportation Coordination Center)
- Provincial Directorate of National Education
- Provincial Health Directorate
- Gemlik Municipality
- Orhangazi Municipality
- Yıldırım Municipality
- Osmangazi Municipality

Photograph 3: Images from the Climate Adaptation Workshop dated October 12, 2017

2 Global Climate Change: International Policy and Action, Strategic Vision and Scope

The effects of climate change have regional and local differences such floods and overflows, drought, hot waves, etc. Hence, it is impossible to find a magic recipe that can be applied everywhere. Local governments have an important role in infrastructure investments as well as in determining means and methods of intervention.

Organizations such as IC-LEI1, C402, and Covenant of Mayors[3], brings local governments from different geographies of the world at different levels of development together and offers an important opportunity for cooperation and experience sharing for local governments seeking to take a step further.

However, determining the methods appropriate to the local conditions is not enough, and local governments must have the financial capacity and political decision-making power.[4]

Taking into consideration the above-mentioned effects, it is understood that cities need active policies, actions and strategies for combating and adapting to climate change, from transportation to infrastructure, from infrastructure to waste management and land use.

Urban climate policy is based on two indicators. The first is mitigation of climate change and the second is an adaptation to the negative impacts and consequences of climate change.

2.1 Turkey and Global Climate Change Impacts

Regional climate projections were created by the Turkish State Meteorological Service (TSMS) using the scale model of RegCM4 model of Had-GEM outputs from the global models used within the CMIP5 project. In the study, years between 1971-2000 were used as the reference period and the projection was made for years between 2016-2099. The TSMS first performed parametrization tests and then selected four different periods to run the model. The four periods used by TSMS in climate projections are between 1971-2000, 2016-2040, 2041-2070 and 2071-2099. The area selected as a model is 20 km x 20 km and has 23,400 (180x130) grids. Especially the summer and winter temperatures seem to be in great harmony when the results of the regional climate model in the reference period and the results of the global models in the same period are compared. As for annual average temperatures, regional model results were found to be lower than global model results and observations.

According to regional climate models during the reference period of winter precipitation by GDM, considering the reference period covering the years 1971-2000, the RCP4.5 scenario for Turkey using HadGEM2-ES global data, the temperature projections (Fig. 2.1) and precipitation projections (Fig. 2.2) are as follows;

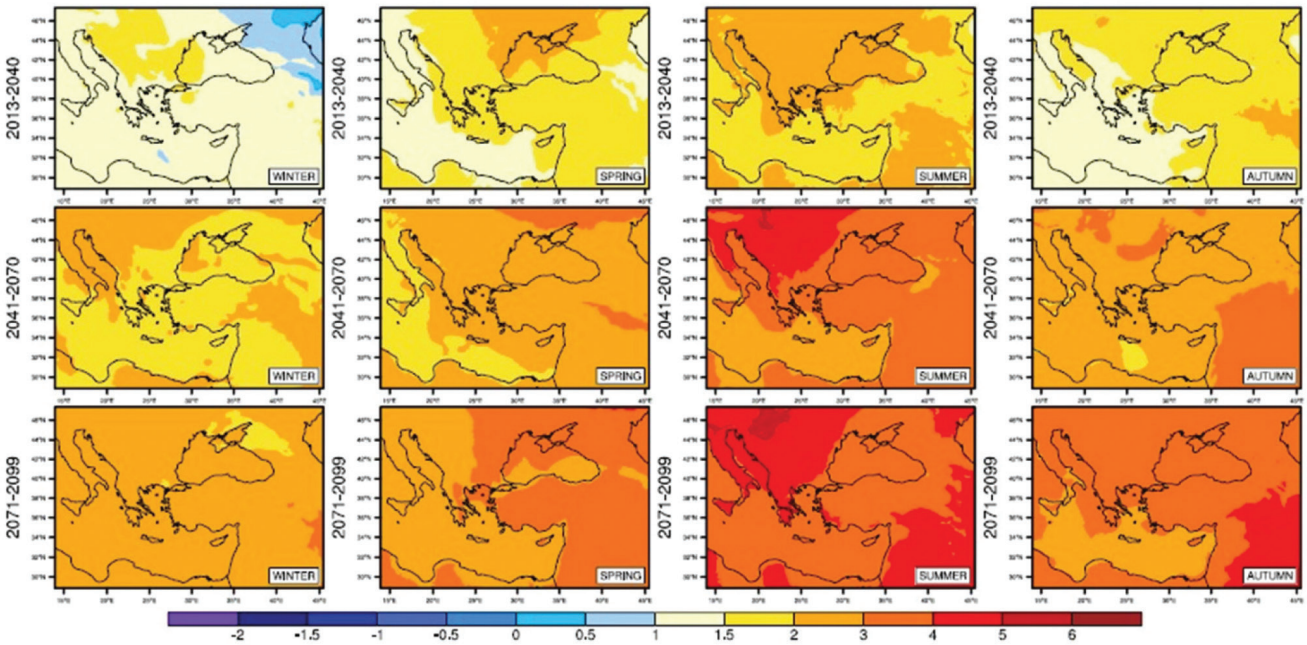


Figure 2-1: TSMS temperature projections according to MGM RCP 4.5

1 ICLEI: Local Government Network for Sustainability
2 C40: Network created by 86 metropolitan governments around the world
3 CoM: Covenant of Mayors, a unity that European Union countries are committed to regarding to climate and energy issues, Green Economy for 4 Climate, Istanbul Sabancı University Policy Center, May 2017

For the 2016-2040 period:

- The increase in temperature will generally be limited to 2°C,
- During the summer season, temperatures in the Marmara and Western Black Sea regions will increase by 2-3°C, and
- The winter rainfall in the Aegean coast, the eastern Black Sea and in Eastern Anatolia is expected to increase, excluding the Aegean coast and eastern Anatolia an approximate 20%reduction in the spring rainfall is projected for most parts of Turkey.

For the 2041-2070 period:

- The temperature increase to be around 2-3°C in the spring and autumn,
- In the summer months an increase of up to 4°C is projected,
- In the case of precipitation, there will be 20% decrease in winter precipitation in Eastern and Southeastern Anatolia and Central and Eastern Mediterranean regions,
- There will be about 30% decrease in precipitation in the summer months in Eastern Anatolia where rainfall is important,
- It is projected that there will be reductions in fall precipitation except for the Aegean coast and a small part of Central Anatolia.

For the 2071-2099 period:

- Temperatures increase of 2°C for the winter,
- and 3°C increases for spring and autumn is expected.
- Temperatures in the Aegean coast and South East Anatolia are projected to exceed 4°C for the summer temperatures.
- In the rainy season, about a 20% decrease for spring precipitation except for the coastal Aegean, Central Black Sea and North East Anatolian regions,
- An increase of around 10% for winter precipitation especially in the coastline,
- A decrease of up to 40% in summer precipitation except for the Aegean, Marmara and the Black Sea shoreline,
- As for autumn precipitation, a decrease throughout Turkey has been projected (GDM_c, 2014).

As there can be different outcomes to different scenarios, it can be clearly seen that the region where Turkey is located will be significantly affected by the changes in the global climate system. One of the topics that have been studied on climate change is the increase or decrease in observations of extreme values in climate parameters. Changes in the frequency values of extreme values resulting from climate change are expected. According to the reports of Chapter 1 of the Status Assessment of IPCC Fifth Assessment Report Working Group I, it was concluded that due to the irregularities in energy distribution and the increase in average temperature, there has been an increase in the intensity and frequency of precipitation and arid extremes in hot or cold weather waves.

2.2 Planning Studies Related to Turkey and Global Climate Change

Yet in Turkey, the consequences of climate change and the increasing risks in terms of traditional development policies do not count as a clear factor in investment decisions of governments or the private sector. Whereas, varied and uncertain climatic conditions make it necessary to evaluate the climatic risk factor included in investment risks, and even to approach climate change effects as a standard in the feasibility stages of the projects.

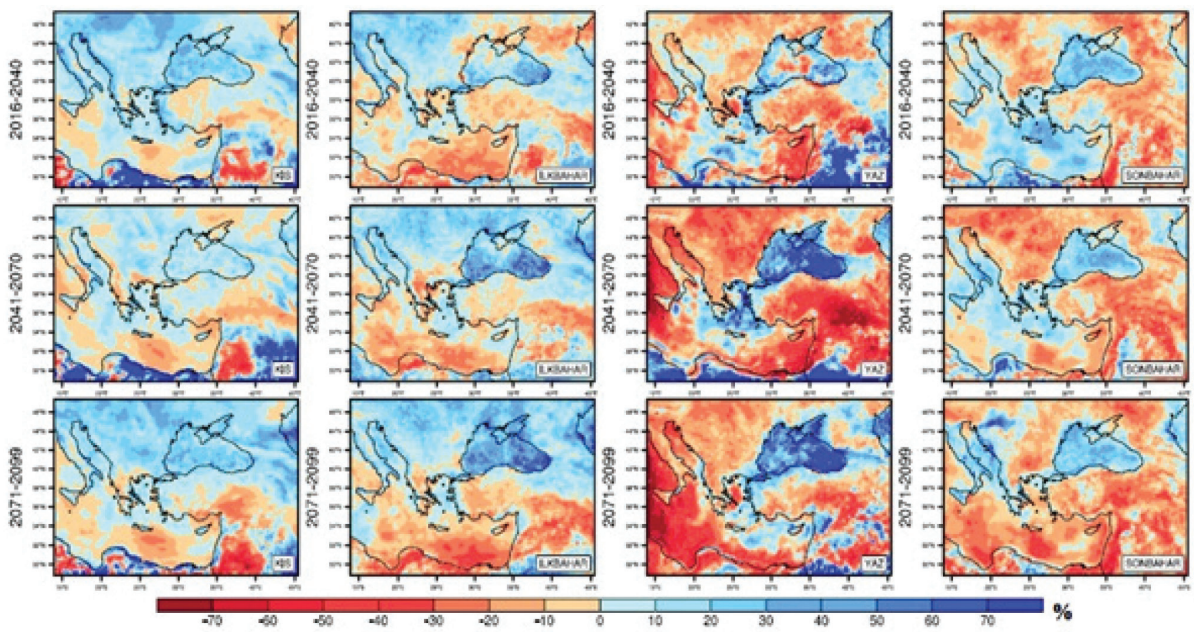


Figure 2-2: GDM precipitation projections according to RCP4.5
Source: Turkey 6th National Communication on Climate Change

This has raised the need to conduct extensive "impact analyses" to clarify climate change in Turkey. Climate change impact analysis is important in terms of determining the impacts of climate change on various sectors and social groups in Turkey, calculating the benefits and costs of climate change adaptation policies, the stakeholders with different opinions to reach an agreement, reducing uncertainties and therefore clarifying priorities.

The five-year development plan for the past five years currently in force is the Tenth Development Plan, which covers the period between 2014-2018. One of the basic principles of the **Tenth Development Plan** is to lead our country to higher levels of the international value chain hierarchy. Generating services and products with higher value added is a way to ascend in the steps of the global value chain hierarchy. According to the plan, R&D and technology policies are expected to play a key role both in increasing productivity of existing sectors and in transforming to a structure in which sectors with higher productivity are dominant. The Tenth Development Plan also states that “green growth” has become an important concept in order to achieve sustainable development goals, and within the framework of this concept, protecting the environment and increasing competitiveness with clean and eco-efficient production is deemed possible.

In order to make the development of our country more regular and planned, many strategy documents and programs have been prepared in line with the principles of development plans. One of these programs is the **Medium Term Programme** and covers the period of 2016-2018. In the introduction of the Medium Term Programme the main objective is stated as "The main objective of MTP is to rise growth and to make it more inclusive while saving the macroeconomic stability and maintaining the decline in current account deficit and inflation gradually". The aim of the program is to contribute to the struggle against climate change with the objectives such as "development of energy efficiency", "activation of water use in agriculture", "more efficient use of natural resources" and "recycling wastes".

The basis of Turkey's policy towards climate change was first laid by the Eighth Five-Year Development Plan. In 2000, the Report on the Specialization Commission on Climate Change was published within the scope of the Eighth Development Plan. With the Ninth and Tenth Five-Year Development Plans prepared afterward, objectives for continuous development were added. The Eighth Five-Year Development Plan states "Efforts to become a party to the UN Framework Convention on Climate Change are underway", as well as indicating that regulations on energy efficiency for greenhouse gas reduction will be formulated. In the Ninth Five-Year Development Plan, a further step on the subject of climate change was taken and Turkey's greenhouse gas reduction policies in accordance with its terms and measures that demonstrate its "National Climate Change Action Plan" was prepared. The Tenth Development Plan, which is still in force states that “green growth” has become an important concept in order to achieve sustainable development goals.

In 2001, with the participation of representatives from public, private and non-governmental organizations "Coordination Board on Climate Change (CBCC)" was established to coordinate the works on climate change measures carried out by various units. The Board was restructured four times in 2004, 2010, 2012 and 2013. Within the scope of the final restructuring in 2013, air management was added to the working area and the name was changed to "Climate Change and Air Management Coordination Board (CCAMCB)." The Board consists of twenty institutions and organizations such as; Ministry of Environment and Urbanization (coordinator), Ministry of EU Affairs, Ministry of Science, Industry and Technology, Ministry of Foreign Affairs, Ministry of Economy, Ministry of Energy and Natural Resources, Ministry of Food, Agriculture and Livestock, Ministry of Internal Affairs, Ministry of Development, Ministry of Finance, Ministry of Education, Ministry of Forestry and Water Affairs, Ministry of Health, Ministry of Transport, Maritime Affairs and Communications, Undersecretariat of Treasury, Turkish Union of Chambers and Exchange Commodities, Turkish Industry and Business Association, Independent Industrialists and Businessmen's Association, Disaster Relief Agency and Turkish Statistical Institute. In addition, there are seven sub-work groups besides CCAMCB consultants and the secretariat. Besides, organizations and specialists related to climate change participate in institutions and organizations under the establishment of the board. These working groups are;

- Greenhouse Gas Emissions Mitigation Technical Working Group (Ministry of Environment and Urbanization MEU)
- The Effects of Climate Change and Adaptation Technical Working Group (MEU)
- Inventory of Greenhouse Gas Emissions Technical Working Group (Turkish Statistical Institute TSI)
- Financial Working Group (Undersecretariat of Treasury UT)
- Technology Development and Transfer Technical Working Group (MSIT)

Education, Awareness and Capacity Technical Working Group (MEU)

- Air Management Working Group (MEU)

The main document used for generation of policies egarding climate change studies is the “National Climate Change Strategy Document” covering years 2010 to 2020. The document was prepared in the coordination of the former MEU with a widely participated study containing CBCC members, related public and private sector representatives, universities and NGOs and approved by Higher Planning Council on May 3, 2010. The document contains the mitigation, compliance, financing and technology policies that Turkey can realize with the help of national and international resources based on the “common but differentiated responsibilities” principle.

i

Climate Change National Action Plan was prepared in accordance to the Ninth Development Plan with the coordination of the Ministry of Environment and Urbanization with a wide group containing CBCC members and other stakeholders and was published in July 2011. The plan provides actions for control of greenhouse gas emissions and compliance studies within the context of National Climate Change Strategy Document and defines the responsibilities and timing for the application of these actions.

Although the impact of climate change will pose a serious threat to Turkey in the future however through planning it is predicted that certain effects will create certain opportunities. This situation needs to be addressed in terms of obstacles and opportunities for the development of climate-dependent sectors, with pressure on natural resources, especially water resources. It is predicted that climate change in Turkey will cause adverse effects such as decrease of water resources, the increase of floods, forest fires, drought and desertification and related ecological deterioration. The climate predictions realized within the framework of Turkey's Development of Climate Change Adaptation Capacity Joint Program, in support with other studies, predicts that the precipitation pattern, that is, the water cycle, will change with significant increases in temperatures which will affect virtually all economic sectors, settlements, and climate-related natural disaster risks.When these estimates are reviewed, the changes in precipitation and temperatures will also threaten the water resources, agricultural production, human health and it will affect economic growth through natural disaster risks and threaten ecosystem services that regulate the quantity and quality of factors that constitute the mainstream in production such as water. Again in 2012, **Climate Change Adaptation Strategy and Action Plan**, issued by the Ministry of Environment and Urbanization, defined areas of vulnerability to climate change in Turkey, supported by the technical and scientific studies and focused on five key areas adopted through the participatory process. These were:

- Water Resources Management;
- Agricultural and Food Safety;
- Ecosystem Services, Biodiversity and Forestry;
- Natural Disaster Risk Management; and
- Public Health.

From the studies on the effects of climate change with findings obtained in Turkey, planning work aimed directly for adaptation has been started in recent years. The identified adaptation measures are mainly the development of modern techniques for the use of water resources, the proliferation of research to manage an estimated increase in water demand due to climate change by increasing irrigation efficiency; the development of plant species that can produce high-quality products with low-quality water; development and breeding of new plant species resistant to drought and salinity. Örneğin, tarım sektörüne bakıldığında; For example, looking at the agricultural sector, a transition from traditional irrigation methods in agriculture in Turkey to the modern methods of irrigation with less water loss (sprinkler and drip irrigation applications) is seen. Financing supports are available for manufacturers who want to use these methods.

Turkey's rapid population growth, due to issues such as effective cohesion policy priorities of increasing urbanization and economic policies and practices are complicated. However, it can also be stated that existing sustainable development policies and objectives support climate change adaptation efforts.

Some of the policies implemented in recent years in various sectoral areas in Turkey are supporting the adaptation to climate change impacts. Additionally, despite the fact that more often than not, it was not specified directly, most of the strategic documents prepared recently for the development of several sectors in Turkey (The Agricultural Strategy, TAKEP, The Rural Development Strategy and Action Plan, the Energy Efficiency Strategy etc.), as well as most of the policies and long-term policy programs (Rural Development Program/IPARD, TUBITAK Vision 2023, National Forestry Program, National Program to Combat Desertification in Turkey etc.) and action plans (National ActionPlan to Combat Desertification (2005, GDF), the Southern Anatolian Project’s Action Plan, Biodiversity Strategy and Action Plan, the Campaign for Forestation and Erosion Control Action Plan, the Waste Management Action Plan, the Waste Water Treatment Action Plan etc.) do include alongside emission decrease measures to tackle climate change, several activities in the scope of adapting to the impacts of climate change.

In the cohesion policies against the effects of climate change, Turkey has focused on increasing water shortages and thereby on drught problems. In Turkey, drought is on the front row of climate catastrophe list. In this area, disaster warning policies and systems are being established and flow of information is being tried to be provided. In order to prevent the serious water problems that may be faced in the future due to the effects of climate change, strategies are being sought to create realistic water policies supported by laws and scientific researches and to quickly carry into effect. Although there are a number of activities on Turkey's major basins that are important in terms socio-economics (Gediz, Büyük Menderes, Seyhan, Konya Basin) to investigate the possible consequences of global climate change impact on a basin scale, more scientific studies are needed. Flood raids are unavoidable in coastal areas where there is no elevation or due to very low shore. There are many low altitude coastal areas in Turkey and this fact causes clumps of cities, populations and industrial regions are subject to coastal erosion caused by storms resulting from rising sea levels, and extreme precipitation events are observed more frequently. Albeit in a lesser degree, Turkey's mountainous terrain, the irregular regimes of its rivers, its steep mountain sides and land utilization practices, make floods important threats to river basins also. In addition, the characteristically barren soil erosion problem in Turkey and floods bring disaster-related flooding and excessive precipitation. Along with climate change in Turkey, drought and floods are predicted to have adverse effects on key sectors, businesses and populations.The table below, taken from the National Climate Change Adaptation Strategy and Action Plan, depicts major climate change impact examples together with relevant sectors and regions as well as an evaluation of the relative intensity of these impacts specific to the characteristics of the sectors and regions in Turkey subject to climatic eff ects causing droughts, floods and self-igniting fires.

2.3 Turkey's Climate Adaptation Strategy

Climate change is one of the biggest and most complex problems mankind is facing today, as well as one that closely influences sustainable development. In the struggle against climate change the difficulties that policymakers face are understanding the impacts of climate change, determining strategies for optimal adaptation and transforming them into rational policies. The United Nations Framework Convention on Climate Change, which many nations have come together to combat the adverse effects of climate change on human life and nature, is an indication of the seriousness of the problem as well as the determination of all Parties to resolve the issue.

The large-scale changes taking place in conjunction with increases in global temperatures creates the necessity to take measures for countries who are vulnerable to climate change, such as Turkey as well as all over the world. Increasing the capacity of adaptation to the effects of climate change and preparing and implementing the necessary plans in this regard is an issue that the Ministry of Environment and Urbanization has placed an emphasis on. In this context, Turkey, in accordance with its specific conditions and opportunities has prepared its National Climate Change Strategy in order to contribute to the global efforts in reducing the impacts of climate change.

The document in question, reveals Turkey's national mitigation, adaptation, technology, financing and capacity-building policies.

Turkey, in order to be a country which can offer a high quality of life with the lowest carbon intensity to all of its citizens, aims to popularize energy efficiency, increase the use of clean and renewable energy sources and to integrate climate change policies with development policies.

Diminishing water resources, forest fires, drought, desertification and ecological degradation linked to these are the impacts of climate change that are evident in Turkey.

Climatic forecasts that are carried out within the scope of the Joint Program on Enhancing the Capacity of Turkey to Adapt to Climate Change also produced similar outputs to support other work, indicating noticeable temperature increases and a precipitation regime, in other words the alteration of the water cycle, that can impact all economic sectors, all settlements, and climate-related natural disaster risks.

When this data is interpreted, the changes in precipitation and temperature in Turkey will affect areas such as water resources, agricultural production, public health and natural disaster risks; and threaten ecosystem services that regulate the quantity and quality of factors that constitute the mainstream inputs in production, such as water.

National Climate Change Adaptation Strategy and Action Plan have focused on five important fields in Turkey which are supported by technical and scientific studies and participatory processes. These fields have been explained in further detail below.

Impacts	Intensity	Susceptible Regions	Susceptible Sectors/Themes
Modification of river/basin regimes	Low	All regions	Ecosystem services and biodiversity
Diminishing surface waters	Medium	Western Anatolia	Agriculture, water distribution infrastructure
Scarcity of exceeding usage water	Yüksek	İstanbul, Ankara, Aydın, Nevşehir, Bursa	Urban areas
	Medium	Afyonkarahisar, İzmir, Kayseri, Muğla, Manisa	Agriculture, industry, energy
Floods	Medium	Black Sea and Southeastern Anatolia	The survival of the agricultural farmer, human health
Soil loss / salinity	Low	Mediterranean, Black Sea and Aegean Regions	Tourism, ecosystem services, biodiversity, marine products
Soil loss/loss of quality of soil	Medium	South western Anatolia	The survival of the agricultural farmer, human health, shallow lakes and wetlands
Coastal Erosion	Low	Black Sea	Fishing, unemployment
Degradation of marine ecosystem	Low	Mediterranean, Black Sea and Aegean Regions	Ecosystem services and biodiversity
Forest fires	Medium	Western Anatolia	Tourism, agriculture
Migration of species to other areas in order to survive	Low	Mediterranean	Tourism, agriculture, food security
Decreasing agricultural productivity	Medium	Mediterranean and Aegean coastal	Agriculture (employment), food security
Lowering Hydro – Energetic potential	Low	Mediterranean	Energy, industry
Lowering production of sea products	Low	Mediterranean	Agriculture, food security, water distribution networks

Table 2-1 The Impacts of Climate Change and Susceptible Sector/Regions in Turkey

2.3.1 Water Resources Management

In general, the priority accepted by all countries in the use of water resources is the principle of meeting the basic requirements necessary for survival. Once this amount has been met, the existing water supply is most appropriately distributed according to the other requirements. Priority for use in allocating water potential is listed as follows:

1- Drinking needs

2- Water needs for the continuation of animals and wildlife

3- Agricultural irrigation water needs

4- Energy and industrial water needs

5- Trade, tourism, fishing etc. water needs

Important studies on the management of water resources in Turkey's Climate Change Adaptation Strategy Action Plan was also carried out.

According to the Sixth National Communication on Climate Change published by the Ministry of Environment and Urbanization, Turkey's annual potential for consumable surface and ground waters is approximately 112 billion m^3 and, of this, 98 billion m^3 is surface water and 14 billion m^3 is groundwater. (Sixth National Communication). The current utilization rate from the existing 112 billion m^3 usable water resource is approximately 36%. The annual amount of water available per capita in Turkey is around 1,519 m^3. 32 billion m^3 of the existing water is used in the irrigation, 7 billion m^3 is for drinking and consumption and 5 billion m^3 is used in industry. In this case, approximately 74% of Turkey's water resources is used for irrigation, 11% for industry and 15% is used for urban consumption.

The total water consumption in Turkey is projected to increase almost three-fold from 2004 to 2030. The total amount of water used in 2023 is a sustainable amount of available water resources (on an annual basis) and is affected by climate change effects, rainfall reduction, increases in irrigation areas, flooding of existing storage areas with sediment and uneven distribution of water resources. Considering the numerous adverse impacts, it is likely that water stress will occur at a significant level. The European Environment Agency has predicted water stress levels between 2000 and 2030 in Turkey and EU countries. Accordingly, it is predicted that, in 2030, Turkey's water stress will be at a rate exceeding 40% in the central western regions. In the Southeast and East regions, this ratio will be between 20-40%.

Although climatic conditions are the leading causes of this situation; excessive use of water in irrigation, illegal groundwater use, problems caused by the operations of current facilities, leakages and loss of water within the water network, administrative and institutional problems, delays in investments and water pollution caused by various reasons are the main issues that need to be addressed in order to adapt to the impacts of climate change.

Impacts in Turkey caused by climate change such as; an increase in summer temperatures, decrease in winter precipitation, loss of surface waters, increase in the frequency of droughts, land degradation, coastal erosion, and floods. This situation especially threatens water resources needed for food production and rural development.

In order to reduce water stress, studies on water saving and reuse of used water (clean production applications in industry), losses and leaks in city networks in the framework of sustainable development principle in industrial investments (precautions to reduce water leaks in the network, studies) are realized. Basin based approaches are being developed to ensure effectiveness in water management, basin protection action plans are prepared, in which integrated protection and control principles are defined. and the follow-up on these implementations is ensured. River basin protection action plans across 25 basins in Turkey is completed. Some of the issues that are considered important for water resource management, climate change, impacts, vulnerability, and sustainable rational use of resources are summarized below.

- Storage Capacity Enhancement
- LAKE-WATER Project
- Basin Protection Action Plans
- Ensuring Water Saving in Irrigation
- Drought Management Studies
- Drinking, Consumption, and Industrial Water Supply
- Protection from floods

Targets for effective and integrated management of water resources in the Tenth Development Plan are indirectly aimed at reducing the vulnerability to the effects of climate change. In the Tenth Development Plan; policies on water management in Turkey have been outlined as follows:

1- Shortcomings and uncertainties in the legislation on water management will be eliminated, duties, powers and responsibilities of institutions will be clarified, and collaboration and coordination among all institutions involved in water management will be enhanced.

2- National water basin classification system will be developed enabling protection and sustainable use of water resources.

3- Quantity and quality of groundwater and surface water will be determined, monitored and relevant information system will be established; protection and improvement of water resources, prevention and control of water pollution will be ensured.

4- Sustainable utilization of all of the national water potential according to requirements, and charging of its use on a tariff basis will be ensured.

5- Through evaluating effects of climate change and all activities in catchments on water quantity and quality, measures for saving water, combating drought and preventing pollution will be taken.

6- Measures will be taken to protect high-quality agriculture lands and forests, particularly for specially protected nature areas. Desertification and erosion combating efforts will be improved; preventive measures will be intensified after monitoring environmental and social impacts of agricultural activities on agricultural land resources.

7- For current and reliable information about lands, remote sensing and geographic information systems will be used in establishing a National Database on Land, and efficient use of land through land use planning will be ensured, especially in agriculture.

8- For sustainability of irrigation from groundwater resources, policy alternatives such as quantity restrictions and variable pricing will be developed.

9- Functioning mechanism of irrigation unions will be reviewed, and alternatives will be developed to improve the system.

2.3.2 Agriculture and Food Security

It is already known that the agriculture sector is not only a victim of climate change but also one of the reasons of it. The destructive impacts of climate change on agriculture should be dealt with the development, food security, environmental, biodiversity and sustainability of the ecosystem services.

Turkey is among sensitive countries in terms of the impact of climate change on agriculture and food production and also because it located in the Mediterranean basin, which is expected to be the most affected from climate change.

Turkey's objectives for Climate Change Adaptation Strategy under heading the agricultural sector and food security have been outlined as follows:

1- Reviewing existing strategy and action plans as well as legal arrangements from a perspective of adaptation to climate change

2- Reviewing signed protocols between institutions from a perspective of adaptation to climate change

3- Developing and expanding R&D activities related to crop, land and water

4- Increasing the capacities and numbers of organizations carrying out R&D and scientific studies

5- Developing a “Soil and Land Database and Land Information System” taking into consideration the effects of climate change

6- Conducting and monitoring disaster analysis for agricultural droughts

7- Determining the socio-economic impacts of climate change on the agriculture sector

2.3.3 Ecosystem Services

Divided into three regions with significant biodiversity values of biological hosting, Turkey, remains among the global 200 ecoregions. These areas are shown in the most important ecological zones of the world in terms of protection values they carry.

Since the most important factors determining the type of an ecosystem are the temperature and precipitation regimes, changes in the climate will cause changes in the structure and function of ecosystems. In recent years, the impacts of climate change on species and ecosystems have begun to be seen more and more. In particular, species with limited habitats and sensitive ecosystems are thought to be more susceptible to climate change.

Ecosystems with protected areas with rich biological diversity in the world will play an important role in protecting rare species, such as being shelter areas for species in the course of climate change. It is not known for sure how the climate change will affect the expansion of ecosystems in the present protected areas. Within the context of climate change, the protected areas are significant in terms of;

- Reduction of the emissions, sustaining the protected areas such as forests and peatlands with ecosystems which enable carbon emission and declaration of new protected areas,
- Adaptation to climate change; ecosystem services, conservation of the distribution of species and ecosystems within the protected areas,
- Due to the present network of protected areas, building resilient for the ecosystems and species against climate change.

It is known that the “Key Biodiversity Areas” (KBA) comprise 26% of Turkey and there are 305 KBA's throughout the country. The protection of KBA means the continuation of many species which are in danger of extinction. Turkey is a country which has the richest flora of Europe, North Africa and Near East with 11,000 types of flowering plants and ferns.

After Turkey became a party to the United Nations Convention on Biological Diversity in 1996, “National Biodiversity Strategy and Action Plan” was prepared as the responsibility of Turkey according to the Article 6 of this Convention. This strategic plan has been updated by taking the necessity of harmony between the activities of Turkey in this field and the arrangements within the scope of nature protection sector of European Union into account and six thematic working areas which are essential for adaptation to the impacts of climate change have been established in this framework. These areas are;

- Agricultural biodiversity
- Forest biodiversity
- Steppe biodiversity
- Mountain biodiversity
- Inland waters biodiversity
- Coast - marine biodiversity

The in-situ protection activities were initiated in Turkey in the 1950s. Today, the totality of protected areas amounts to 4.6 million hectares, which corresponds to 6% of the country’s total surface area.

Protected areas have been classified under various statutes listed as below:

- 41 National Parks
- 42 Natural Parks
- 31 Nature Protection Areas
- 14 Special Environmental Protected Areas
- 135 Wetlands Bearing International Importance

Climate Change Adaptation Strategy of Turkey based on the targets set out in terms of ecosystems and biodiversity are as follows;

1. Reviewing existing strategies a a perspective of adaptation to climate change
2. Identifying and monitoring the effects of climate change on the species in forest land
3. Identifying land use changes due to the impacts of climate change in forest land
4. Monitoring the health of forest ecosystems
5. Carrying out R&D activities oriented to identify and monitor the effects of climate changes in protected areas
6. Taking into consideration the climate adaptation activities in the socio-economic development of forest villagers, and thereby supporting rural development
7. Identifying and monitoring the effects of climate change on the mountain, steppe, inland water and marine ecosystems and on the ecosystem services they provide, and developing measures for adaptation to climate change
8. Integrating climate change adaptation into the marine and coastal zone management framework
9. Protection of forests against fires

2.3.4 Natural Disaster Risk Management

According to climate change scenarios, 1-2°C increase which could be seen in the mean air temperature means extreme temperatures and a few times increase in heavy precipitation. Thus, many regions of the world witness a large number of hydro-meteorological disasters which are unique in terms of severity, impact, duration and the place of occurrence. (6th National Communication. As Turkey's disaster legislation and institutions mainly focus on post-disaster crisis management, prevention of risks and reducing implications are not prioritized, therefore, disaster and risk management policies are far from overseeing the priority of risk reduction. Excluding active volcanoes and typhoons, Turkey is located in a region with all kinds of natural disasters. Although earthquake events are considered most important in Turkey, there has been an increase in awareness of meteorological disasters in recent years.

The number of people who died in floods and overflows between 1900-2014 is 1,342, and the number of affected people is 1,778,520, while the total damage is 2.2 billion dollars.

There have been 700 deaths because of landslides, 100 deaths because of windstorms, and 15 deaths because of wildfires. The deaths in extreme temperatures have been reported as 100.

National Disaster and Emergency Response Plan was prepared in order to to be used as a guide in conducting disaster risk mitigation, preparation, response and post-disaster recovery works in coherence.The policies set out in the Tenth Development Plan on disaster management are as follows;

- Institutional authorization and responsibilities will be reorganized in order to determine, evaluate and supervise disaster risks and to improve the effectiveness
- Microzoning practices will be completed primarily in high-risk areas and disaster risks will be taken into consideration in master plan processes
- Risk mitigation practices, which vary depending on socio-economic and physical characteristics of regions and different disaster types, will be accelerated and post-disaster recovery plans of high-risk areas will be prepared
- Implementation mechanisms that will reduce disaster risks will be strengthened, retrofitting of public places like hospitals, schools and dormitories that are important for disaster preparation and response processes, and critical infrastructures like energy, transportation, water and communication will be prioritized
- In order to combat disasters more effectively, disaster information management system, that enables fast, safe and efficient information exchange among public institutions, will be established, infrastructure will be reinforced to provide efficient and uninterrupted communication
- Resilient buildings and infrastructure will be built and the supervision of construction activities will be strengthened via independent, capable and authorized individuals and institutions.

Threats and risks should be identified for the management of natural disasters caused by climate change; for this, natural disaster risks such as floods, overflows, avalanches and landslides should be determined first. In fact, in the National Climate Change Strategy, it was foreseen that necessary measures would be taken to determine the natural disasters that might increase due to climate change such as floods, avalanches, and landslides and minimize the effects of disasters by using early warning systems. Objectives set forth according to the Turkey Climate Change Adaptation Strategy and Action Plan for natural disaster risk management are as follows;

1. Identifying risks of natural disasters caused by climate change, such as floods, overflows, avalanches, landslides etc.
2. Reviewing the legislation on natural disasters caused by climate change, and determining implementation principles
3. Strengthening the capacities of local public organizations with regard to responding to natural disasters caused by climate change, and reaching the level of being able to make field exercises
4. Establishing a community-based disaster management in combating disaster risks that may arise due to climate change

5. Continuing the training activities that will increase public awareness and participation with regard to the disaster and risk impacts that may arise due to climate change, establishing a community-based disaster management in combating disaster risks that may arise due to climate change.

2.3.5 Public Health

The effects of climate change on human health can be direct or indirect. While extreme climate events such as floods, extreme heat waves, and storms directly affect human health, the long-term effects of climate change have indirect impacts on human health, causing water, food and shelter problems. Climate change can also cause changes in the distribution of vectors carrying infectious diseases by destroying ecosystems and population density, thus increasing the frequency of vector-transmitted diseases.

The direct and indirect effects of climate change on human health can be listed as follows:

- Injuries and deaths due to extreme climate events
- Temperature-related diseases and deaths
- Canser
- Cardiovascular diseases
- Diseases transported with food and malnutrition
- Asthma, respiratory allergies and respiratory diseases

Effects on human development

- Mental health and stress-related diseases
- Neurological diseases and disorders
- Diseases transmitted by vectors and animals
- Waterborne diseases

In order to minimize the negative effects of climate change on human health and take proper measures against possible effects, activities were initiated by the Ministry of Health. Existing and planned activities by the ministry against the negative effects of climate change on human health are being carried out in three different fields;

i) effects of warm air and extreme heat waves,
ii) effects of extreme weather events and
iii) communicable diseases.

In Turkey; especially during heat waves, many deaths occur due to heart attack, cardiovascular diseases, kidney diseases, respiratory tract diseases and metabolic diseases.

Public information activities about warm air and heat waves are being continued especially in summer by the Ministry of Health and, deaths and diseases caused by heat are watched.

In the "National Program and Action Plan to Reduce the Adverse Effects of Climate Change on Health" published by the Turkish Public Health Agency in 2015, a relationship is established between climate change and public health and statistics for Turkey and the world, in general, were provided and the diseases which may surface due to climate change were listed. In the Action Plan, the objectives and strategies are listed separately for each adverse impact. The main objectives of the program are summarized below.

1- Reducing the impacts of extreme weather events (extreme precipitation, extreme heat, and cold weather, air pollution) resulting in natural disasters (flood, fire etc.) which are effecting human health

2- Strengthening the institutional infrastructure for follow-up and/or increasing diseases in our country after the climate change, increasing the intra-institutional and inter-institutional cooperation

3- Provision of water and food safety, fight against water and foodborne diseases

4- Making the necessary actions so that vulnerable groups are not affected by the disadvantages of climate change

5- Reducing negative contributions of health institutions to climate change

6- Increasing public awareness for more effective protection against the negative effects of climate change on health

7- Execution of monitoring and evaluation studies.

3 Bursa Greenhouse Gas Inventory and Sustainable Energy Action Plan

Within the scope of "Project for the Preparation of Bursa Climate Change Action Plan (BIDEP) with the Urban and Corporate Carbon Footprint Inventory" initiated in 2014 under the coordination of the Department of Environmental Protection and Control Department of Bursa Metropolitan Municipality, firstly greenhouse gas emission sources were determined and greenhouse gas inventory was established on the basis of collected data on institutional and urban scale and then Bursa Climate Change Action Plan including actions for reducing the identified emission sources was prepared. As the Bursa Metropolitan Municipality by signing the Covenant of Mayors in July 2016, which is an organization within the European Union, had committed to reduce greenhouse gas emissions by 40% (per capita), this study had to be revised. In addition, following the COP21 Paris negotiations in 2015, the Covenant of Mayors Sustainable Energy Action Plan along with the local governments' Action Plan on Climate Adaptation was compulsory in line with the decisions taken. For this reason, Bursa Metropolitan Municipality prepared the Climate Adaptation Action Plan in 2017 by revising the previous work.

3.1 Bursa Metropolitan Municipality Corporate and Urban Greenhouse Gas Inventory

Bursa Metropolitan Municipality Corporate greenhouse gas inventory constitutes a very small part of the urban inventory (1,6%). The biggest share in corporate inventory is 42% with public transportation.

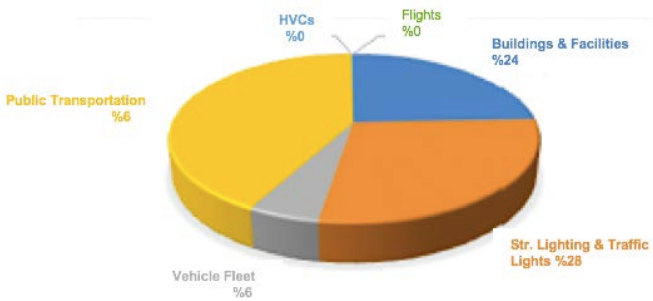


Figure 3-1: Bursa Metropolitan Municipality Corporate Greenhouse Gas Inventory Breakdown, 2014,%

It includes fuel consumption and electricity consumption of Bursa Metropolitan Municipality buses and public buses and electricity operated public transportation vehicles such as train, metro, cable car, tram. Followed by street lighting (8%), buildings and facilities (24%) and vehicle fleet (6%).The total carbon footprint of the province of Bursa is 13.209.619 tons of CO2e for the year 2014. As seen in the following figure, the electricity consumption of the city is the largest source of greenhouse gas with about 36% (scope 2). With scope 1 emissions, which make up 64% of the total inventory, the greenhouse gas emissions are from agriculture, livestock, waste, and wastewater, as well as transportation in the city as well as fuel consumption in industrial facilities and buildings.

Municipality				
Category	CO_2	CH_4	N_2O	Total
	ton CO_2e			
Buildings and Facilities	**52.743**	**197**	**197**	**53.137**
Scope 1 Stationary Combustion Emissions	7.889	106	16	8.011
Scope 2 Electricity Consumption	44.853	91	182	45.125
Street Lighting and Traffic Ligths	**61.301**	**124**	**248**	**61.673**
Scope 2 Electricity Consumption	61.301	124	248	61.673
Scope 2 Electricity Consumptioni	-	-	-	-
Vehicle Fleet	**11.510**	**19**	**165**	**11.694**
Scope 1 Mobile Combustion Emissions	11.510	19	165	11.694
Scope 2 Electric Vehicle Electricity Consumption	-	-	-	-
Public Transportation	**90.473**	**147**	**1.055**	**91.674**
Scope 1 Public Transport Municipal Buses	68.075	104	959	69.138
Scope 1 Public Transport Air transport	793	0	6	799
Scope 2 Public Transport Rail sys. Electricity Consumptioni	20.776	42	84	20.902
Scope 3 Employee Commute	828	1	6	835
Fugitive Emissions	**372**	**0**	**0**	**372**
Scope 1 HVCs	372	-	-	372
Other Scope 3 Emissions	**11**	**0**	**0**	**11**
Scope 3 Flights	11	0	0	11
Total	**216.409**	**487**	**1.665**	**218.561**

Table 3-1: Bursa Metropolitan Municipality Corporate Greenhouse Gas Inventory, 2014

Scope 1 - are defined as 'emissions from stationary or mobile sources that are owned or controlled by the organization

Scope 2 - are defined as 'emissions from the consumption of purchased electricity, steam, or other sources of energy generated upstream from the organization'.

Scope 3 - are defined as 'emissions that are a consequence of the operations of an organization, but are not directly owned or controlled by the organization'. Scope 3 includes a number of different sources of GHG including employee commuting, business travel, third-party distribution, subcontractor activities.

Source: Urban Carbon Footprint Inventory Calculations for Bursa Metropolitan Municipality

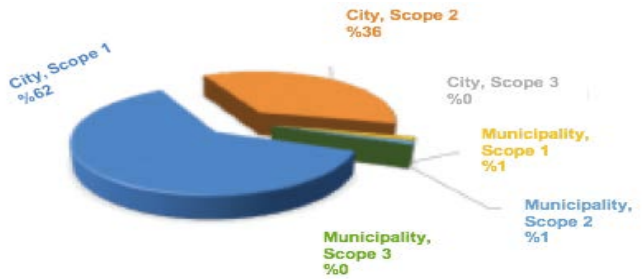


Figure 3-2: Bursa Urban Greenhouse Gases by Scopes, 2014

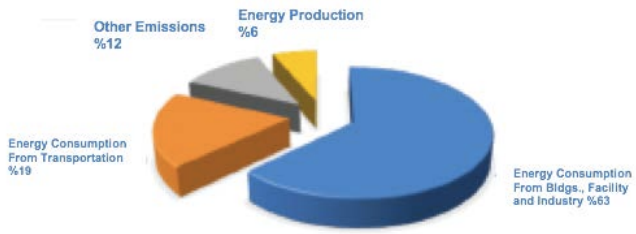


Figure 3-3: Transportation, Building - Industry and Other Bursa Greenhouse Emission Allocations, 2014, %

The sectoral breakdown of the inventory is provided below. The largest share of inventory is due to energy consumption (62%) in buildings, equipment/plants and industry. Secondly, transportation (19%), solid waste/wastewater management, industrial process emissions (clinker production only) and other emissions (12%) including agricultural livestock. Lastly, there are emissions from the electricity generating plants for their own needs in the city (6%).

In order to determine the mitigation strategies, greenhouse gas emissions are shown under the breakdowns in different headings, separated by subdivisions as in Table 3-2, according to international notations.

The results of the calculations indicate that Bursa's urban greenhouse gas emissions are approximately 13.2 million tons of CO2e. As expected in urban emissions, this total stems largely from energy consumption in the categories of housing, transport and industry / trade.

On the other hand, the extent of the existing industrial activities in Bursa took came in first reaching the highest rank in this category, mainly due to the use of energy in industrial activities, with Scope 1 and 2 emissions reaching just over 4 million tons.

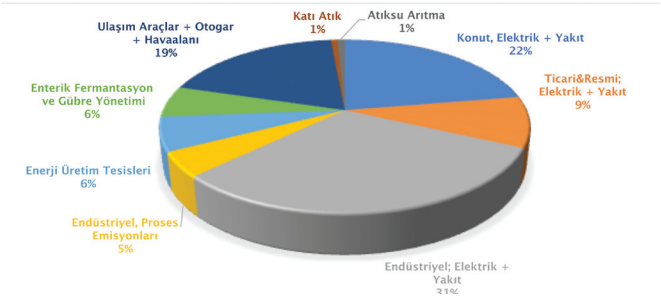
As expected after this category, greenhouse gas emissions from houses and transportation are equivalent to approximately 3 million tons and 2.5 million tons of carbon dioxide, respectively.

The results reflect both Turkey's as well as Bursa's urban dynamics and specific geographical distinctive elements of economic and political decisions.

The emission data summarized in the table below are shown schematically in Figure 3.4.

Urban				
Category	CO_2	CH_4	N_2O	Total
	ton CO_2e			
Housing	**2.852.998**	**90.076**	**15.970**	**2.959.042**
Scope 1 Stationary Combustion Emissions	1.977.211	88.303	12.424	2.077.937
Scope 2 Electricity Consumption	875.786	1.773	3.546	881.105
Commercial & Official	**1.244.635**	**2.788**	**3.759**	**1.251.182**
Scope 1 Municipality Stable Combustion Emissions	7.889	106	16	8.011
Scope 1 Stationary Combustion Emissionsı	363.188	915	208	364.311
Scope 2 Municipality Electricity Consumptioni	106.154	215	430	106.799
Scope 2 Electricity Consumptioni	767.031	1.553	3.105	771.689
Scope 1Municipality AC gasses	372	-	-	372
Industrial	**4.025.384**	**48.769**	**18.354**	**4.092.505**
Scope 1 Stationary Combustion Emissionsı	1.000.528	42.646	6.107	1.049.279
Scope 2 Electricity Consumptioni	3.024.856	6.123	12.246	3.043.226
Energy Production Facilities	**838.181**	**2.162**	**432**	**840.775**
Scope 1 Stationary Combustion Emissionsı	838.181	2.162	432	840.775
Transportation	**2.454.016**	**12.014**	**35.083**	**2.501.113**
Scope 1 Municipality Mobile Combustion Emissions	80.378	123	1.129	81.631
Scope 1 Mobile Combustion Emissions	2.319.477	11.805	33.440	2.364.723
Scope 2 Rail Public Transport Electricity Consumption	20.776	42	84	20.902
Scope 3 Mobile Combustion Emissions - Bus Terminal	27.172	41	383	27.596
Scope 3 Transport of Municipality Employees	828	1	6	835
Scope 3 Airport	5.384	2	41	5.427
Industrial Process Emissions	**604.662**	**-**	**-**	**604.662**
Scope 1 Emissions from Cement processing	604.662	-	-	604.662
Solid Waste	**-**	**85.951**	**-**	**85.951**
Scope 1 Methane Emissions	-	85.951	-	85.951
Wastewater	**-**	**77.256**	**28.125**	**105.381**
Scope 1CH4 and N2O Emissions	-	77.256	28.125	105.381
Agriculture and Land Use	**318.999**	**450.008**	**-**	**769.007**
Scope 1 Enteric fermentation	-	370.332	-	370.332
Scope 1 Fertilizer Management	-	79.677	-	79.677
Scope 1 Chemical Fertilizer Use	318.999	-	-	318.999
Total	**12.338.874**	**769.025**	**101.722**	**13.209.619**

Table 3-2: Greenhouse Gas Inventory in Bursa Provincial Scale, 2014 ***Source****: Institutional and Urban Carbon Footprint Inventory Report for Bursa Metropolitan Municipality*



Şekil 3-4: Bursa İli Kent Sera Gazı Envanter Dağılımı, 2014, %

As emphasized, the energy consumption of industrial activities within the borders of Bursa (including the melting industry) constitutes about 31% of total emissions. According to the population, the high level of industrial activity leads to this result, and the employment mainly concentrated in the Organized Industrial Zones (OIZ) also marks the city's main transport texture. Emissions from residential energy consumption and transportation are calculated at similar ratios of 22% and 19%, respectively. Apart from these categories, the two major sources of Bursa's emissions are energy-related emissions from non-residential building structure and emissions from fossil-based power generation as a Bursa-specific case. As can be seen in the inventory indications, their approximate shares are 9% and 6%, respectively. There is serious power generation from fossil fuel sources in the city. In the Bursa urban inventory, only greenhouse gas emissions from facilities where the company produces electricity for its own consumption (6%).

Energy generating plants for the national power grid are not included in the inventory as they are considered within the electricity emission factor. In addition, greenhouse gas emissions resulting from the cement processes in the city constitute 5% of the urban inventory. Transportation emissions of the city have an important place in the inventory with 2.5 million tons CO2e. As shown in Table 3.4, the share of transportation in 2015 and 2016 has increased to 22% and 23%. While the number of automobiles in the city was 293 thousand in 2011, this number increased to 436 in 2016 with an almost 50% increase.

3.1.1 Development of Various Greenhouse Gas Resources in Recent Years'

After the 2014 base year, greenhouse inventory of 2015 and 2016 are calculated by collecting certain energy consumption data. The data taken into account in calculations according to statistical data issued by TurkStat and EMRA regarding the city are as follows.

- Urban electricity consumption (sector based)
- Natural gas consumption (sector based)
- Diesel
- Gasoline
- LPG (tubular, bulk, autogas)
- Air transport data

While the calculations were being made, the other data regarding the city updated by the Bursa Metropolitan Municipality are listed below.

Urban				% Distribution		
Category	2014	2015	2016	2014	2015	2016
	ton CO2e					
Residence	**2.959.042**	**2.837.387**	**3.010.214**	**22**	**22**	**21**
Scope 1 Stationary Combustion Emissions	2.077.937	1.978.490	2.124.933	16	15	15
Scope 2 Electricity Consumption	881.105	858.897	885.281	7	7	6
Commercial & Official	**1.251.182**	**1.319.945**	**1.335.663**	**9**	**10**	**9**
Scope 1 Stationary Combustion Emissions	372.695	357.481	279.210	3	3	2
Scope 2 Electricity Consumption	878.488	962.464	1.056.453	7	7	7
Industrial	**4.092.505**	**3.453.052**	**4.004.760**	**31**	**27**	**28**
Scope 1 Stationary Combustion Emissions	1.049.279	1.083.668	1.088.046	8	8	8
Scope 2 Electricity Consumption	3.043.226	2.369.384	2.916.713	23	18	21
Free Consumer	**-**	**-**	**-**	**-**	**-**	**-**
Scope 2 Electricity Consumptioni	-	-	-	-	-	-
Energy Production Facilities	**840.775**	**838.290**	**838.290**	**6**	**6**	**6**
Scope 1 Stationary Combustion Emissions	840.775	838.290	838.290	6	6	6
Transportation	**2.501.113**	**2.902.165**	**3.316.240**	**19**	**22**	**23**
Scope 1 Mobile Combustion Emissions	2.447.188	2.843.522	3.249.550	19	22	23
Scope 2 Electricity Consumption - Rail public transport	20.902	25.647	29.208	0	0	0
Scope 3 Mobile Combustion Emissions - Bus Terminal	27.596	27.596	27.596	0	0	0
Scope 3 Airport	5.427	5.400	9.886	0	0	0
Industrial Process Emissions	**604.662**	**652.290**	**674.844**	**5**	**5**	**5**
Scope 1 Cement processing emissions	604.662	652.290	674.844	5	5	5
Solid Waste	**85.951**	**86.780**	**89.656**	**1**	**1**	**1**
Scope 1 Methane Emissions	85.951	86.780	89.656	1	1	1
Waste water	**105.381**	**106.397**	**109.923**	**1**	**1**	**1**
Scope 1 CH4 and N2O Emissions	105.381	106.397	109.923	1	1	1
Agriculture and Land Use	**769.007**	**769.007**	**769.007**	**6**	**6**	**5**
Scope 1 Enteric Fermentation	370.332	370.332	370.332	3	3	3
Scope 1 Fertilizer Management	79.677	79.677	79.677	1	1	1
Scope 1 Chemical Fertilizer Usage	318.999	318.999	318.999	2	2	2
Total	**13.209.620**	**12.965.314**	**14.148.597**	**100**	**100**	**100**
Per capita ton CO2e	**4,74**	**4,56**	**4,88**			

Tablo3-3: Bursa ili sera gazı envanteri 2014, 2015, 2016

- Public transport data (diesel, electricity, aircraft fuel, BUDO-sea bus consumptions)
- Inegöl and Yenikent Solid Waste Storage areas waste data

As shown in Table 3-4, while the greenhouse gas inventory of 2015 does not show a significant difference compared to the 2014 year inventory, there was a serious increase of 6% to 7% in the greenhouse gas inventory in 2016.

One of the most important reasons for this increase is the increase in electricity consumption. An increase in almost every fuel consumption (except LPG) is observed. The second most important cause of the increase in 2016 is the increase in emissions is from transportation, particularly diesel consumption.

3.1.2 GHG Reduction Inventory as per Covenant of Mayors

While various international networks have identified greenhouse gas reduction measures, they offer the option of excluding sectors that local governments cannot intervene directly or indirectly. Büyükşehir Sectors in the competence area that the Metropolitan Municipality can intervene and/or direct remained in the inventory; sectors that are not affected by local governments such as industry, agriculture, and animal husbandry have been removed from the inventory to serve as a base for mitigation measures. The Metropolitan Municipality has committed itself to a reduction of at least 40% per capita emissions by 2030 as per Covenant of Mayors. Emissions related to the economic sectors directly affected by country policies such as industry, agriculture and livestock were excluded from the inventory because they were not under the control of Bursa Metropolitan Municipality.

With the decrease of the sectors included in the greenhouse gas inventory, the distribution of greenhouse gas emissions by sectors varied greatly. The changes are compared to the base year of 2014 and for the years of 2015 and 2016.

The table below shows the sectors within the scope of the local government in 2014, 2015 and 2016 and the distribution of these sectors in the inventory.

- While the share of the "Housing" category in the urban greenhouse gas inventory was in all sectors, it rose to around 40% from 21-22%, and it increased by nearly 2% compared to 2014.
- While the shares of the "Commercial & Official" category in the greenhouse inventory was around 9-10%, with the exlusion of some sectors it increased to 17-18%. In 2016, an increase of nearly 7% compared to 2014 was observed.
- The share of the "Transportation" category in the greenhouse inventory increased from 20-23% to 36-42%. The increase in greenhouse gas emissions from transportation is around 16% per annum. In this category, an increase of nearly 33% compared to 2014 is observed in 2016. The main source of the increase in emissions of greenhouse gases in 2016 is the increase in transport emissions.

3.2 Bursa Sustainable Energy Action Plan

The distribution of GHG emissions in urban Bursa clearly holds a mirror to the nature of the general economic dynamics of urban development which emerged after the 1980s in Turkey . Immigration, urban income, rapid automobilization, the incentive of the consumption economy based on the credit, has placed a considerable pressure on the city. The current urban dynamics and problems of Bursa have been determined in detail by the local government with a large number of reports compiled by the city's stakeholders.

Two very important documents prepared by the local government and aimed at carrying out urban development in accordance with modern standards from short to long terms are emphasized; the 1/100000 scaled Environment Plan prepared in consideration of the year 2030 and the Bursa Transportation Master Plans.

Urban				% Distribution		
Category	2014	2015	2016	2014	2015	2016
	ton CO_2e					
Residence	**2.959.042**	**2.837.387**	**3.010.214**	**43**	**39**	**38**
Scope 1 Stationary Combustion Emissions	2.077.937	1.978.490	2.124.933	30	27	27
Scope 2 Electricity Consumption	881.105	858.897	885.281	13	12	11
Commercial & Official	**1.251.181**	**1.319.945**	**1.335.663**	**18**	**18**	**17**
Scope 1 Stationary Combustion Emissions	372.694	357.481	279.210	5	5	4
Scope 2 Electricity Consumption	878.488	962.464	1.056.453	13	13	13
Transportation	**2.501.113**	**2.902.165**	**3.316.240**	**36**	**40**	**42**
Scope 1 Mobile Combustion Emissions	2.447.188	2.843.522	3.249.550	35	39	41
Scope 2 Electricity Consumption - Subway	20.902	25.647	29.208	0	0	0
Scope 3 Mobile Combustion Emissions - Bus Terminal	27.596	27.596	27.596	0	0	0
Scope 3 Airport	5.427	5.400	9.886	0	0	0
Solid Waste	**85.951**	**86.780**	**89.656**	**1**	**1**	**1**
Scope 1 Methane Emissions	85.951	86.780	89.656	1	1	1
Wastewater	**105.381**	**106.397**	**109.923**	**2**	**1**	**1**
Scope 1 CH4 and N2O Emissions	105.381	106.397	109.923	2	1	1
Total	**6.902.669**	**7.252.674**	**7.861.696**	**100**	**100**	**100**
Per capita ton CO2e	**2**	**3**	**3**			

Table 3-4: Targeted GHG Inventory Not Including Industry, Agriculture and Animal Husbandry

Implementing a modern city-friendly urban transport system in harmony with the reconstruction plan to organize the long-term development of the city is the only way to deal with existing planning problems.

Energy flows and urban development need to be planned together for modern urban management for world cities under threat of climate change, resource shortages, adverse and sudden climate events. Climate Change or Sustainable Energy Action Plans are indispensable planning and management tools for recording, monitoring and reducing long-term mitigation of urban energy and greenhouse gases. Long-term urban planning and integrations of Zoning and Transportation increase stakeholder participation, hence, enable the city's vision to be expressed in different subfields. The industrial and agricultural production sectors, which are the outward-oriented elements of Bursa city economy, make the intensity of energy and greenhouse gas of the city 'unordinary'. On the contrary, it also points to 'extreme' areas to which the low-carbon economy will be subjected. Renewable energy sources, whose costs are falling rapidly, the dense spatial and sectoral concentration of the Bursa industry, Bursa's high bio-based energy production possibilities, as well as the urban stakeholders protecting future of the city are creating a great synergy for sustainable urban development. 'Climate Change Action Plans' presents an important assessment tool for local governments by setting and prioritizing all resources and possible potentials.

As it can be seen in Table 3-5, the sectors in the competence area that the Metropolitan Municipality can intervene and/or direct are left in the inventory and sectors that are not within the jurisdiction of local governments such as industry, agriculture and animal husbandry have been removed from the inventory.

It has been deemed appropriate that measures for residence, commercial buildings (including official buildings), transportation, waste and wastewater, which the local government can aim for mitigation through training, directing or direct involvement, should be included in the inventory in accordance with the principles of the Convention of Mayors.

3.2.1 Current Situation and Possible Future

According to the 1/100000 Environment Plan Plan prepared for the province of Bursa in 2030, it is expected that the population of the province of Bursa will reach 3,362,000 people with an increase of approximately 21% by 2030.

It is predicted that Bursa urban greenhouse gas emissions will follow a trend as shown in Figure 3.5 if current trends continue.

Future projections were calculated from values such as population and sectoral trends obtained from the reports and studies of Bursa Eskişehir Bilecik Development Agency (BEBKA) and Bursa Metropolitan Municipality (BMM). Bununla birlikte, However, technological developments in legislation and economic dynamics of Turkey imposed a 'natural' tendency to increase energy efficiency.

For example, the government's official "Energy Efficiency Strategy Paper 2010-2023" aims to reduce energy intensity in industry and service sectors by 15%, average 15-30% in building structures, and for household appliances and vehicles to be in line with EU norms (3-4% per year for automobiles, 30% by 2020 for home appliances with reduced emissions).

Public institutions have been instructed to save 20% energy by 2023. In the light of the predictions of the official institutions of the state and Turkey's recent developments in the energy efficiency field and in terms of the BUSECAP study, a 7% average energy efficiency gain by 2030 compared to 2014 was considered a safe value. This 'natural' decline in energy consumption brings Bursa urban emissions to 9.919 kton of CO2e by 2030 according to the projection of the year 2016.

Future assumptions for energy consumption have been made by taking into consideration various strategic plans related to greenhouse gas emissions on an urban scale. The works carried out by Bursa in recent years has been very useful in this respect. The "Bursa 1/100000 Scaled Provincial Environment Plan" prepared by the Metropolitan Municipality of Bursa and the analysis reports prepared within this plan and the "Bursa Metropolitan Municipality Main Transportation Plan" are the primary sources benefited from.

According to the projected increase in urban strategic plans (population, industry, etc.) after 2015, energy consumption and greenhouse gas inventory are projected for each year.

In the following subheading in the table below, according to the projections made, the amount of savings that can be achieved is determined on a yearly basis as a result of possible mitigation measures / actions.

Data from 2014	MWh	tCO_2e
Energy Consumption in Bldgs. Equipment / Facilities and Industries	**13.707.976**	**4.209.852**
Municipality Building/Facilities	128.354	53.137
Residences	10.114.073	2.959.042
Bldgs. & facilities other than the Municipality Bldgs.	3.341.458	1.136.000
Municipality Street Lighting	124.091	61.673
Energy Consumption in Transportation	**9.374.422**	**2.501.113**
Municipality Vehicle Fleet	43.109	11.694
Public Transportation Municipality Buses + Air Transportation	257.787	69.937
Public transport Metro + Tram	42.057	20.902
City vehicles	8.909.044	2.365.558
Transit - Bus Station	101.674	27.596
Aviation	2.075	5.427
Other Emissions	**-**	**191.704**
Solid Waste Disposal	-	85.951
Wastewater purification	-	105.381
Fugitive emissions	-	372
Total	**23.082.397**	**6.902.670**

Table 3-5: Predicted Energy Consumption Reduction within the scope of BUSECAP, 2014

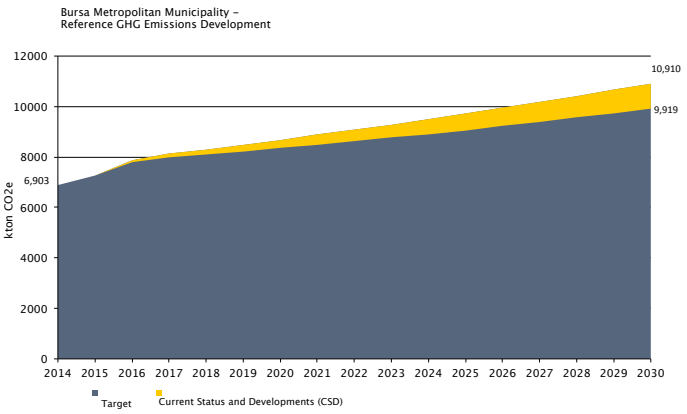


Figure 3-5: Bursa Greenhouse Gas Emission Forecasts, 2017-2030

The reduction rates presented in the report are the final reductions to be achieved in 2030. The possible mitigation potential for different sectors was adopted from the "general" approach of the international literature and also benefited from the outputs of works on energy efficiency in Turkey.

For example, the total impact of interventions to improve energy efficiency in Turkey, due to the differences in starting points will be very different from those in Germany. The cost and duration of the interventions will vary from country to country. The average impacts on the transportation emissions due to various improvements to urban transport are also calculated by using the values used in various reports prepared in this area.

The calculation methods used for urban greenhouse gas emissions are increasingly similar in recent years, but the debate on the assumptions made for "developed" country cities may not apply to "developing" country cities is still continuing.It is stated that in the "developing" countries where the speed of renewal and expansion of urban infrastructures has lagged behind the urban population increase, unit service increases (eg unit increases in rail public transport distances) should be based on different parametric assumptions. The increase in studies in this field in Turkey, elimination of differences and uncertainties in the calculation methods, will increase the sensitivity in urban emission inventories as well as in the estimates of reductions.

A large part of the mitigation measures will begin in 2017 and will increase at certain rates over the years, thus the % values for 2030 stated in the relevant sections were determined.

When we examine the mitigation results, even if a significant reduction in absolute terms is not achieved compared to 2014, a reduction of over 40% was achieved in per capita emissions. In 2030, according to the BAU scenario, a reduction of 54% can be achieved.

3.2.2 Scope of the Sustainable Energy Action Plan and Greenhouse Gas Mitigation Measures

The Bursa Climate Change Action Plan consists of 6 main headings. These are; urban development, service sector, renewable energy, transportation, solid waste and wastewater management and actions for raising awareness. As mentioned earlier, the measures for the industry, agriculture and livestock are excluded hence are not included in the inventory.

For the headings mentioned, firstly, strategies to reduce the greenhouse gas emission sources were developed based on the present situation. Care has been taken to ensure that the identified strategies are compatible with other plans at local and national level.

Under the heading of Urban Development and Built Environment, high feasibility measures, which are also recognized in the international arena for reducing the energy consumption of residential, municipal and other commercial buildings in the city, have been determined and targets have been set in view of national strategic plans and workshop decisions.

Under the transport heading, the objectives of the city's Transportation Master Plan have been taken into consideration to a great extent.

In terms of Renewable Energy, it is known that Bursa has a higher potential over Germany, which widely uses solar energy for electricity generation.

Although we have excluded the industrial sector for mitigation measures, there are suitable areas for applications, especially on the premises, due to a large number of industrial structures. Yet again, the fact that Bursa is one of the leading producers of agriculture and livestock, also makes the city strong in terms of biomass and biogas potential.

There is a significant contribution to GHG mitigation due to the fact that the city carries out large-scale regular storage of solid waste and energy recovery from landfill gas. Measures for the reduction of greenhouse gas emissions for with the expected population increase in 2030 have been envisaged.

Bursa Metropolitan Municipality will provide guidance and examples in cooperation with the related institutions, awareness campaigns that can be organized and information points that can be set up to inform the public about energy efficiency and renewable energy fields.

3.2.2.1 Urban Development - Built Environment

According to the Greenhouse Gas National Inventory for 2015; 72% of national CO2 emissions (475.1 million tons of CO2e) are due to energy. According to Business as Usual Scenario; it is estimated that the energy consumption of the building industry, which is 28.3 million TOE, will reach 47.5 million TOE (tons of oil equivalent) by 2030, which is twice the CO2 emission.

On the other hand, the building sector offers significant opportunities in terms of cost-effective emissions and potential for energy savings. In the First National Communication submitted under the UNFCCC (United Nations Framework Convention on Climate Change), the Government stated that investment in energy efficiency in emission reduction is more cost-effective than using renewable energy.[5]

Population growth and rapid urbanization increase the need for housing, especially in big cities. According to TURKSTAT's building census for 2000, while the number of buildings was 4.3 million in 1984, it has increased by 78% in 2000 and reached 7.8 million and the number of housing reached to 16.2 million with a 129% increase compared to the same year.

According to the building census for 2000, the area of residential, commercial and public buildings is equivalent to 913 million m2, of which about 400 million m2 is estimated to be heated.

The building stock constructed before 2000, even when compared to current construction standards, consumes at least twice as much energy according to today's legislation.

While the General Directorate of Renewable Energy (formerly EIE) stated that the energy efficiency potential of the buildings is at 35%, by 2023, it is estimated that there will be 2400 GWh of electricity for cooling with heat insulation for 10 million homes and 2.3 million TEP fuel savings for heating.

5 Türkiye'nin İklim Değişikliği Eylem Planı'nın Geliştirilmesi Projesi Binalar Sektörü Mevcut Durum Değerlendirmesi Raporu, Tülin Keskin, August 2010

One of the main axis of the Bursa Eskişehir Bilecik Development Agency (BEBKA) 2014-2023 Regional Plan is Habitable Spaces, Sustainable Environment. On this axis of this development, it is desirable that the distribution and layout of the settlements be adapted to the level of income and development in terms of the quality and functioning of the working and living areas, the harmonization of land uses and the environmental effects. Ensuring the provision of basic quality of life standards for all settlements in urban and rural areas to reduce regional imbalances, minimizing the constraints arising from spatial disadvantages for inclusive development and equal opportunity, ensuring that the production organization takes into account the competitiveness of the regions in order to spread the production in a more balanced manner throughout the country, transforming cities into livable spaces that are able to manage their risks, ensuring urban transformation to be an application that has system integrity aimed at needs, restructuring local governments with governance principles, the enrichment of rural area policies and practices, protection of environmental quality, ensuring that economic growth complies with social and environmental elements, determination of economic values of natural resources through the development of environmental standards in production and consumption with an understanding of competitiveness and green growth, ensuring sustainable climate change and biodiversity, to include disaster management and pre-disaster risk reduction measures are included in the settlement planning and zoning planning processes are targeted.

Bursa developed a population increase after 1980 due to the development of the industry and the immigration it received. It is possible to say that a significant part of the population increase in the region where the net migration rate is high with a value of 4.23 per thousand is due to migration from outside the region.

In addition, it can be said that Bursa has the highest population density and the highest number of immigration among TR41 Region as a result of the migration caused by the job growth due to development of industry.

According to TurkStat data for 2014, the population of Bursa was 2.787.539, in 2016 this figure has risen to 2.901.396. In terms of population, Bursa the fourth largest city with 44% after Istanbul, Ankara and İzmir. While Turkey's population growth was at 13.4 per thousand, it was 17.0 for Bursa.

The city of Bursa ranks among the first in the region in terms of social and economic development level, population size and increase, economic activities, regional services, infrastructure and transportation facilities and 4th in the country.

Not only in the region but also throughout the country, the city has developed rapidly in terms of population and economics and has taken important steps towards becoming a metropolis.

In the 1/100.000 Scale Environment Plan Synthesis Report prepared by Bursa Metropolitan Municipality for 2030, the following determination in terms of the trace left by all these developments in an urban form was made;

"...In parallel to constantly increasing population of Turkey and the Marmara region and the emerging economies, Bursa province also shows continuous growth and development. Located in the center of three major cities (Istanbul-Ankara-Izmir) geographically, Bursa is a metropolitan city with its dynamic population, industry, agriculture and tourism sectors which are constantly growing. This growth also brings traffic and transportation problems. It is believed that if the necessary planning is not carried out in the near and mid-term and if the measures are not taken, the problems may grow even bigger.. .."

With the approach that recognizes the principle of sustainability in the Environmental Plan, the urban area is divided into Strict Protected Areas, Priority Protected Areas and Habitable Areas.

In the Bursa Climate Change Action Plan (BIDEP) study completed in 2015, information such as housing needs, demand analyzes, unstructured residential areas and the population calculated for these areas along with various problems related to the settlement in the Bursa province were covered in detail (see BIDEP 2015).

Considering the population projection data for 2020 and 2030 made by the social, economic and spatial structure analysis group for Bursa in general, it is assumed that the population of Bursa will increase by over 580 thousand between 2014 and 2030.

A simple calculation of the average household size implies about 160 housing needs.

In the first stage, as BUSECAP has done in the previous work while giving priority to measures to reduce existing building stock to increase energy efficiency and renewable energy use, the 'habitable' area proposed by urban plans has developed proposals for new building stock.

Generally, it is observed that while the population of the Bursa is increasing in the districts of the former metropolitan municipality and İnegöl district and the population in mountain regions and the regions dominated by rural character have begun to decrease. In case the assumptions on population projections continue, it is expected that new housing will be concentrated within Bursa Metropolitan Municipality borders and İnegöl district.

Thousand people	2015	2018	2020	2023	2030	2040	2050
BEBKA	2802	2909	2977	3073	-	-	-
Environmental Plan	2781,5	2888,8	2960	3079,5	3362,2	3699,5	3970,2
Bursa Integrated Waste Management Plan - UNDP Method	2779,9	-	2994,8	-	3342,1	3649,6	3933,5

Table 3-6: Bursa Province Population Projection, BEBKA Regional Plan, 1/100000 Scaled Bursa Provincial Environment Plan, Bursa Integrated Waste Management Plan

3.2.2.1.1 Reduction Measures for Buildings

Objective B1: Reduction of consumption via energy efficiency applications in existing buildings in Bursa

Target: To prevent heat loss in the winter and heat gain in the summer, to reduce fuel consumption, to reduce greenhouse gas emissions

Stakeholders: Homeowners and tenants, manufacturers of insulation materials, application firms, Ministry of Energy and Natural Resources (MENR), financial institutions, professional organizations, İZODER (The Association of Heat, Water, Sound and Fire Insulators) Energy Efficiency Association

Objective B1: Energy efficient renewals in existing housing
Action B1.1: Heat isolation in existing housing
Action B1.2: Renewable energy application in existing housing
Action B1.3: Use of energy efficient lighting systems in existing homes (energy saving-LED lighting)
Action B1.4: Heating of about 100,000 residences with localized heating

Action B1 .1	Heat isolation in existing housing
Current situation	The number of electricity subscribers in Bursa indicates that there are more than 1.1 million residential subscribers. The energy consumption in the houses accounts for 43% of entire Bursa and 43% of the emissions (10.114.073 MWh and 2.959.042 tCO2e). The residence, like other buildings, has to obtain an Energy Identity Certificate until 2020 under the Energy Efficiency Law and the Energy Performance Regulations in Buildings, which entered into force in 2008. According to research conducted by the Ministry of Public Works and İZODER, buildings built after 2000 across country including buildings with isolation as per appropriate TS 825 standard across does not exceed 20%. It can be assumed that the same ratio applies for Bursa. In addition to raising the awareness on the subject, various financing opportunities must be created. The distribution of funds from abroad related to the subject have begun.
Activities / Steps	It is foreseen that 80% of existing buildings in the city will complete facade, roof and glass insulation until 2030. As a result of these activities, it is envisaged that energy saving will be realized in the related houses by 10% electricity and 35% heating fuel. At the same time, it is foreseen that there will be 80% reduction in coal consumption in the residences and that these residences will convert to natural gas and other fuels (biomass, etc.).
Timing	2017 - 2030
Cost	Assuming that an average home is 100 m2 and the cost is around TL 50/m2, an estimated of 5000 TL per home is foreseen. A total cost of approximately TL 2.55 billion is foreseen.
Savings Amount	In 2030, 155,161 MWh of electricity, 1,684,138 MWh of natural gas and 2,221,638 MWh of coal, totaling 4,060,936 MWh of saving and, as result, in a total emission reduction of 1,339,253 tCO2e resulting from 77,115 tons of electricity, 341,038 tons of natural gas and 921,101 tons of coal.
Investor	Building and/or Home Owners
Stakeholders	Financial institutions, insulation material manufacturers, implementation companies, Municipal Development Department, District Municipalities
Contribution of BMM	The municipality cannot be expected to be an investor in increasing the energy efficiency of homes. However, the municipality can be a guide by bringing related stakeholders together. It is possible that financial institutions can offer cheap financing opportunities to citizens by developing joint financial solutions with different material producers. If the municipality can spare the human resources, the municipality can provide support to the financial institutions for the supervision of the projects to be developed and for the proper use of the projects..

Action B1.2: Renewable energy application in existing housing

Especially in terms of Bursa, photovoltaic and heat pump applications are at the beginning of the distributed renewable energy applications. After a short standstill period, PV technology market is expanding at a rapid pace and pushing the prices down. As already mentioned, it is envisaged that it will take time to adapt to the distributed photovoltaic practices of the newly privatized distribution companies, while completing the major deficiencies in terms of legislation. On the other hand, with the decline in technology and increase in electricity prices in Turkey, applications of PV as of 2017 is projected to have a reasonable reimbursement in houses. The roof applications for Bursa are addressed in the estimated Renewable Energy emission reduction projects under section RE 1.3.

Action B1 .3	Use of energy efficient lighting systems in existing homes
Current situation	Various studies conducted in Turkey indicate that around 10-20% of all electricity consumption is from lighting consumption in homes. The number of residential electricity subscribers in the province of Bursa proves that by 2030, all of the residences will switch to energy efficient lighting systems, reducing their energy consumption by 50-80% and reducing their total electricity consumption by 10%. (It is accepted that 70% incandescent and 30% compact fluorescent lamps are used for lighting in accordance with the reference residence building parameters defined in the Building Energy Performance Regulation.)
Activities / Steps	In residential areas, it is predicted that the most used lighting will be replaced by LED lighting, and after that, 10% of electricity consumption will be saved.
Timing	2017-2030
Cost	Approximate cost of changing 12 lights of per house is 240 TL, total 102.4 million TL.
Savings Amount	217.901 MWh of electricity consumption and 108.297 tCO2e emission reduction are targeted.
Investors	Homeowners, tenants
Contribution of BMM	To be informative and a guide

Action B1.4	Providing heating for about 100,000 residences with localized heating
Current situation	Another ever increasing important issue is the fact that heating homes individually in Turkey is an incorrect application in terms of energy efficiency. In buildings, with the Energy Performance Regulation, the use of the central heating system has been made compulsory if the total usage area of the new buildings is more than 2.000 m², the transfer of the buildings with a central heating system to an individual system is made difficult under Article 42 of Property Ownership Law. The district heating system is a large-scale heating system that can be transported to heat users (industrial facilities, mass housing applications, neighborhoods, cities, etc.) by means of preheated piping systems produced by one or more energy sources to meet the heating and hot water needs. There are many large facilities in the province of Bursa, such as a cement factory. Their waste heat can be used to heat houses in their surroundings. There are many applications in the world where district heating systems that use biomass fuels are used as an alternative fuel.
Activities / Steps	Feasibility studies will first be required to heat 100,000 dwellings with district heating. The fact that district heating systems are on the agenda of the central government will accelerate the steps to be taken in this regard. TUBITAK throughout Turkey has completed a study that analyzes the potential utilization of waste heat from power plants.
Timing	2020 - 2030
Cost	Cost may vary due to applied technology and other factors
Savings amount	Reduced energy consumption with 537.130 MWh heating and hot water supply and 108,769 tons CO2e emission reduction is targeted
Investors	District heating systems are within the jurisdiction of Metropolitan Municipalities.
Stakeholders	Metropolitan Municipality, waste heat producing industrial establishments, contractors, funding organizations.
Contribution of BMM	While the district heating infrastructure was under the responsibility of county municipalities previously, following the 2014 local elections the responsibility passed to Metropolican Municipalities as per the law also known as the Metropolitan Act. For this reason, the Bursa Metropolitan Municipality may be a direct investor. The obligation to distribute the purchased and/or produced waste heat to subscriptions is a municipal obligation.
Risks	High initial investment cost, There may be logistical problems in supplying the waste needed to produce biogas.

Objective B2: Energy efficient planning of the new settlement areas in Bursa province

Target: Providing low-carbon urban development with energy efficiency and project integration of renewable energy sources while designing new settlement areas and rebuilding buildings that are not suitable for earthquake regulations and houses consuming 40% less energy.

Stakeholders: BMM, Housing Development Administration (TOKİ), City planners, occupational chambers, Ministry of Energy and Natural Resources, IZODER, ENVERDER, construction companies, financial institutions, various funding sources, development agencies

Objective B2: Energy efficient planning of new settlement areas
Action B2.1: Energy-efficient urban transformation in housing
Action B2.2: Sustainable premise design in new residential areas

Action B2.1: Urban transformation area

Action B2.1	Energy-efficient urban transformation in housing
Current situation	One of the focus areas of the Bursa Metropolitan Municipality Urban Planning Service is the planning and implementation of urban transformation. 5-year strategic actions in Focus Area 1 in the Bursa Metropolitan Municipality, Strategic Plan 2015-2019 are listed below. - Preparing Urban Transformation Concept Projects - Developing Mathematical Models of Urban Transformation - Implementing Urban Transformation Projects - Ensuring the Integration of Urban Transformation Projects with Development Plans - Preparing Urban Regeneration Implementation Projects
Activities / Steps	According to a workshop conducted in September 10, 2015, it was assumed that about 60,000 dwellings, in Gürsu, Yıldırım and Osmangazi districts would have been demolished and planned to be constructed with 100,000 dwellings with urban transformation. From the design stage of project and planning studies of the urban transformation area, building energy efficient residential buildings with integrated renewable energy systems will lead to significant gains in terms of energy efficiency. Insulation, efficient lighting and passive measures (architectural design) are predicted to reduce energy consumption by 40%.
Timing	It is targeted that all plans will be finalized by 2019. It is foreseen that the urban transformation will progress gradually from 2019 until 2030.
Cost	It is envisaged that designing and constructing energy-efficient buildings in areas that are currently undergoing urban transformation will increase the cost per apartment by 6%. The approximate cost per residence is around 6000 TL.
Savings amount	With a total electricity of 95.802 MWh and 547.394 MWh of natural gas, a total of 643.195 MWh is targeted for a total of 158.461 tCO_2e with 47.614 tCO_2e electricity emission reduction and 110.847 tCO_2e natural gas emission reduction.
Investor	Building owners, construction firms
Stakeholders	BMM, Ministry of Environment and Urbanization, contractors, financial institutions, related professional chambers, audit companies
Contribution of BMM	Planner, guide, unifier and changes can be made in the zoning plan notes to areas with licensing authority
Risks	High cost, lack of information

Action B2.2: Sustainable premise design in new settlement areas

Action B2.2	New settlement areas / sustainable premise design practices in new settlement areas
Current situation/ Objective	By 2030, nearly 200,000 of the necessary dwellings will need to be built to accommodate a population increase of approximately 600,000 people. Some of these will be realized by an increase in floors that will be rebuilt under urban transformation. From the design stage of the new buildings, it is aimed to build new residential where renewable energy systems will be integrated and will be energy efficient, with urban public transportation systems. In addition, Energy Efficiency Strategy Document published in 2012 states, the utilizing facilities of renewable energy sources and cogeneration or microgeneration, central and regional heating and cooling and heat pump systems shall be analysed in the public housing projects, the applications corresponding to at least 10% of the dwelling cost shall be encouraged in the framework of the criteria defined by the ministry and until the legislation in the context of the activity SA02/SH-01/E-01shall be in force.
Activities / Steps	It is necessary to revise the municipality's zoning plan notes and the Metropolitan Municipality zoning regulation. In order to encourage building owners, it is possible to apply the methods of increasing floor area ratio (like 0.5-floor area ratio increase in Bursa), tax reduction, fee reduction. This project, which is one of the important outputs of the "Planning the Sustainable Future of Bursa" project, is designed as an exemplary and repeatable structure and urban facilities to show new practices and technologies in terms of individual structures and regions. Examples of international good practice can be assessed in preparatory work in this regard. A detailed plan and feasibility study should be conducted by examining the international green building certification systems ("BREEAM Communities" and/or "LEED for Neighborhood Development") and newly established domestic certification systems.
Timing	2021 - 2030
Cost	The cost of the proposed improvements, which are expected to bring an additional investment of 15% to the housing investment cost, is estimated to be 15.000 TL per housing.
Savings amount	Since the effect of this is multidimensional, it is difficult to calculate the amount of savings.
Investor	Construction firms, landowners
Stakeholders	BMM, District Municipalities, Ministry of Environment and Urbanization, contractors, financial institutions, related professional chambers, architects, implementation companies
Contribution of BMM	Planner, guide
Risks	High cost, social acceptance

Objective B3: Reduction of consumption through energy efficiency applications in existing commercial buildings in Bursa

Target: To prevent heat loss in the winter and heat gain in the summer, to reduce fuel consumption, to reduce greenhouse gas emissions

Stakeholders: *Commercial building users, manufacturers of insulation materials, implementation companies , ministers of Bursa Chamber of Commerce and Industry, MENR, financial institutions, professional organizations, IZODER, ENVERDER, all ministries with affiliated public buildings.*

Objective B3: Energy efficiency applications in existing commercial buildings
Action B3.1: energy efficiency applications in existing commercial buildings (heat insulation)
Action B3.2: Energy efficient lighting in existing Commercial Buildings

Action B3.1	**Energy efficiency applications in existing commercial buildings (heat insulation)**
Current situation/ Objective	In terms of electricity subscribers in Bursa, it is seen that there are more than 210 commercial subscribers in the city. When the 2014 data is analyzed, it is seen that about 9% of the total energy consumption comes from commercial and official buildings. Energy consumption and energy prices of commercial buildings are higher than for residential buildings, thus, insulation and other energy efficiency applications will be more cost effective and it is envisaged that by 2030 at least 90% of the heat insulation measures will be taken and energy consumption will be reduced by at least 30%.
Activities / Steps	- Raising awareness of commercial building owners about the subject - Assistance in finding easy funding opportunities - Demonstration of financial returns with simple feasibility studies
Timing	2017-2030
Cost	Because the size of commercial buildings vary, it can be very difficult to predict
Savings amount	Energy savings of 1.083.574 MWh, reduction of 437.382 tCO2e
Investors	Commercial building owners
Stakeholders	Building owners, application companies, material manufacturers, IZODER, ENVERDER
Contribution of BMM	Guide and coordinator
Risks	Especially Commercial building owners who rent out may not want to invest because the owners are not interested in the reduction in consumption.

Action B3.2	**Energy efficient lighting in existing Commercial Buildings**
Current situation/ Objective	Electricity consumption in commercial buildings is around 4% of the city's entire consumption. A significant portion of this energy consumption comes from lighting. Energy costs are relatively more expensive and high consumption causes costly investments to be made. Previous studies have shown that the conversion to energy-efficient systems was amortized over a short period of one year. It is envisaged that 50% of commercial buildings will save 10% energy.
Activities / Steps	It is estimated that with the enforcement of the central government and the relevant ministries it is likely to occur at higher conversion rates.
Timing	2017 - 2030
Cost	Since the lighting quantities are unknown, it is difficult to make a total cost
Savings amount	235.166 MWh of electricity consumption reduction and 116.877 tons of CO2e emission reduction are foreseen.
Investors	Commercial enterprises
Stakeholders	Energy efficient lighting manufacturers, recycling plants
Contribution of BMM	To be informative and guide
Risks	There are no commercial or technical risks

Objective *B.4:* Reducing energy consumption practices in public buildings, especially in the municipality of Bursa

Target: To prevent heat loss in public buildings in the winter, to prevent heat gain in the summer, to reduce fuel consumption, to reduce greenhouse gas emissions, to create awareness through good practices

***Stakeholders**: BMM, District municipalities, manufacturers of insulation materials, electro-mechanical application firms, MENR, financial institutions, professional chambers, İZODER, various funding sources, development agencies, ENVERDER*

Objective B4: Energy efficiency applications at the municipality
Action B4.1: Energy efficient renewals in existing municipal buildings

Action B4.1	Energy efficient renewals in existing municipal buildings
Current situation/ Objective	The number of municipal subscribers in the province of Bursa is high when the district municipalities and subsidiaries participate. While the share of all these units in energy consumption is quite low in total, it is important to create awareness in the public and increase their energy efficiency awareness. "Energy Efficiency Strategy Document" prepared by MENR in 2012, states "Energy efficiency studies will be prepared in the buildings and facilities of public institutions and efficiency improvement projects will be prepared and budget appropriations related to maintenance and repair will be used primarily for these projects". MENR has started to work on this subject and energy studies have been completed in many public buildings, primarily in their own. Insulation applications in the municipal buildings can reduce the consumption of natural gas. Lighting expenses, which make up a significant part of electricity consumption, will also decrease.
Activities / Steps	20% savings in total electricity consumption Energy efficiency applications (heat insulation, thermostatic valve usage, energy management system, etc.) to be applied in 50% of the municipal buildings aimes to provide 40% energy saving.
Timing	2017 - 2030
Cost	-
Savings amount	A total of 35,215 MWh of electricity and 17,502 tons of CO2e emission reduction were targeted in all municipal buildings foreseen by lighting energy reduction. With heat insulation applications, it is aimed to reduce 81.433 MWh and 37.315 tCO2e by 19.813 tCO2e emission reduction with 46.218 MWh natural gas and electricity (cooling) savings.
Investor	Metropolitan Municipality
Stakeholders	Lighting companies, financial institutions, implementation companies
Contribution of BMM	Investor
Risks	High initial investment cost, lack of human resources in the municipality

Objective B.5: Reducing the consumption of street lighting in the province of Bursa through energy efficiency applications in public buildings, especially in the municipality

Target: Energy saving with energy efficient street lighting

Stakeholders: *BMM, District municipalities, energy efficient lighting producers, financial institutions, MENR, various funds, development agencies*

Objective B5: Energy efficient street lighting systems
Action B5.1: Energy efficient street lighting systems
Action B5.2: PV integration into street lighting system

Action B5.1	Energy efficient street lighting systems
Current situation/ Objective	There are a total of 6,907 lighting subscribers in Bursa, as of the end of 2014. With no clear information about the number of fixtures and lamps, it accounts for 0,3% of the city's total electricity consumption. It is planned that the municipal area (parks and gardens) and street lighting will be replaced by LED lighting. LED lighting applications have begun to be seen at different points of the city. It is known that LED illuminations can last much longer than other lighting systems. The targets below are aimed for by replacing lighting with energy efficient ones; µ Reducing energy losses and inefficiency, µ Reducing energy, repair and maintenance costs, µ Energy & natural resource conservation and, µ Waste reduction.
Activities/Steps	As an important part of visibility and awareness-raising activities, it is important to announce the change with energy-efficient systems. It is predicted that until 2030 all the lighting in the city will be replaced by LED lighting. All street lighting will be replaced with LED lighting, saving 80%.
Timing	2017 - 2030
Cost	It is known that there are 6,907 lighting subscribers are available, but the cost of lighting is not known because the number of light poles are not exactly known.
Savings amount	In the event, all the lighting systems in the city are replaced by LED lighting, an emission reduction of 141,356 MWh energy by 70,254 tCO2e is targeted.
Investor	BMM, Other public institutions, district municipalities
Stakeholders	MENR, financial institutions, manufacturer
Risks	Lack of financial resources of the municipality, lack of employee resources to carry out the feasibility studies

Action B5.2	PV integration into street lighting system
Current situation Objective	With the integration of photovoltaic power systems to street lighting, consumption is already reduced by 80%, however, it is possible to reduce to 0 (zero). Solar energy integration can be achieved in 20% of the street lighting that has converted to the LED lighting system.
Activities / Steps	Reduction of energy consumption by PV application in 20% of all poles replaced with LED lighting system
Timing	2017 - 2030
Cost	Since the number of poles is unknown, it cannot be calculated.
Savings amount	Energy savings of 9.047 MWh and emission reduction of 4.496 tCO2e are targeted.
Investors	Metropolitan Municipality, district municipalities
Stakeholders	Finance institutions, funds, lighting manufacturers
Contribution of BMM	Investor and a guide
Risks	Element of cost

Other Reduction Measures Discussed at the Workshop

The mitigation measures proposed by the relevant working group at the workshop dated 24 May 2017 but were not digitized are listed below.

- The municipality should develop incentive mechanisms for energy-saver building owners
- Reducing the pressure on the Nilüfer district by creating new centers of attraction
- New settlement areas are not to be selected from agriculture, forests and green areas, and increase of green areas
- Increasing inter-institutional collaborations

3.2.2.2 Transportation

Transportation is regarded as one of the major components in quality of life. The European Union policies and programs address, in particular, the link between the quality of life and transportation in terms of sustainability and social cohesion.

The sustainability of natural resources and energy resources and the prevention of environmental pollution are the main determinants in the development of transportation policies. On the other hand, it is stated that the efficiency of transportation in daily life is important in terms of raising the quality of life and happiness of the individuals.

In the BIDEP project completed in 2015, the transportation sector in the city has been examined and explained in detail on the basis of the outputs of the Environmental Plan.

According to the report prepared in 2015, an important difference is observed in automobile use. Automobile ownership in Bursa has increased very rapidly in recent years. While the number of automobiles was around 293 thousand in 2011, this number increased to 436 thousand in 2016, indicating an increase of nearly 50%. A car generates 125 times more air pollution per passenger per kilometer than a bus and when considering the energy consumption per passenger/km, it consumes five times more energy compared to subways and buses.

In the BIDEP 2015 inferences, it has been determined that transport emissions, which have an important place in Bursa's greenhouse gas emission inventory, can be reduced by the implementation of a long-term Urban Transportation Strategy rather than eliminating existing acute problems.

The "**Bursa Transportation Master Plan**" completed by the Metropolitan Municipality in 2012 is a transportation strategy aimed at planning this long-term urban development.

The Transportation Master Plan medium-term proposals, as it appears in the BIDEP 2015, is as follows;

- The public transport network needs to be completely restructured with a hierarchical configuration. This is necessary for permanent consolidation of public transport. At the same time, a number of conditions must be met in order to put this fundamental restructuring into practice. In this context, improvement and development of the light metro system are necessary in order to have 2,5 minutes between stops at the central route section, and sufficient capacity for light metro and tram should be ensured.
- During the expansion of the settlement areas, a suitable public transportation system should be established. For this, the target concept of 2030, which is also planned for public transport, should be fully implemented by 2020.
- With the expansion of settlement areas, it is necessary to extend the railed system up to these zones in order to ensure the public transport connection to the resident population.

Expansion of bus and minibus networks in new settlement areas should also be implemented before residency begins. When the settlement starts here, it can be implemented with a low number of voyages or smaller vehicles, at first. Then the services should be improved depending on the demand. Likewise, bike-and-ride and park-and-ride (in which drivers leave their cars/bicycles at public transportation spots and continue traveling with public transportation) capacities should be extended.

The Transport Master Plan long-term proposals are also provided below.

Regarding the development of demand in the whole network, continuous monitoring is required. For this purpose, the statistics of electronic tickets can also be evaluated. In order to meet passenger demand and obtain a high economy, it is necessary to make regular arrangements in the travel services. These adjustments should be implemented annually, but at most on a regular basis for the entire journey service at most every six months. In the case of a very good line load, first the use of larger vehicles, then the frequency of stops of that line must be checked. For example, if increasing the number of stops is not possible via light metro or tram, then the burden of the route should be alleviated by adding new lines. In general, efforts should be made to configure different services in a similar way across the entire line network. When the load is weak and the demand is low, the lowest public transport level should always be the case. Particular attention should be paid to appropriate transfer facilities.

BUSECAP has updated the mitigation measures in this sector in line with the Transportation Master Plan.

3.2.2.2.1 Mitigation Measures for Transportation

Objective *U1:* With the widespread use of public transportation, it is aimed to reduce the number of motor vehicles used in traffic

Target: 7.5% mitigation in transport emissions

***Stakeholders**: BMM, Burulaş, Traffic division, Ministry of Transport, Maritime Affairs and Communications, financial institutions*

Objective U1: Popularizing public transportation
Action U1.1: Increasing the rate of public transportation usage
Action U1.2: Providing connection to Bursa with Highway and High-speed train network

Action U1.1	Increasing the rate of public transportation usage
Current situation Objective	Although there is an increase in the usage of the rail system, the use of private vehicles is increasing day by day in Bursa due to the length of waiting periods at stations, lack of integrated of some public transportation with other public transportation and the fact that it is relatively expensive. Service vehicles used in some public institutions until recently have been removed to encourage public transport, but unfortunately, this seems to have increased the use of private vehicles (the number of vehicles in institutions' car parks is increasing day by day). Public transport usage ratios should be increased with various applications. Although it is planned in the 2030 Transportation Master Plan to increase the share of public transportation from 25.1% to 26.7%, it is foreseen it can be increased to 30% with the measures to be taken. This will reduce the use of private cars. The withdrawal of a vehicle from traffic causes an emission reduction of about 2 tonnes CO2e annually.
Activities/Steps	• Reduced passenger waiting times at stations • Line Optimization of road transport vehicles • An increase of Bursaray's voyage frequency • Development of rail system network • Increasing the supply lines to the rail system. Making the public transportation more economical by providing integrated ticketing system optimization • Improvement and infrastructure of public transport stations 7% energy saving is targeted with such measures.
Timing	2016-2030
Cost	Additional wagon purchases must be made to shorten passenger waiting times. The cost of other actions is relatively lower.
Savings amount	1.157.260 MWh energy, 305.897 tCO2e emission reduction is targeted
Investor	BURULAŞ
Stakeholders	BMM, Various funds, Provincial Bank, Manufacturers of public transport vehicles, Bursa Regional Traffic Directorate, Ministry of Transport, Maritime Affairs and Communications
Contribution of BMM	BMM may be in cooperation with its subsidiary, BURULAŞ. Can optimize various roads, intersections, signaling implementations
Risks	The passenger behavior patterns cannot be changed, the municipality has to create funds for the related investments

Action U1.2	Providing connection to Bursa with Highway and High-speed train network
Current situation Objective	Although Bursa is close to big cities like Istanbul and Ankara and it is an important industrial city, it does not have a connection to the train network. It is expected that the 75-kilometer section between Bursa and Yenişehir of 105 km of the project to be connected to Ankara-Istanbul line from Bilecik will be completed by the end of 2015 with a budget of 393 million TL. The implementation projects of the 30-kilometer Yenişehir-Vezirhan-Bilecik section were completed and the tender was realized at the beginning of 2012. Bursa 's envisaged transport routes and the connection to major cities will provide many benefits. From the perspective of BUSECAP, these benefits are summarized as follows in terms of reducing the energy intensity in transportation and also reducing the emissions from transportation: 1. As a result of the modern and fast implementation of intercity railway option, it is predictable that a significant part of these trips will be realized by high-speed train rail lines. This will reduce the number of buses at the Bursa bus terminal. 2. Railway transportation provides cost and speed advantages for freight transportation. An important part of Bursa-derived agricultural production will benefit from this option. 3. From the tourism point of view, it can be said that this option will also alleviate an important burden in this sector as well.
Activities/Steps	• Improvement of rail system network • Increase of feed lines to the rail system
Timing	2020-2030 (gradually)
Cost	The high-speed train connection will save 10% of 40% of transportation.
Savings amount	487.267 MWh energy saving and 178.833 tCO2e emission reduction are targeted.
Investor	Ministry of Transport investment
Stakeholders	BMM, international funding agencies, Provincial Bank, wagon producers, Ministry of Transport, rail and road construction contractors
Contribution of BMM	Public transport must be directed to the high speed train connection points.
Risks	The need for financial resources, the difficulty of changing passenger habits

Objective *U2:* Encouragement of bicycle use and pedestrian traffic in the city

Target: Increase of bicycle use and reduction of motor vehicle usage such as private cars, taxi, aimed to increase the current rate of cycling from 0.5% to 2.5% and to increase the pedestrian traffic from 42% to 47%.

Stakeholders: *BMM, Highways, public, large building administrations, universities, schools*

Objective U2: Increasing pedestrian traffic and bicycle use, integration into public transport
Action U2.1 To Increase bicycle use from <0.5% to 2.5%
Action U2.2 To increase pedestrian traffic from 42% to 47%

Action U2.1	To Increase bicycle use from <0.5% to 2.5%
Current situation Objective	Increasing the use of bicycles is mainly an infrastructure issue. As demonstrated by the European experience, the separation of bicycle routes, which are cost-efficient, and ensuring safety are a matter of planning in principle. Bicycle transport percentage in Bursa is very low today compared to other transportation types. Only 0.5% of all journeys are carried out by bicycle. For this reason, about 5% of the dwellings have one or more bike ownership. In addition, due to the urban layout and usage reason (residence, work, school, shopping, leisure time, etc.), it is necessary to create suitable areas for bicycle transportation in all parts of the topographically flat areas. Some streets (Sanayi Str, Fatih Sultan Mehmet Blv etc.) have bicycle paths. However, these roads are used as car parks in some places and are not suitable for use due to structural and design related defects. - Central urban areas, - Dense settlement areas, - Important stations (especially rail system stations).
Activities / Steps	In the Transportation Master Plan, the following measures have been put in place to increase the use of bicycles: **Short and medium term measures;** - Improvement Railway System station access, - In the city, the construction of a bicycle transport network between Uludağ University and Görükle, **Long-term measures:** - Completion of the bicycle transportation study with a bicycle lending system, - Construction of the bicycle transportation network in the new settlement areas in the outer regions, - Completion of road signs It is aimed to reduce energy consumption by 2% in all city transportation.
Timing	2017-2030
Cost	Bicycle lane km costs
Savings amount	456.813 MWh energy reduction and 120.749 tCO2e emission reduction are targeted.
Investor	Bursa Metropolitan Municipality, District Municipalities
Stakeholders	Various funds, Provincial Bank, the public
Contribution of BMM	Investor, encourager
Risks	The need for financial resources, the difficulty of changing passenger habits

Action U2.2	To increase pedestrian traffic from 42% to 47%
Current situation Objective	The share of pedestrian traffic in Bursa Metropolitan Municipality is 42,2% and this is a significant value. There is an especially high number of pedestrian traffic in the city center, at the district centers where shopping is intensively carried out, where there are volume intensive individual directions (eg schools, sports fields) and where there are significant public transport links. Measures that can be taken to increase pedestrian traffic in the Transportation Master Plan are as below. **Short term measures** ▪ Improving the means to cross over where high crossing needs are observed ▪ Unrestricted access to public transport stations **Long-term measures** ▪ Expansion of pedestrian areas in urban and district centers ▪ Completion of guiding and traffic signboard applications
Activities / Steps	▪ Expansion of pedestrian pathways ▪ Creation of traffic enclosed areas ▪ Healthy living trainings
Timing	2018 - 2030
Cost	Approximate cost is estimated to be 2.4 million TL
Savings amount	With the increase of pedestrian traffic from 42% to 47%, 456,813 MWh of energy and 120,749 tons of CO2e emission reduction are targeted with 5% energy saving.
Investor	Bursa Metropolitan Municipality, District Municipalities
Stakeholders	Provincial Directorate of Health, Various Funds, Provincial Bank, the public
Contribution of BMM	Local government is responsible for converting urban roads to be pedestrian-friendly, to pedestrianize certain routes closed to make them safe and attractive for pedestrians and cyclists
Risks	Changing urban citizen habits

Objective *U3:* Alternative technology and fuel usage of the vehicles in the city

Target: To save fuel and energy by using energy efficient technologies

***Stakeholders**: BMM, Ministry of Transport, Maritime Affairs and Communications, BURULAŞ, the public*

Objective U3: Alternative technology / fuel usage and Intelligent Traffic Management
Action U3.1 Replacement of public transport with energy efficient vehicles (CNG, electricity)
Action U3.2 Encouragement of the use of electric vehicles, dissemination of incentive applications (establishment of solar energy charging stations)

Action U3.1	Replacing public transport with energy efficient vehicles
Current situation Objective	It is estimated that the share of public transport in urban energy consumption is over 1%. The municipal buses have started to be renovated and the average age of the vehicles is around 7-8 years. Measures foreseen in the Transportation Master Plan are as follows. Precautions required: Modern and high-capacity bus operation, Although not in the Transportation Master Plan, it is important to note that the use of alternative fuels should also be taken into account, considering that BUSECAP will be a positive contributor to the following steps.
Activities / Steps	BURULAŞ has its own 325 buses (as of 2014). The replacement of older vehicles with new, low-fuel vehicles is an important step to take. Replacement of some of the vehicles with CNG vehicles during the renewal process Progressively replacing vehicles with electrical and biofuel consuming vehicles
Timing	2018 - 2030
Cost	One CNG filling station is 200-250 thousand and the conversion of the vehicles is 2,500/vehicle. With the widespread use of technology, prices are expected to decline further in a few years. The cost of the electric charging station is about 40,000 TL (negotiations with manufacturers).
Savings amount	80% energy saving is aimed by replacing all public transportation vehicles. Energy savings of 245.915 MWh and 66.745 tCO2e emission reduction are targeted.
Investor	BURULAŞ, Private Public Bus Owners
Stakeholders	Funding sources, Provincial Bank, the public
Contribution of BMM	Investor institution
Risks	High initial investment costs

Action U3.2	Encouragement of the use of electric vehicles, dissemination of incentive applications (establishment of solar energy charging stations)
Current situation/ Objective	Since electricity production in our country is still provided by fossil fuels and inefficient facilities, care should be provided to encourage the use of electric vehicles while promoting solar power. An enormous effort to develop electric vehicle technologies, and especially storage systems are observed. Since this issue is closely related to national policies, some applications have been included in BUSECAP to serve as a demonstration element.
Activities / Steps	• 80% of the municipal vehicle fleet is to replaced by electric/hybrid vehicles by 2030. Review of renting electric vehicles as an option as well as purchasing • Encouraging vehicle owners to use electric vehicles
Timing	2018-2030
Cost	Electric vehicle fast-charging station costs about 40.000 TL and 50 kWp with photovoltaic power panel requires an investment of 175.500 TL (discussions with private companies).
Savings amount	By replacing 80% of the municipal vehicle fleet with electric and hybrid vehicles, 22.451 MWh of energy and 6.090 tCO2e will be mitigated.
Investor	BMM, Municipality subsidiaries
Stakeholders	Various funds, Provincial Bank, vehicle manufacturers, car maintenance companies
Contribution of BMM	Infrastructure investments, privileged road and park applications
Risks	Example applications are still very limited, costs

Objective U4: Reduce traffic density and energy consumption with low-investment traffic optimization implementations

Target: Reduce energy consumption due to traffic intensity

***Stakeholders**: BMM, BURULAŞ, the public*

Objective U4: Alternative technology/ fuel usage and Smart Traffic Management
Action U4.1 Low-cost traffic optimization

Action U4.1	Low-cost traffic optimization
Current situation/ Objective	What the municipalities have already implemented, public transit routes and lines that are revised according to the density and changes in traffic, traffic flow control, speed and signalization optimizations help to avoid traffic congestion and save energy. Surveys show that by such measures, up to 20% of carbon emissions is avoided.
Faaliyetler /Adımlar	Establishment of a traffic management center in the municipality (work on this subject is still continuing) Development of passenger/driver information system Development of a signaling system.
Timing	2016 - 2030 (Signaling adjustments should be carried out regularly, depending on the new roads and traffic volume changes.)
Cost	An assessment can be made by examining the plans and the studies that the municipality has already conducted.
Savings amount	These measures are expected to result in a 10% reduction in emissions from total transportation. 873.870 MWh of energy and 289.797 tCO2e emission reduction is targeted.
Investor	Metropolitan Municipality Transportation Department, Security General Directorate, Traffic Directorate
Stakeholders	The public
Contribution of BMM	Implementing institute
Risks	Financial and human resource needs

Objective U5: Reduce emissions caused by logistics and transportation fleets

Target: Reduce the energy demand from the logistics and transportation sectors in the city where the industry is concentrated

***Stakeholders**: All industry and logistics organizations, BMM, Bursa Chamber of Commerce and Industry (BCCI)*

Objective U5: Reduce emissions caused by logistics and transportation fleets
Action U5.1: Reduce emissions caused by logistics and transportation fleets

Action U5.1	Reduce emissions caused by logistics and transportation fleets
Current situation/ Objective	Bursa is an important industrial city with developed automotive, textile, food industries. Turkey's proximity to the largest markets and export causes an increase in value-added, however, also has negative effects on city's traffic. Transportation emissions from logistics are estimated to account for 48% of all urban transport emissions. (This is achieved by estimating the annual fuel consumption of trucks and light trucks in the city)
Activities / Steps	The establishment of the Bursa Logistics Center is among the strategic plans of the BCCI. It is expected that the center will reduce the local logistics needs of the city. Urban distributions have begun to be made with e-car fleets under the heading "last mile delivery" in the EU. Turkey is also expected to have a similar development.
Timing	2018 - 2030
Cost	-
Savings amount	It is aimed to reduce the emissions from logistics by 15%. 691.298 MWh, 187.628 tCO2e emission reduction is targeted.
Investor	Industry and trade sectors, logistic firms
Stakeholders	BMM, industry and trade sectors
Contribution of BMM	As an organizer, authority to indicate an area and enforcer
Risks	Costs do not decrease

Action U6.1 Training and Awareness

Action U6.1	Training and Awareness
Current situation/ Objective	Providing economical driving techniques to taxis, especially public transport vehicle drivers, and all commercial and private vehicle owners will enable the vehicle users to reduce fuel consumption in urban traffic. Various studies show that economic driving training leads to reductions of up to 10% in vehicle fuel consumption.
Activities / Steps	Such training can be disseminated through municipal training centers. Support can be obtained from the district municipalities, industrial organizations and especially logistic companies.
Timing	2018 - 2030
Cost	In Turkey, economical driving techniques training costs about 200 TL/person.
Savings amount	It is aimed to reduce the emissions from logistics by 5%. 230.433 MWh of energy and 62.543 tCO2e emission reduction is targeted.
Investor	Industry establishments, logistic firms, private public transportation drivers, BMM, Burulaş, district municipalities
Stakeholders	Various agreements and collaborations can be made with educational institutions.
Contribution of BMM	Investor and guide
Risks	Social acceptance, lack of time for training

Other Reductions Measures Discussed at the Workshop

- Improvement of urban parking system and integration with public transportation system
- Increase of railway usage rate in logistics transportation
- Development of passenger and driver information system

3.2.2.3 Renewable Energy

While increasing the efficiency of energy use and popularizing the use of renewable energy resources in the TR41 region is an important requirement but renewable energy potential is not being utilized effectively. It is seen that the hydraulic capacity is the most used renewable energy in spite of the existence of bio-fuel energy potential as well as solar and wind energy in Bursa and Bilecik areas. Significant declines in precipitation are among the impacts of climate change that are expected from 2030 onwards.

It is also important to improve energy efficiency and to develop energy production systems that assess the potential of renewable energy sources in the region.

In BIDEP 2015, Bursa wind, solar, geothermal and biogas energy potentials have been examined in detail (see BIDEP 2015). In this respect, the data on Bursa's renewable energy potentials are not included in BUSECAP. The new report, prepared in accordance with the CoM, is updated with the renewable energy installation potentials discussed in BIDEP 2015, as follows.

3.2.2.3.1 Mitigation via Renewable Energy Investments

Objective RE1: Reducing the energy demand from fossil fuels by popularizing renewable energy applications in Bursa

Target: Renewable energy applications and clean energy

***Stakeholders**: Ministry of Energy and Natural Resources, General Directorate of Renewable Energy, those who carry out agricultural irrigation, warehouses, industrial buildings with large roofs, Regional Directorate of Forestry, renewable energy investors, financial institutions, building/home owners, commercial enterprises*

Objective RE1: Renewable energy applications - Solar Energy
Action RE1.1: Renewable energy applications in the municipality and affiliated buildings
Action RE1.2: Establishment of solar energy systems in agricultural irrigation
Action RE1.3: PV implementation on the building roofs

Action RE1.1	Renewable energy applications in the municipality and affiliated buildings
Current situation/ Objective	Studies are being carried out on the use of renewable energy sources in Bursa. Upon Bursa Metropolitan Municipality's request, Turkish Northel company specially manufactured Turkey's first domestic wind turbines and erected them at Bursa Mudanya wind energy power plant. Apart from the wind power plant, various activities are carried out such as solar energy, hydroelectric power, methane gas energy, energy sludge in the sludge incineration plant. 2.5 MWh of electricity is produced from the domestic wastewater incineration plant. 400 tons/day of sludge is being disposed of at the facility. 9,000 MWh of electricity is generated from methane gas generated from Yenikent Landfill Site, where 4000 tons of waste is disposed daily from the methane gas power plant. Electricity production is realized by using solar panels installed in wastewater treatment plants, suitable areas, water reservoirs and sports facilities. In addition, hydroelectric power plants are installed on water depot entrances and water lines. Renewable energy integration in existing buildings is more difficult, but it is envisaged that the implementation of unlicensed photovoltaic power systems will reduce energy consumption and reduce the electricity bill of the municipality. Renewable energy applications of public institutions are already supported by Development Agencies. Considered that different types of financing that will be introduced over time, it is possible to set up a license-free PV systems on BMM's warehouse, workshop, facility, parking lot etc. The current legislation allows for the installation of unlicensed applications with a capacity of 1 MW, which will soon be raised to 2.5 MW It is envisaged that by 2030, BMM will be able to establish a total of 2.5 MW PV systems with both roof systems and appropriate land applications. It is foreseen that a total of 25 MW PV system will be installed together with other public institutions. Electricity consumption by the municipality and its affiliates was 82.8 million kWh in 2014. It equals to 0.23% of the city's energy consumption. Although the measures to be implemented are not an important influence in reducing the energy consumption of the city, it can be an example to the citizens and be a guide with the experience gained.
Activities / Steps	It is envisaged that by 2030, BMM, will be able to establish a total of 2.5 MW PV systems, both with roof systems and with appropriate land implementations. It is envisaged that a total of 25 MW PV system will be installed together with other public institutions. Preliminary studies and feasibility studies should be carried out in the areas where the municipality and/or its affiliates can establish PV installations.
Timing	2017 - 2030
Cost	Approximately 10-15 million Euros
Savings amount	25,000 MWh/year renewable energy production, 12,425 tCO2e reduction
Investor	Bursa Metropolitan Municipality, other public institutions
Stakeholder	Local and international development agencies, financial institutions, PV manufacturers, implementation companies
Contribution of BMM	BMM is in a direct investor position. Priority should be given to feasibility studies for the projects they will develop.
Risks	High initial investment cost

Action RE1.2 Establishment of solar energy systems in agricultural irrigation	
Current situation/ Objective	The energy used in agricultural irrigation is 66.4 million kWh and constitutes 0.2% of the total urban energy consumption. The agricultural sector, which is an important source of livelihood in Bursa, struggles with energy costs as well as many difficulties.
Activities / Steps	Raising farmer, villager awareness Providing information about public incentives Investigation of financing possibilities
Timing	2017 - 2030
Cost	Approximately 3-4 million Euros
Savings amount	If 10% of total consumption is provided by solar energy, 6500 MWh per year and 3.231 tCO2e emission reduction are targeted.
Investor	Farmers, cooperatives
Stakeholders	Public incentives, financial institutions, PV manufacturers, implementation companies
Contribution of BMM	Role of a guide
Risks	None

Action RE1.3 PV implementation on the building roofs	
Current situation/ Objective	Photovoltaic and heat pump applications are leading renewable energy applications, especially in terms of Bursa. After a short period of stagnation, FV technology is expanding its market at a rapid pace, pushing the prices down. As already mentioned, it is envisaged that it will take time to adapt to the distributed photovoltaic practices of the newly privatized distribution companies, while completing the major deficiencies in terms of legislation. In contrast, it is estimated that as of 2017, PV application in residential areas will have a reasonable redemption value due to the reduction in technology prices and rising of electricity prices in Turkey In the Bursa urban GHG inventory, it is stated that 58% of the houses are 1-2 story buildings. This indicates that the applicability of PV on 133,000 units is relatively easier compared to others.
Activities / Steps	A total of 400 MW installed power will be achieved if 133 kV PV systems are installed on 133,000 buildings.
Timing	2019-2030
Cost	The cost of photovoltaic systems is declining rapidly, resulting in price reductions of 8-12% due to doubling the market every 2.5 years. With the estimation that the average installed system prices until 2020 will fall below 0.5 Euro per Watt-peak, this figure is taken as an average. The total investment cost will be approximately 15 million Euros. There is a great uncertainty in the photovoltaic system installation market, but there is also the possibility that these values are far above those calculated here, due to dramatic price declines.
Savings amount	600,000 MWh/year renewable energy production and 298,200 tCO2e emission reduction are targeted.
Investor	Home/building owners
Stakeholders	Various international funding sources, institutions providing green financing opportunities, PV system producers and implementing companies
Contribution of BMM	The municipality can act as a guide to the citizens with regard to the subject, as well as acting as a guide in terms of the network connection and communicating with the producers.
Risks	Regulatory details

Objective RE2: Reducing the energy demand from fossil fuels by popularising renewable energy implementations in Bursa

Target: Increasing use of clean energy with renewable energy implementations

***Stakeholders**: Ministry of Energy and Natural Resources, General Directorate of Renewable Energy, Private sector, Local government*

Objective RE2: Energy production from animal and agricultural wastes
Action RE2.1: Energy production from animal and agricultural wastes

Action RE2.1 Energy production from animal and agricultural wastes	
Current situation/ Objective	Agriculture and food sectors, as they are the most important economic sectors of Bursa, also contain significant renewable energy resource potentials in terms of animal and plant wastes. Information obtained from the studies conducted for Bursa Metropolitan Municipality bu consulting firms.
Activities / Steps	Necessary feasibility studies are required for energy production from 40 million m3 natural gas equivalent of animal and agricultural wastes
Timing	2017-2030
Cost	-
Savings amount	383,200 MWh of energy production and 77,598 tCO2e emission reduction are targeted.
Investor	BMM or private investors
Stakeholders	Farmers
Contribution of BMM	Could be an investor and a guide, encourager to the private sector
Risks	High initial investment costs

Objective RE3: Reduction of greenhouse gas resulting from wastewater sludge in Bursa and energy recovery

Target: Reduction of greenhouse gas emissions and renewable energy production

***Stakeholders**: MENR, BMM, treatment plant manufacturers*

Objective RE3.1: Energy recovery from wastewater sludge
Action RE3.1: Energy recovery from wastewater sludge

Action RE3.1 Energy recovery from wastewater sludge	
Current situation/ Objective	Investments in incineration plants for wastewater treatment sludges have begun and, in the present case, disposal at solid waste areas is also being carried out. 2.5 MWh electricity is produced in the fluidized bed combustion plant made by Bursa Water and Sewerage Administration (BUSKİ). The facility is disposing of 400 tons of sludge per day.
Activities / Steps	Biogas should be produced in the decomposer to be installed in the wastewater treatment plant, and renewable energy should with the disposal of waste sludge.
Timing	2017 - 2030
Cost	-
Savings amount	22,205 MWh of energy production and 3.195 tCO2e emission reduction are targeted.
Investor	BUSKI
Stakeholders	BUSKI, BMM
Contribution of BMM	To provide various support to BUSKI
Risks	Cost of initial investment

Other Migitation Measures Discussed at the Workshop

The mitigation measures proposed by the relevant study group at the workshop held on 24 May 2017, which cannot be digitized, are given below.

- Promoting the use of biofuels by reducing fossil fuel-fired power plants
- Alg based energy production
- Energy recovery by pyrolysis method
- Electricity generation through pressure sensors

3.2.2.4 Solid Waste and Wastewater Management

According to the Bursa Integrated Solid Waste Management Plan prepared by Bursa Metropolitan Municipality, while 98% of the household waste generated in the province of Bursa in 2014 is disposed of at Yenikent and İnegöl Solid Waste Regular Storage areas the remaining 2% is disposed of at irregular storage areas. According to the address based population registration system (ABPRS), the population of Bursa in 2014 was 2,787,539. In the survey conducted with the districts, waste services were provided to 2,730,838 people in 2014. With this value, waste collection efficiency in Bursa province was determined as 98%.

Waste from Osmangazi, Yıldırım, Nilüfer, Mudanya, Gürsu, Kestel, Gemlik, Karacabey, Kemalpaşa and Orhangazi districts arrive in Yenikent Solid Waste Regular Storage and waste from Yenişehir, İznik and İnegöl districts arrive in İnegöl Regular Storage. Orhaneli, Büyükorhan, Harmancık, Keles districts dispose of their waste in an uncontrolled manner. According to the data from 2017, 3600 tons/day of waste is sent to Yenikent Solid Waste Regular Storage Site, 370 tons/day to İnegöl Solid Waste Regular Storage Site and 350 tons/day to wild storage sites. In order to terminate the irregular storage activity carried out by the 4 districts, especially the mountain districts, transfer stations are being built to reduce the transportation distances. The construction of four transfer stations in the east, west, north and south are foreseen, and currently, the Western transfer station has begun operation.

According to Law No 5216 Law of Metropolitan Municipalities, it is within the District and first-tier municipalities responsibility to collect solid waste at the origin and transport it to transfer stations and it is within the Bursa Metropolitan Municipalities responsibility to store and dispose of solid waste. Changes made and to be made in the legislation within the context of EU harmonization require separate accumulation and duplication in the source in order to disseminate and streamline the recovery and reduce the entry of organic matter into landfills. In this case, the importance of collecting is increasing ever more.

According to the Regulation on the Regular Storage of Wastes, it is envisaged that the deposited biodegradable waste will be gradually reduced, starting from 75% in 2015, through 50% in 2018, until reaching the level of 35% by 2025, as compared to the mass of waste generated in 2005.

Yenikent Solid Waste Regular Storage Area: The regular storage area where the districts in the Central Region send their wastes is located within Osmangazi district boundaries. The facility began accepting waste for the Osmangazi District in 1995 for the first time. The plant is planned to be used until 2025.

İnegöl Solid Waste Regular Storage Site: Inegöl, İznik and Yenişehir municipalities transport their wastes to the regular storage area in İnegöl. İnegöl regular storage area started accepting waste acceptance in 2011 and it is planned to be used until 2037.

Irregular Storage Areas: The districts in the southern part of Bursa (Orhaneli, Keles, Harmancık and Büyükorhan) dispose of their wastes by irregular storage methods. The rehabilitation of 21 out of the 29 irregular landfill sites identified in 2014 were completed as of October 2017.

Landfill Gas Management: Yenikent Solid Waste Landfill energy production facility (Build-Operate model), was tendered to ITC Bursa Enerji Üretim Sanayi Ticaret Inc. in 2010 for 29 years. The facility started operation in 2012. Starting from 2012, the facility started to produce 9.8 MWh of electricity with approximately 5.400 m3 of landfill gas. Renewable Energy Production License was obtained from EMRA for the electricity generated. A burning chimney and flue gas cleaning system are used at the facility to burn the gas in the lines in case of an interruption in energy production.

Figure 3-6: Yenikent Solid Waste Landfill Site and Energy Production Facility

Objective AA1: To ensure greenhouse gas reduction in solid waste storage areas

Target: Reduce emissions from solid waste landfills which make up 1% of CO2e emissions

Stakeholders: *BMM, District Municipalities, financial institutions, companies generating energy from landfill gasses*

Objective AA1: To reduce greenhouse gas emissions in solid waste storage areas

Action AA1.1: Conversion of all wild landfills into regular landfills and energy production from feasible sites

Action AA1.1	**Conversion of all wild landfills into regular landfills and energy production from feasible sites**
Current situation/ Objective	With the project currently being carried out by the municipality, all the wild landfills will be closed and waste will be sent to the Yenikent and İnegöl regular storage areas. Wastes remaining in the existing areas should be rehabilitated and converted into landfills, the methane gas generated should be disposed of by burning or used for energy recovery purposes.
Activities / Steps	A feasibility study needs to be carried out
Timing	2027-2030
Cost	-
Savings amount	99,141 tCO2e emission reduction is targeted
Investor	BMM, LFG plant investors
Stakeholders	District municipalities, companies producing energy
Risks	High initial investment cost

Objective AA2: To reduce the amount of waste going to landfills

Target: To reduce GHG emissions by separating solid waste at its origin

Stakeholders: *BMM, District Municipalities, financial institutions, companies producing energy from landfills*

Objective AA2: Obtaining energy and raw materials from solid waste
Action AA2.1: Sorting of solid wastes at its source and recycling Action AA2. 2. Establishment of Bursa Integrated Solid Waste Recycling and Disposal Facility

Action AA2.1	Sorting of solid wastes at its source and recycling
Activities / Steps	Reducing the amount of waste going to landfills, increasing the recycling and disposal rates by separating the wastes at its source, especially household wastes, into organic, recyclable wastes (packaging wastes), It is aimed that the industrial waste quantities will be used as a production input of another industry and to encourage the industries for symbiosis production and to convert the existing OIZ's (Organized Industrial Zones) with symbiosis production capabilities.
Timing	2018-2030
Cost	-
Savings amount	Since the recycling processes differ based on materials to be recycled, the amount of energy saved and therefore the effect on the greenhouse inventory could not be calculated
Investors	BMM, LFG plant investors
Stakeholders	District municipalities, companies producing energy
Risks	High initial investment cost

Action AA2.2	Establishment of Bursa Integrated Solid Waste Recycling and Disposal Facility
Activities / Steps	Within the context of the Bursa Integrated Solid Waste Management Plan, studies regarding recovery and disposal of solid wastes at Kuruçeşme Integrated Solid Waste Recovery and Disposal Plant, which includes Mechanical Biological Treatment Facilities (MBT), Refuse Derived Fuel (RDF), landfill, leachate treatment units and associated units are continuing. Within this scope; the preliminary permission was obtained from the General Directorate of Forestry for the investment to be made at Nilüfer District, Kayapa Quarter, Kuruçeşme Locality between 29.12.2015-29.12.2017, a Preliminary Feasibility Report including technical information on the project area and the facilities envisaged by the investment plan has been prepared and approved by the Ministry of Environment and Urbanization on 25.10.2016. In addition, the preliminary project for investment has been prepared and the EIA process is currently in progress.
Timing	2018-2030
Cost	-
Savings amount	Greenhouse gas reduction was not calculated
Investor	BMM, LFG plant investors
Stakeholders	District municipalities, companies producing energy

Objective AA3: To reduce greenhouse gas emissions at wastewater treatment plants

Target: To reduce greenhouse gas emissions by improving the operating conditions and biogas and energy production from sludge

Stakeholders: *BMM, district municipalities*

Objective AA3: To reduce greenhouse gas emissions at wastewater treatment plants
Action AA3.1.Improving the operation conditions of all wasterwater treatment plants

Action AA3.1. Improving the operation conditions of all wasterwater treatment plants

It is expected that with biogas and energy production from wastewater sludge 49,304 tons of CO2e GHG will be mitigated by 2030 through improving the operating conditions of all existing municipal wastewater treatment plants.

Other Migitation Measures Discussed at the Workshop
The mitigation measures proposed by the relevant study group at the workshop held on 24 May 2017, which cannot be digitized, are given below.

- Promoting good waste and water management practices in the industry, ensuring the effectiveness of the legislation through inspections, raising waste and water management awareness
- Ensuring sustainability by creating flood and drought action plans, taking precautions to use rainwater as domestic water
- Reduction of water consumption
- Increase gray water usage and wastewater recycling
- Purification of wastewaters for green area watering purposes

3.2.2.5 Industry and Services

Turkey, besides its transitional economy as a result of being an OECD member, is a country with different dynamics with its young population, increasing production and technology infrastructure. Within the framework of these dynamics, there is a need for different resources for employment, competitive power, improvement of public services and similar areas. Industry in Turkey, largely due to the impact of having 20-25% share in GDP and growth rate, is an indispensable resource for sustainable development. The industrial sector, in the context of the contribution, development and competitiveness of the country, has a significant influence on resource consumption and greenhouse gas emissions and climate change.

The greenhouse gases that emerge as a result of the activities in the industrial sector can be examined under two titles: production-based and energy-based. The share of industry in Turkey's final energy consumption is approximately 37%. The level of greenhouse gas emissions from the industrial sector depends on the amount of CO2 emitted for electricity generation and the distribution of fuel types used in the industry. It has been observed that the increase of coal consumption in industry is over 6 times. In addition, the use of waste as fuel in the industry is very low. In addition, industry generates indirect emissions from the electricity sector. Therefore, it is stipulated that the increase of renewable and low carbon emission technologies in the electricity sector will have a high impact.

According to various national and international institutions, Turkey is defined as with high potential for energy efficiency. According to the International Energy Agency data, the energy density is 0.38 and 2 times the OECD average. Various studies are being carried out in the industrial sector to mitigate greenhouse gas emissions, which lead to increased energy efficiency and consequently climate change. The results of energy surveys and scans indicate that the industry has at least 20% of the energy saving potential.

Within the scope of BUSECAP study, industrial mitigation measures have not been quantified and included in the action plan since they are not within the municipality's domain and authority. However, it would not be possible not to address the possible measures for a city where the industry is very intense. Looking at Turkey's export structure, the prominent sectors appear to be the sectors of Bursa's economy. Textile- ready-to-wear, motor vehicles (automotive) and food sectors, either due to production values or employment values, are among the sectors that stand out in Bursa. Approximately 18% of the country's exports in the automotive and machinery sectors belong to Bursa.

The structure of the industrial sectors of Bursa has changed considerably over time (as textile share has decreased and the automotive sector has come to the fore) and it can be easily said that it will continue to change. As migration and investments continue to accumulate throughout the region, there will be pressure for spatial growth. In the region, which will maintain its importance within the country's economy, together with transport investments, the intra-regional input-output relations will also increase.

Increasing energy prices are reducing the return on investment of any improvements to industrial establishments with very high consumption. It also helps to reduce the risks of institutions to reduce consumption of fossil fuels, which are difficult to supply from time to time. The following studies can be planned for mitigation but we have not quantified the reduction results that can be obtained from industry because we have excluded the Industry from our greenhouse inventory.

Energy studies should be initiated in industrial establishments.

With a transition into ISO 50001 Energy Management System, which is also required for public support, detailed monitoring of energy consumption is one of the important steps that industrial organizations can take in order to control their energy consumption. 25% of energy saving is possible by encouraging the industry to apply clean production plans.

Other Migitation Measures Discussed at the Workshop

The mitigation measures proposed by the relevant study group at the workshop held on 24 May 2017, which cannot be digitized, are given below.

- Increasing legislative controls on the controlled burning of industrial wastes
- Popularizing centralized system applications in industry
- Beginning to implement the co-operative processes for energy consumption
- Leaning towards mitigated GHG in the industry's R&D works
- Arranging trainings to raise awareness of employees and their families on energy consumption and productivity
- Popularizing energy and waste minimization applications in industrial applications
- Development of incentive systems for emissions reduction (tax exemption, etc.)
- The creation of renewable and industrial energy efficiency projects by the Development Agency
- Initiating labeling practices related to greenhouse gas emission reduction on products

3.2.2.6 Agriculture, Animal and Forestry

The physical location of Bursa and its suitable climatic conditions provide for a rich appearance in terms of agricultural structure, quality, variety and quantity. Within agricultural activities, crop production with its volume value is in the lead, compared to animal production. Agricultural production is carried out rather by smaller businesses. There is a great increase in the use of machinery in the agricultural sector.

Within the scope of BUSECAP study, agricultural mitigation measures, like industry mitigation, have not been quantified and included in the action plan since they are not within the municipality's domain and authority. However, the agricultural sector, which has a very important place in the urban economy, should be addressed.

Agricultural land in Bursa is 477,094 hectares. Bursa has an increasing agricultural production, each year.

The main reasons for this are the utilization of new technologies, the enhancement of irrigation opportunities and the expansion of irrigated land, placing emphasis on fertilizers and disinfectants, and the use of scientific methods in agriculture.

The most important vegetative products produced in Bursa are wheat, barley, sugar beet, potatoes, onions, tobacco, tomatoes, peppers, grapes, olives, peaches, apples.

In addition, 600 tons of silk cocoon production per year is realized.

Nearly half of the total surface area is classified as forest land and most of the agricultural land is located in the eastern and western districts of Bursa.

With sustainable practices, the use of chemical fertilizers can be limited in order to achieve greenhouse gas mitigations in agriculture. During the workshop, the knowledge that 94.100 tons of chemical fertilizer was used in the province of Bursa in 2014 was learned from the officials of the Provincial Directorate of Agriculture. The chemical fertilizer releases 318,999 tons of CO2e to the atmosphere. This corresponds to 2.5% of urban inventory.

Other Migitation Measures Discussed at the Workshop
The mitigation measures proposed by the relevant study group at the workshop held on 24 May 2017, which cannot be digitized, are given below.

- Popularizing the use of natural fertilizers
- Educating the farmers about the subject, raising awareness
- Use of organic solid and liquid fertilizer in agricultural areas, which is released after biogas production from animal and agricultural wastes
- Use of organic fertilizer after agricultural disposal with other recycling technologies and composting of organic wastes in agricultural areas

Husbandry

Bursa, which hosts the milk processing plants (Sütaş, Eker, Nestle, Golf) that offer products to the national market, especially dairy farming has gained momentum and reached an important capacity over the years. Establishment of facilities with economical capacity and with EU standards has accompanied the growth of animals with cultural and cultural crossbreed. Culture and culture hybrid rate has reached 95% in total cattle existence.

Uncontrolled disposal or storage of organic waste from an agricultural or animal causes odor formation as well as the contamination of ground and surface waters

In Turkey, approximately 11 billion tons of animal excrement is formed per year. The evaluation of these wastes is very important in terms of the country's economy and environmental health.

Methane gas (CH_4) is released during natural decay process of the wastes stored in the open area, and the decaying water mixes with the soil by forming lakes. These waters mixed with soil pollute the land because they contain high amounts of Nitrogen, Nitrate, Phosphate. The polluted waters formed during in the decay process are mixed to the ground waters and reach the seas. They cause pollution of sea water and algae.

Elimination of animal wastes by model disposal techniques such as biogas production and composting was stipulated. This action is related to the reduction target of biogas production from planned wastes in Action YE2.1. A 50% reduction in emissions from animal wastes can be targeted.

Other Migitation Measures Discussed at the Workshop
The mitigation measures proposed by the relevant study group at the workshop held on 24 May 2017, which cannot be digitized, are given below.

- Efforts to improve the efficiency of arid land in forest areas and to increase carbon sinks should be continued.
- Works to prevent the damage of wild animals to agricultural areas and plants should be carried out.
- Agriculture and forest areas should not be damaged while wind power plants are being installed.
- The public should be educated and the public should be directed towards the protection of forest areas (fire).
- Wastes from forests and non-forest areas should be used for energy production (biomass, pellet, etc.)
- Special forest areas should be increased.
- Inefficient use of forests should be avoided due to the irregular use of underground waters.

The separation of the lands either by inheritance and/or sales has resulted in inefficient agricultural practices. In addition, idle capacity and yield loss arise from the agricultural equipment not being shared.

- Land consolidation activities should be increased,
- The preference and common use of less fuel-consuming vehicles,
- Use of new agricultural techniques (agriculture without soil processing etc.)
- Increase the use of renewable energy in agriculture (irrigation with solar energy, biogas use, etc.).
- To increase the common use of vehicles and human power and to implement efficient farming practices by establishing agricultural cooperatives or the activation of existing ones,
- Zoning plans should be made according to the agricultural areas, should not be used except for agricultural purposes
- Careful attention must be paid to the accuracy of the intended use of the soil board decisions.

With measures such as these, it was stipulated that greenhouse gas emissions from agriculture would be reduced.

3.2.2.7 Awareness Campaigns

Objective: To increase saving consciousness at energy consumption point, to encourage the purchase of efficient electric appliances consuming less energy, technical support when it reaches the investment point; economical driving methods to save fuel.

Target: 5% savings with 255.455 MWh 81,993 tons CO2e reduction on 50% of the houses,
5% energy savings with 148.360 MWh 55.663 tons CO2e reduction on 75% of the commercial buildings,

Stakeholders: *BMM, District municipalities, citizens, vehicle owners, transport companies, consumer associations*

Objective B1: Energy efficiency campaigns
Action B1.1: To create information centers at the municipality
Action B1.2: To organize activities related to energy saving throughout the city

Action B1.1	To create information centers at the municipality
Current situation/ Objective	To increase saving consciousness at consumption point, to encourage the purchase of efficient electric appliances consuming less energy, technical support when it reaches the investment point; economical driving methods to save fuel. Residential electricity consumption structure in our country, varies widely according to the family's livelihood and the device and from home to home and according to the Turkish White Goods Industrialists Association, 85% of the electricity used in households is consumed by electrical and electronic goods and the highest share in domestic electricity consumption is refrigerators by 32%. With the technologies developed in the last 10 years in our country, the products have improved their energy consumption by 60%. Today, the Turkish manufacturer is in a position to produce products that consume the least amount of energy in terms of technology, capacity, and knowledge. Our country's white goods producers are the second largest producers in Europe and are a driving force in the EU market for electrical household appliances. Harmonization with the EU's "Council Directive 92/75/EEC of 22 September 1992 on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances" has been ensured by our country. 20% of the energy consumed in homes in Turkey, although varies according to income group, is used for lighting. It is possible to save up to 80% by using efficient lamps. Compared to incandescent normal lamps fluorescence are 5-10 times efficient and the compact fluorescents are 4-5 times more efficient. When the incandescent normal lamp is compared in terms of a lamp light flow; a lamp with 100 watts can receive a value of 14 lm/watt, while a compact fluorescent lamp can receive a value of 70 lm/watt. Incandescent lamps are widely used in lighting in our country. This is bad lighting in terms of energy efficiency. Similarly, electricity consumption of lighting in offices and commercial buildings can be as high as 30-40%.
Activities / Steps	It is planned to establish information centers in Bursa to provide information on energy consumption, savings, new technologies, application firms etc. to the residents and employees of Bursa and to put into effect other centers which can distribute leaflets to the citizens in service buildings and/or at different visible places. Consumption habits have an influence on energy savings that is more than anticipated. Minor changes in the daily habits of consumers can be reflected in their energy consumption over expectations. For example, the standby status of electrical equipment accounts for 10% to 20% of total consumption. In other words, a device that remains on standby for 10 hours consumes as much energy as the 1-hour working state with the most optimistic prediction. While the scenario was being created, it was estimated that changing the habits of energy consumption will affect energy consumption and greenhouse gas emissions by as much as 5%. The experiences in different cities that already provide a similar service to large masses and citizens should benefit from and other issues such as energy saving lighting, energy efficient electronic devices, insulation, public transportation usage as well as renewable energy technologies should be added to the topics. In this regard, cooperation with the district municipalities can be arranged. The job descriptions of advisers who will work at information points need to prepared and trained. Establishing a structure which consultants will be affiliated to and the creation of an implementation plan is necessary for the coordinated execution of all activities. Advisers; ▪ should help those in need to find the best technology in terms of energy and environmental performance and adapt them to the properties of their premises or the buildings they will implement. ▪ get support from trade associations and unions working in this area and joint action should be taken if possible. ▪ should inform about appropriate financial incentives. ▪ when necessary, should assist with the legal procedures related to the installation of energy technologies. ▪ should assist in the selection of efficient heating and cooling systems for air quality and energy efficiency.
Timing	2017-2030
Cost	
Savings amount	Energy consumption reduction of 418.249 MWh and reduction of 126.791 tCO2e are foreseen
Investor	BMM
Stakeholders	District municipalities, citizens, various producer implementing companies, financial institutions
Contribution of BMM	As an investor and a guide
Risks	Citizen behavior patterns can not be changed

Action B1.1: To create information centers at the municipality

Action B1.2	To organize activities related to energy saving throughout the city
Current situation/ Objective	To increase the saving consciousness at energy consumption point, to encourage the purchase of efficient electric appliances consuming less energy
Activities / Steps	2nd week of January is "Energy Efficiency Week" throughout Turkey. Fairs that can be organized especially during this period should be aimed at raising energy-saving awareness with stands to be installed in various areas (shopping malls). Campaigns can be jointly organized by leading electrical appliance manufacturers, insulation companies, lighting equipment manufacturers to support awareness campaigns (discount campaigns, cheap credit campaigns). It is known that a significant part of the electricity consumed in the houses is caused by the use of appliances such as refrigerators, washing machines and dishwashers, air conditioners which fall into the category of white goods. By replacing electronic devices in active energy-consuming residences with high energy efficiency class (A, A +, A ++) devices, energy savings of between 40% and 70% is achieved.
Timing	2017-2030
Cost	
Savings amount	An energy reduction of 199.387 MWh and an emission reduction of 75.327 CO2e are foreseen.
Investor	BMM
Stakeholders	District municipalities, transport companies, consumer associations, leading manufacturers, vehicle owners
Contribution of BMM	As an investor, and a guide
Risks	

3.3 Evaluation of the Sustainable Energy Action Plan

The Bursa Sustainable Energy and Climate Adaptation Action Plan (BUSECAP) sets out a roadmap for mitigation of emissions from energy consumption in different sectors identified with the participation of urban stakeholders. The point of this origin of this plan is the city-scale greenhouse gas inventory, the bases of which are prepared by various institutions according to the future visions of the urban stakeholders and the future of the city, as well as the Metropolitan Municipality.

Bursa urban greenhouse gas emissions, ie the total carbon footprint of Bursa, is a total of 13,209,620 tons of CO2e as of 2014, the reference year. Covenant of Mayors recognizes the freedom of local The biggest proportion in the Bursa city scale emission inventory is 43% with emissions from fuel and electricity consumption in residences. It is followed by the transportation sector (total 36%) and commercial buildings (18%), respectively.governments to exclude sectors that cannot be intervened and/or are not in the jurisdiction.

Following this cutback, Bursa's urban greenhouse gas emissions are approximately 6,902,669 tonnes CO2e for the reference year 2014 (excluding industry, agriculture, animal husbandry). Of this, 218,561 tonnes are attributable to the municipal direct corporate activities (3,2%). 71% of the total carbon footprint emissions of Bursa consists of urban vehicle traffic, housing, commercial building within the Scope 1 category, 26% from electricity consumption within the Scope 2 category, and 3% from other emissions such as solid waste and wastewater.

The biggest proportion in the Bursa city scale emission inventory is 43% with emissions from fuel and electricity consumption in residences. It is followed by the transportation sector (total 36%) and commercial buildings (18%), respectively.

BUSECAP has set out Bursa's BAU (Business as Usual) scenario using predictions from different institutions on population, sectoral growth and calculated 2030 emissions as approximately 10.9 million tons of CO2e. Unlike the reference year, the largest component of 2030 emissions is transportation (44%). It is expected that the category of residential and non-residential buildings will be 36% and 16%, respectively.

Turkey's urban growth rate, is similar to developing countries rather than industrialized countries in terms of quality and quantity. Since it is not possible to make reference to absolute emission reductions at these growth rates, it would be appropriate to express emission reduction targets as per-person emissions. According to the BAU scenario, per capita emissions increase from 2.48 tCO2e to 3.24 (31% increase).

As shown in the BUSECAP, with the reduction measures put forward in every sector, Bursa can achieve its development by 2030 with 22% less greenhouse gas emissions, while per capita emissions can achieve a reduction of about 40% by 2030 compared to 2014. In this case, per capita emissions will be reduced by 40% to 1.56 tonnes of CO2/day, compared to 2014.

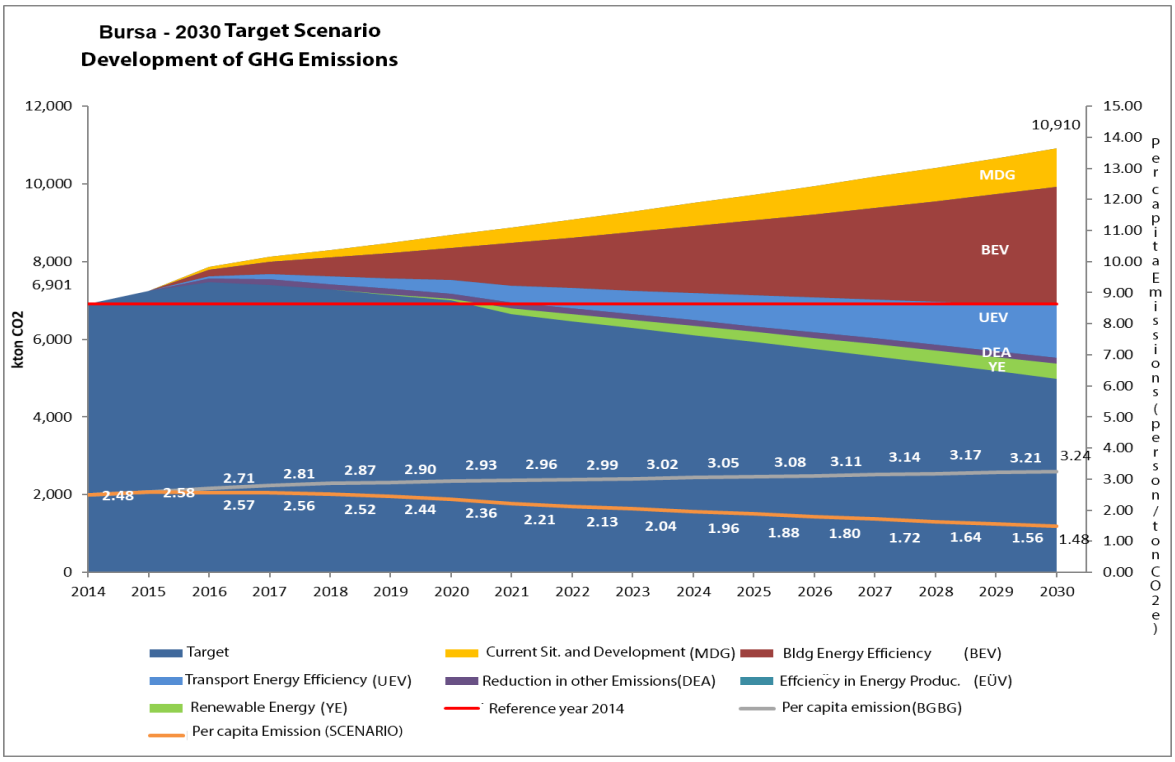


Figure 3-7: Bursa 2030 Greenhouse Gas Emissions Target Scenario

The graphs below show total emissions in 2014- Bursa's reference year, 2030 emissions according to the BAU and emission reductions that could be achieved by 2030 in line with the various measures proposed by the Sustainable Energy Action Plan for different resource sectors.

As it can be seen in the graphics, due to high population growth and high growth rates in the transport sector, absolute emissions may be reduced by only 28% compared to the base year of 2014, despite the proposed measures. Energy efficiency measures in various sectors and investments in renewable energies are estimated to reduce the possible emissions of 2030 to 5.9 million tonnes of CO_2e. The per capita GHG emissions can be significantly reduced by the same reduction scenario, with a reduction of 54% according to the BAU scenario and a 40% reduction over the reference year 2014. This can be seen below.

On the contrary, the reduction scenario shows that despite high growth rates, Bursa can achieve growth by reducing its emissions, which should be regarded as a significant achievement.

When the BAU and Mitigation Scenario are examined on a sectoral basis, the following results are encountered.

The energy and carbon densities of buildings are the greatest sources of Bursa urban inventory. It is important that the changing population, both in terms of structural characteristics and consumption habits, is encouraged to low-carbon routes, energy-efficient construction and construction of new buildings with lower energy demand.

The following two figures show the emissions from the buildings in Bursa and the reduction scenarios in terms of absolute and per capita values. With various measures, it is stipulated that building emissions could be reduced to approximately 3 million tonnes of CO2 by 2030 (awareness-raising campaigns have been included in the abovementioned figure, reductions as per renewable energy investments have not been included in the figure).

While has been shown that high growth rates in population make it difficult to achieve a significant decline in absolute emissions, per capita emissions can be reduced by 54% compared to the reference year. It has been shown that local administrations can be effective in terms of energy efficiency and renewable energy applications in the existing buildings, or in new buildings, with permission and licensing processes and plan notes methods.

Transport as the most important third emission factor is a sector where local governments are most likely to control. The sources of emissions are vehicles using fossil fuels, and this transportation method is high in urban transportation. The figures below summarize the transport emissions as the reference year, BAU and mitigation scenarios. With various measures, it is predicted that transportation emissions could reduce to about 1.3 million tons of CO2 by 2030.

In spite of mitigation measures to be taken, transportation emissions of Bursa increase by 24% in parallel with the growth of the city. It is observed that even per capita emissions are slightly increased compared to the reference year, despite mitigation measures.

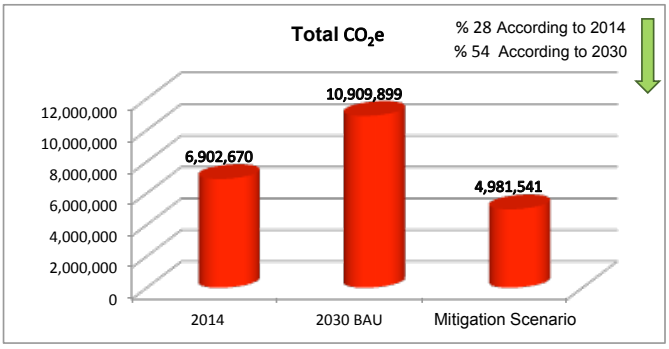


Figure 3-8: Bursa Total GHG Emissions Year 2014, 2030 BAU, and Mitigation Scenario Comparison

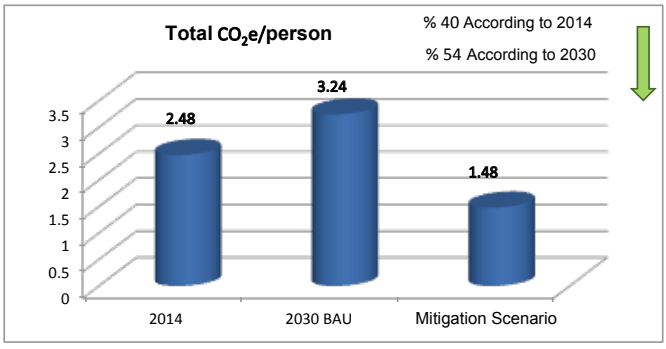


Figure 3-9: Bursa Per Capita GHG Emissions Year 2014, 2030 BAU and Mitigation Scenario Comparison

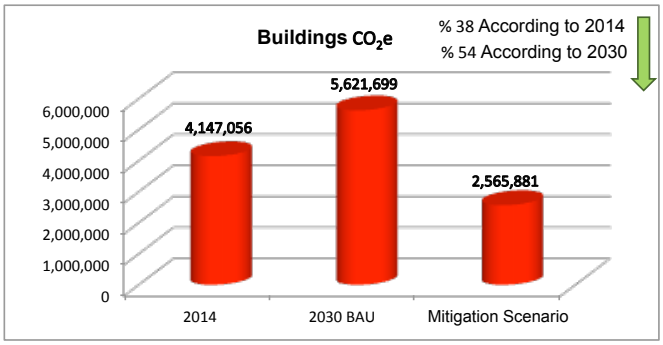


Figure 3-10: Emissions from Buildings in Bursa Year 2014, 2030 BAU and Mitigation Scenario Comparison

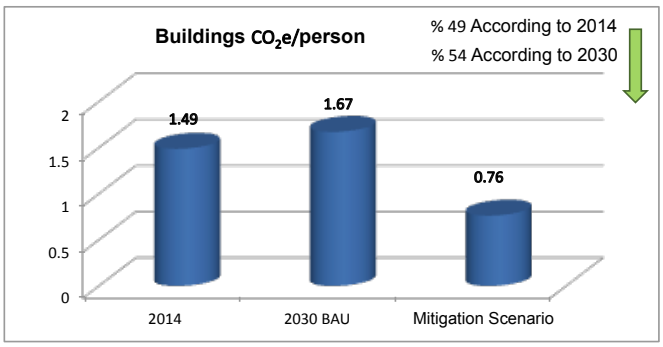


Figure 3-11: Emissions from Buildings/Per Capita in Bursa Year 2014, 2030 BAU and Mitigation Scenario Comparison

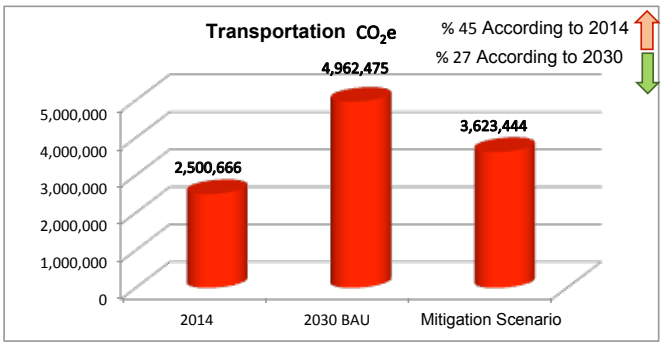


Figure 3-12: Bursa Emissions from Transport Year 2014, 2030 BAU and Mitigation Scenario Comparison

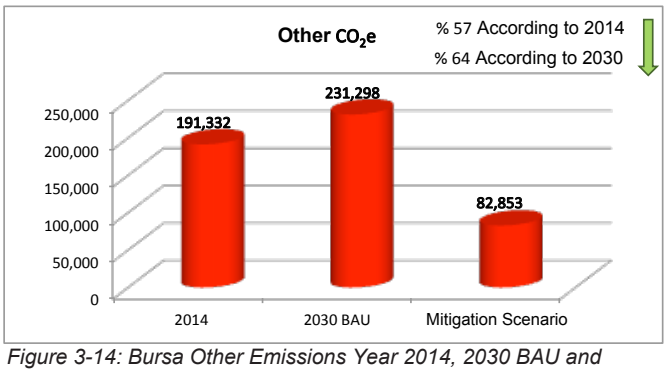


Figure 3-14: Bursa Other Emissions Year 2014, 2030 BAU and Mitigation Scenario Comparison

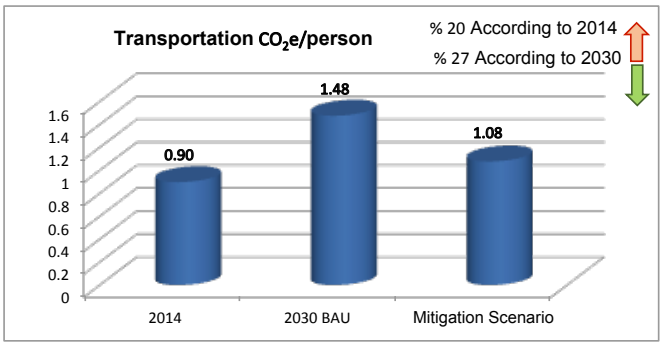


Figure 3-13: Bursa Transportation/Per Capita GHG Emissions Year 2014, 2030 BAU and Mitigation Scenario Comparison

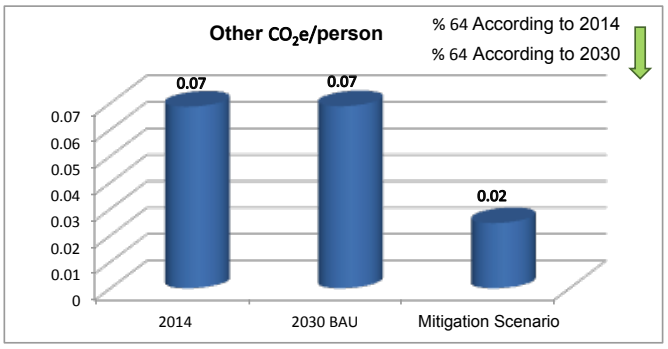


Figure 3-15: Bursa Other Per Capita Greenhouse Gas Emissions, Year 2014, 2030 BAU and Mitigation Scenario Comparison

The measures that the local government in this sector can take towards the reduction of emissions and the policies that can be enforced are addressed in the Bursa Transportation Master Plan. Popularizing rail transportation within the city and the use of public transportation in general and urban pedestrian and bicycle-friendly infrastructure will not only reduce energy and carbon intensity in transportation but will also decrease air pollution and increase the habitability of the city.

Although waste and water management, process-based emissions, forest and agricultural GHG emissions affecting the inventory is low, it is possible to achieve substantial reductions in emissions under the "Other" category.

The following figures summarize the other category releases and scenarios. With various measures, it is predicted that such emissions can be reduced to about 0.15 million tons of CO2 by 2030.

Including the 0.6 million tons of CO2e of possible mitigation through renewable energy applications to agricultural irrigation and wastewater treatment plants as well as the 7% natural energy recovery according to the state's official institutions projections and developments in Turkey's energy efficiency, until 2030, it is shown that by 2030, 5.9 million tons of CO2e could be saved from 10.9 million tons of CO2e greenhouse gas emissions if no measures were taken.

MITIGATION MEASURES	Energy Saving (MWh)	tCO_2e Reduction
Urban Development - Built Environment	7.009.698	2.853.700
Transportation	4.622.123	1.339.031
Renewable Energy	1.036.905	394.662
Solid Waste and Waste Water Management		148.445
Awareness Campaigns	617.636	202.118
Natural energy efficiency	2.845.055	990.402
TOTAL*	**16.131.416**	**5.928.358**

Table 3-7: Mitigation Measures and Savings Quantities

*National policy and technological developments in energy efficiency were assumed to have "natural" emission reduction of 7%.

4 Climate Change Impact Assessment on a Bursa Scale

According to the report of the International Panel on Climate Change (IPCC), 95% of the climate change is caused by mankind.[6] Adverse effects posed by climate change can be observed across the world, in Turkey as well as in Bursa. In this context, it is understood that the city profile should be rearranged with an integrated planning approach considering the natural and human characteristics of Bursa city.

By analyzing all the influential factors from the past and the present situation for Bursa; plans for the future and compatible new projects need to be established.In existing projects, the upper and lower-scale approaches should also be integrated and adapted to the climate change.

Summarizing the Impacts of Climate Change for Bursa

The first settlement of Bursa was in the skirts of Uludağ skirts. After the 1960's, with the effect of urbanization settlement spread across between skirts and plains of Uludağ. With this situation, the number of green areas decreased and the building heights increased.

The air pollution caused by industrial zones and warming is concentrated in the center of Bursa. After the 1990s, the direction of construction shifted towards Kestel, Yenişehir and İnegöl districts to the east of the city center and new settlement areas started to form in the western part of the city. These areas, which are in a location with a high meteorological pressure, are the settlements where the pollution is most experienced.

While the Mediterranean climate effect was observed in Bursa, with the effect of climate change in recent years the climatic effects of the Black Sea were observed. In the northern region, the soft and mild climate effects created by the Sea of Marmara are observed, while severe climate effects are observed in Uludağ in the south.

Unplanned growth, urbanization and industrialization in the plains of the city's borders have caused changes in the climate of Bursa in the last 20 years.

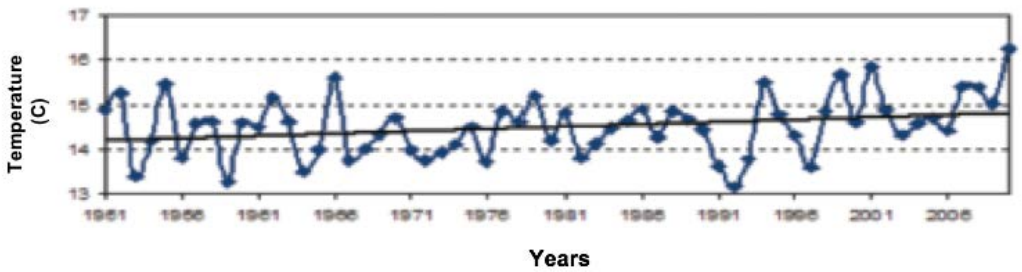


Figure 4-1 Bursa Average Temperature Indicator

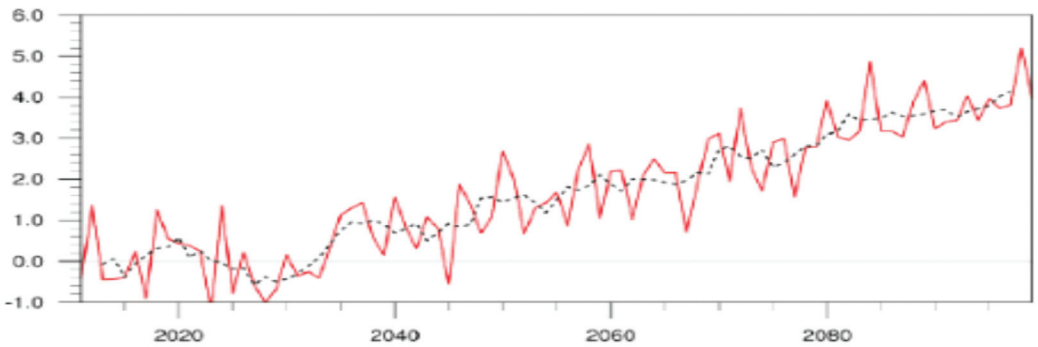


Figure 4-2 Bursa Yearly Temperature Anomaly °C

6 Global Warming, Climate Change and Socio-Economic Effects, Editor: Prof. Dr. Hayriye Atik, Nobel, 1. Edition, 2017, May 7 2030 Bursa provincial environmental planning plan natural building sector climate, air pollution and quality report, 2013

The temperature increases in Bursa over the past 20 years have been observed at around 0.5°C. However, due to urbanization, the decrease in green areas, increasing industrialization rate, excessive concretization, high build up and population density has caused a 25% increase in solar intensity.

According to the climate projections, it is determined that after the 2040s, there will be a serious rise in temperature and this increase will be 3°C at the end of the century.7 Figure 4-1 shows the temperature change graph from 1951 to 2006. In Figure 4-2, the temperature increase anomaly is expressed for the coming years.

Bursa is located 155 meters above sea level. As a result of an observation period of 52 years, annual precipitation amount has been determined to be 706 millimeters. Figure 4-3 shows the amount of precipitation change between 1951 and 2005..

As a result of the adverse effects of the climate change on the precipitation, negative effects such as flood-overflow and drought are emerging. Sudden precipitation changes in Bursa has caused floods in the past. The 2010 flood disaster due to irregular structuring, planning far from the scientific reality, and uncontrolled growth resulted in the loss of life and property. In order to avoid such losses and minimize the risk, it is necessary to act with an understanding of planning based on the climate change effects.

According to the precipitation projections shown in Figure 4-4, precipitation values which are above average in the first half of the century will decrease in the second half. At the end of the century, it is predicted that the amount of rainfall will decrease dramatically. According to these projections, it is necessary to conduct studies on areas with flood-overflow risks.

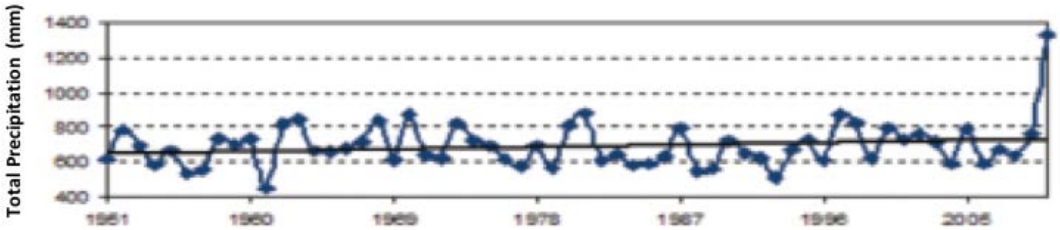


Figure 4-3 Bursa Annual Total Precipitation

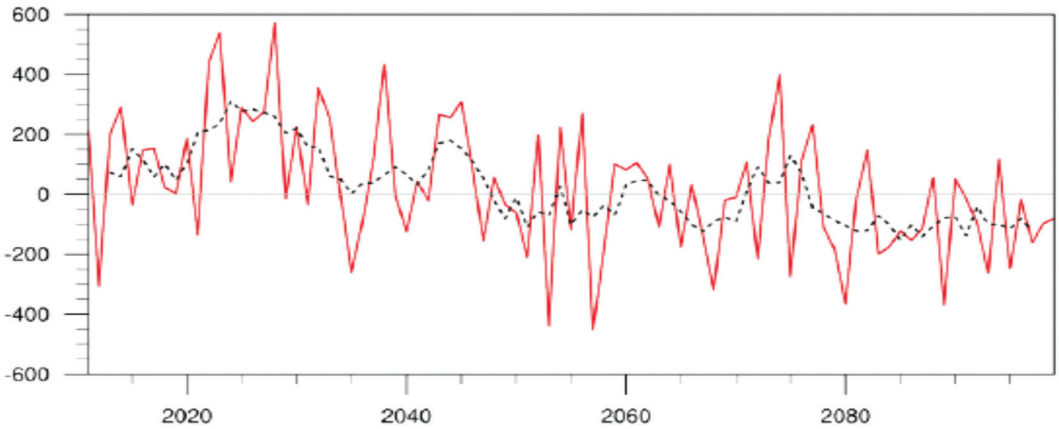


Figure 4-4 Yearly Precipitation Anomaly (mm)

Another issue that contributes to the effects of climate change is air pollution. In this context, the air pollutant values of Bursa city center are above the limit values, especially in winter months. This poses a danger to human health. As seen in Table 4-1, Bursa is a city with a problem of air pollution according to world standards. Air pollution is known to have a negative effect on public health. Especially in areas where there is pollution, the number of green areas must be increased and the air polluting factors must be removed.

As a result, the adverse effects of climate change have been experienced in both Bursa city center and in the city as a whole has been observed due to the speed of urbanization and the pressure for industrialization. In order to prevent these adverse effects which threaten natural resources and biodiversity, it is necessary to carry out detailed studies and produce projects and enforce plans according to the future years.

BURSA PM10						
	2008		2009		2010	
	Average PM10 Value 0	No of days Exceeding Value	Average PM10 Value 0	No of days Exceeding Value	Average PM10 Value 0	No of days Exceeding Value
Winter	91,7	42	93,2	64	62,9	42
Spring	87,5	62	94,6	39	51,1	45
Summer	78,7	63	69,7	18	59,2	61
Autumn	83,6	70	104,8	40	79,2	48
Annual	86,9	253	91,3	158	63,6	200

Table 4-1: PM10 seasonal averages and days exceeding the limit value (50mg / m3) these values are too old it wouldn't be accurate to comment accordingly

No. of days	No. of days per year EU target values for ozone exceeded (Ave. 8 hours)				No. of days per year PM10 EU limit values exceeded (daily average)			
	2013	2014	2015	2016	2013	2014	2015	2016
Bursa Beyazıt Cad.	-	-	-	-	214	273	264	209
Bursa İnegöl	-	-	-	-	206	254	210	169
Bursa Kestel	-	-	-	-	216	240	215	218
Bursa Kültür Park	3	5	10	7	153	5	10	7
Bursa Uludağ Üniversitesi	18	12	15	17	-	-	-	-

Table 4-2: Number of days ozone and PM10 limit values exceeded

4.1 Urban Heat Island Effect

The effect of urban heat island emerges as a consequence of irregular urbanization, lack of green space, dense construction and concreted areas. This effect is not directly related to climate change, but it is the area where the adverse effects of climate change are most visible in urban areas. The change of temperature in rural areas up to 50°C is explained by the effect of urban heat island. Minimum temperature values were compared and investigated to see whether Bursa was affected by heat island or not. Minimum temperature is also known as the night temperature. When there is no solar radiation, the effect of the long-wave radiation from the surrounding (such as buildings, the ground) is an important factor in the value of night temperature. In this respect, the annual average minimum temperatures in Bursa appear to increase over the past 30 years (Figure 4.5).).

Looking at the seasonal variation of temperature, there is an increase in the last 30 years during the summer, which is close to 2°C, despite the tendency to decrease in winter (close to 0.5°C). (Figure 4.6). In summer, overheated concrete and asphalt surfaces increase the temperature by emitting long wave radiation at night.

Period	Population-based growth rate (%)	Growth rate due to sprawl (%)
1984-1995	60,00	40,00
1995-2003	34,50	65,50
2003-2014	83,00	17,00

Table 4-3 Comparisons of Urban Growth in Bursa with Holdren Model by Periods[8]

Thus, they are warmer than the surrounding rural areas. The minimum temperature values measured between 1970 and 2010 reveal that Bursa is among this classification of cities.

In a study conducted at the Gazi University Faculty of Architecture, it was researched whether the spatial development was influential on local climate change. According to the results obtained from the study, the urban settlement grew sixfold between 1984 and 2014 while the urban population revealed an increase of two and a half. In addititition, it was observed that the growth of the urban area is a result of decrease in forests and agricultural areas. As shown in Table 4.2, as a result of the application of the Holdren Model, it was determined that the growth during 1995–2003 stemmed from the 65% urban sprawl. During the same period, an increase of 1.36°C in monthly minimum temperatures was observed from the local climate parameters.

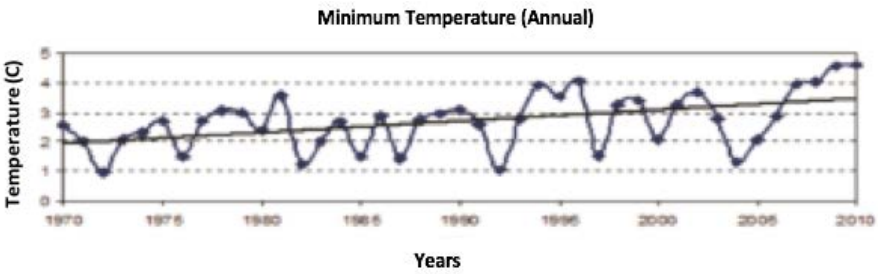


Figure 4-5: Minimum temperature change observed between 1970 and 2010 at Bursa Central Station

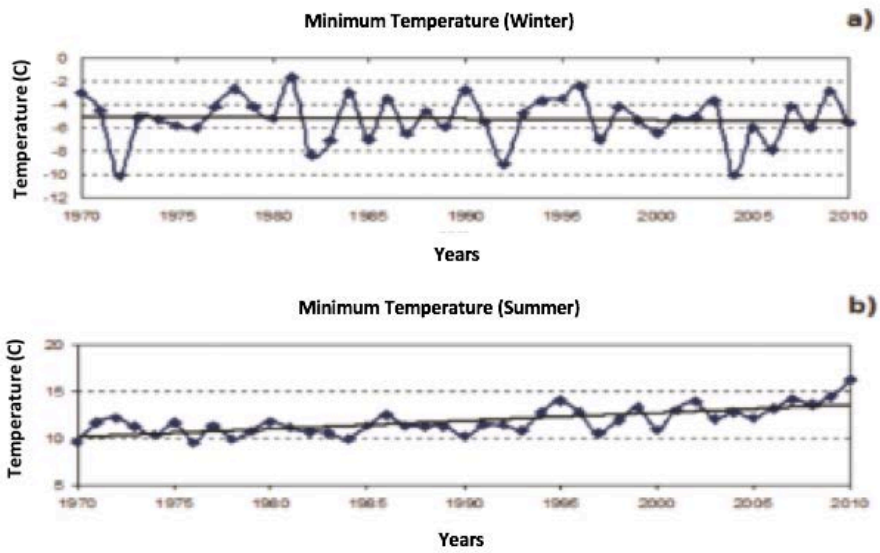


Figure 4.6: Minimum temperature variation observed by Bursa Central Station between 1970 and 2010 a) Winter season, b) Summer season

8 Reference: The Impact of Urban Growth on Local Climate Change in Bursa Case, Mortaza Moradi, Nilgün Görer Tamer, Gazi University Faculty of Architecture, Department of City and Regional Planning, Ankara, 2017

It may be said that the opening of the Bursa Plain to urban development has played a major role in this change. Figure 4.7 shows the plain areas (black contours) and settlement areas (orange areas) of the city. According to the map prepared with the data from 2012, it is seen that settlements are spreading within the boundaries of the plain. With the opening up of the Bursa Plain, the loss of forest and agricultural lands leads to an increase in the effect of the urban heat island.

Moreover, the growth of the city of Bursa as shown in figure 4.8, affects transportation demands and travel times, especially between the workplace and the residence. On one hand, greenhouse gas emissions increase as city fossil fuel consumption increases with the change of land use, on the other hand, the important sink areas (land cover) around the city such as agriculture and forest areas decreases. This bi-directional change has affected the local climate and caused an increase in the measured temperatures.

Starting from 1995-2004 period, the results of the statistical analysis of climate data showed that the increase in temperature parameters reached the highest level in 2005-2004. These temperature differences were observed during the winter months, especially during January and February. During the period of 1974-1985, the average parameter of monthly minimum temperatures increased by 1.04 ºC for the months of February and 2,78 ºC for the period of 2005-2014. Ortalama sıcaklıklarda 1,74ºC artış yaşanmıştır. The average temperature showed an increased by 1.74ºC. When we look at the same paramater for August average, the average temperature for the period 1974-1984 was 15.87 °C, whereas it was 19.09 °C for the period between 2003-2014. The difference in average monthly minimum temperatures between these two periods is 3.22 °C. There is a noticeable increase in temperature during the summer months. The heat island effect caused by urbanization prevents the city from cooling. The upward increase in minimum average temperatures is an important proof of this circumstance (Moradi, 2016).

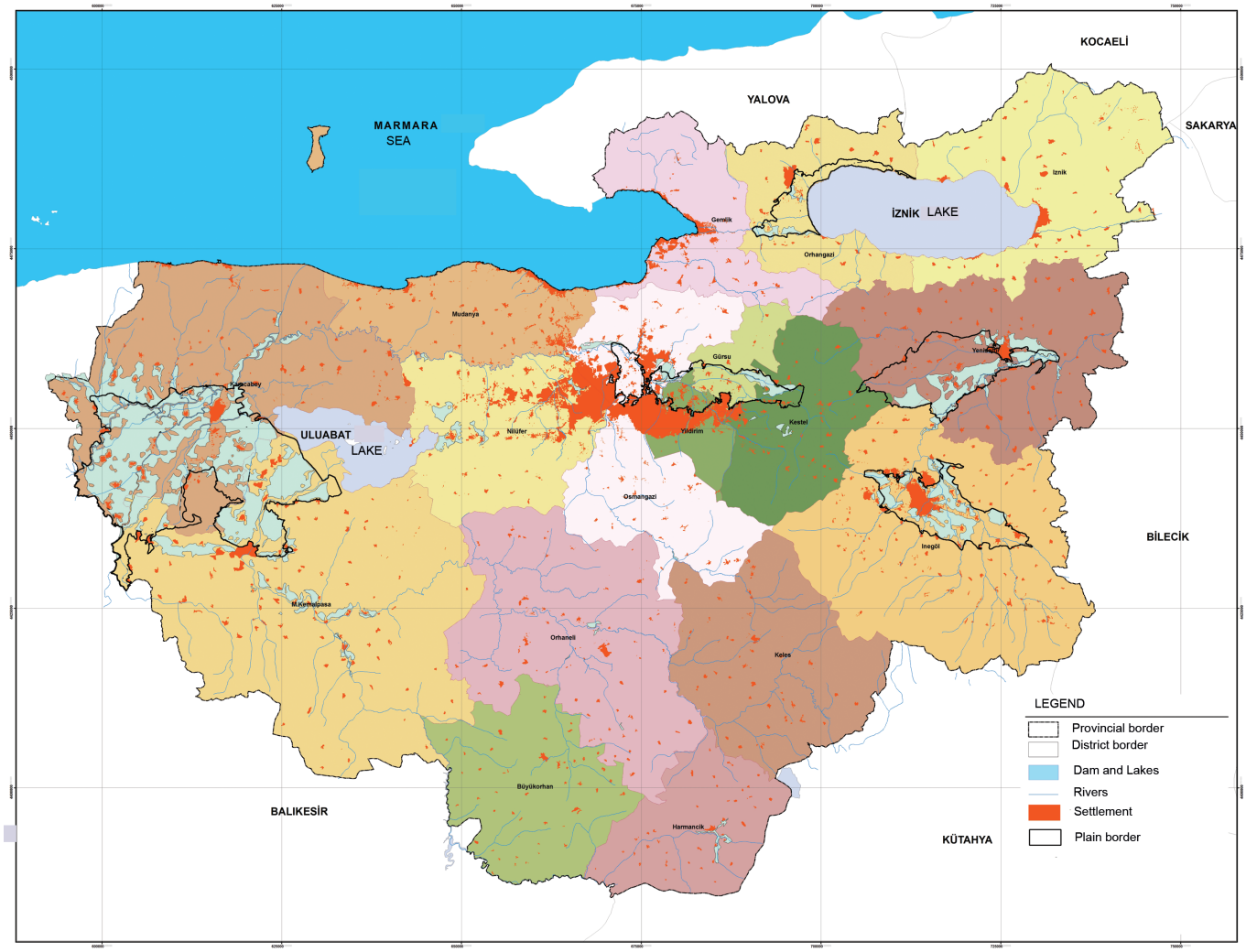


Figure 4-7 Map of plain and settlement borders of Bursa Province (constructed according to the Environmental Impact Plan report)

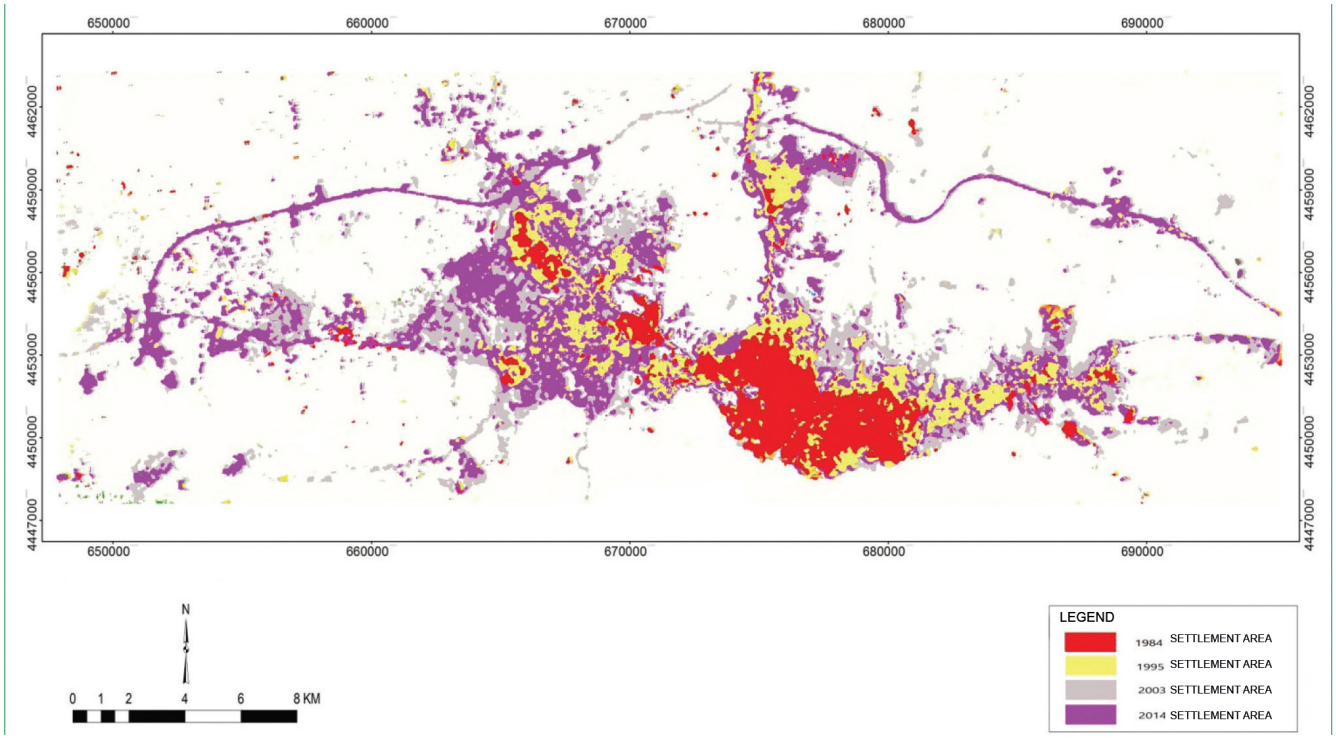


Figure 4-8 Bursa Urban Growth Pattern 1980-2014[9]

As a result, changes such as agricultural activities on land use, deforestation, afforestation and expansion of residential areas directly affect the climate systems and reveal urban heat island effect[10]. In this process, urban growth and sprawl should be controlled and spatial planning decisions should be reassessed.

4.2 Urban Water Areas

5% of Bursa's surface constitutes as water areas. As of today, Doğancı and Nilüfer Damn in Bursa meet 85-90% of water needs and 10% of spring resources. There are 145 water resources in Uludağ and its skirts apart from the spring resources. In addition, when the rainfall decreases and the dam and spring water levels are not sufficient, the water needs are met with underground water resources. 120 wells meet approximately 5% of water needs[11]. Figures 4-9 show the main dams and streams within the city of Bursa. When the map is examined, it can be seen that Nilüfer River passes through the city center. In this context, settlement and water relations need to be well-structured and it is possible to create an opportunity to reduce the impact of climate change through integration with green areas.

As shown in Figure 4-10, the location of Bursa within the macro and micro basins also reveals the diversity of the water richness and natural structure of the city.

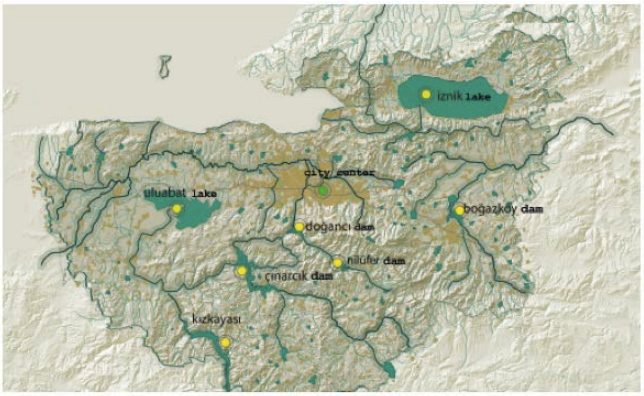


Figure 4-9: Water areas and dams in Bursa city (constructed according to the GIS data obtained from the BMM-2017)

In this sense, it is understood that a detailed basin conservation plan, both on a micro and macro basin scale, is needed for Bursa. Existing studies should be reevaluated according to basin management criteria. Based on an ecological approach and on the preservation and development of natural resources to ensure sustainable development, an integrated basin management plan that will advance the social and economic structure of the society is needed in Bursa.

9 Source: The Impact of Urban Growth on Local Climate Change in Bursa Case, Mortaza Moradi, Nilgün Görer Tamer, Gazi University Faculty of Architecture, Department of City and Regional Planning, Ankara, 2017
10 The Impact of Urban Growth on Local Climate Change in Bursa Case, Mortaza Moradi, Nilgün Görer Tamer, Gazi University Faculty of Architecture, Department of City and Regional Planning, Ankara, 2017
11 Environmental Pollution and Control, Editor: Prof.Dr. Özer Çınar, 2.Edition, 2013, nobel academic publishing

Figure 4-10: Bursa Province Basin Boundaries (constructed according to the basin plans and the Nilüfer Sub-Basin Report)

The annual water consumption of Bursa is 43,500 lt / person. The water seapage ratio, which was around 63% in 1993, has been reduced to 24% and has reached European standards. Efforts are underway to improve and develop the water infrastructure. However, according to population projections, reservoirs, desalination and force main for water needs should be designed and preparations based on the needs of subscriber should be carried out. However, despite the increasing water demand due to rapid population growth, the problems arising from the lack of appropriate resource availability and the overuse and pollution formation that occur in parallel with the increasing industrial and agricultural activities have increased the importance of water resources management especially on watershed basis.

It is seen that more comprehensive scientific studies on the water areas emerging from the river richness of Bursa Province should be realized. In this sense, rehabilitation studies are carried out about Nilüfer River and its bayous passing through the city center.

However, while rehabilitation works are being carried out parallel to the rapid growth of the city, it was revealed during discussions with institutions that increase of flow measures equivalent to climate adaptation strategies were not obtained at a desired level. Rehabilitation studies are being carried out with the integration of green areas and in accordance to flood-overflow risk, and problems with integration of green and the use of permeable surfaces are arising due to constraints from structuing.

Despite the fact that the immediate surroundings of some rehabilitation sites in the city center are not suitable for settlement, settlement in these areas constitutes one of the most critical problems in rehabilitation projects.

Bursa is a city where urbanization is intense and under the pressure of industry the increase of mining activities is observed. Along with these features, particularly low-income families in illegal settlement areas, increased demand for housing, is both threatening and changing the structure of the natural values of the city. The flood disasters that have been taking place in Bursa in the past period under the influence of this situation have also caused many losses and damages. For this reason, it should be discussed whether the work carried out to reduce the flood and overflow risk is sufficient enough, and more extensive studies should realized. Figures 4-11 show Panayır and Alacahırka areas that were damaged by flood-overflow disaster that occurred in 2010. It is known that the low-income population lives in these settlement areas and the illegal construction is intense. In recent years, stream bedding and rehabilitation works have been accelerated. The works to protect Nilüfer river and its tributary rivers settlement areas have been carried out in accordance with the master plan.

In order to eliminate flood and overflow risks, the infrastructure should be improved, adaptive urban transformation projects should be accelerated and river and stream rehabilitation projects should be carried out in accordance with the climate adaptation strategies.

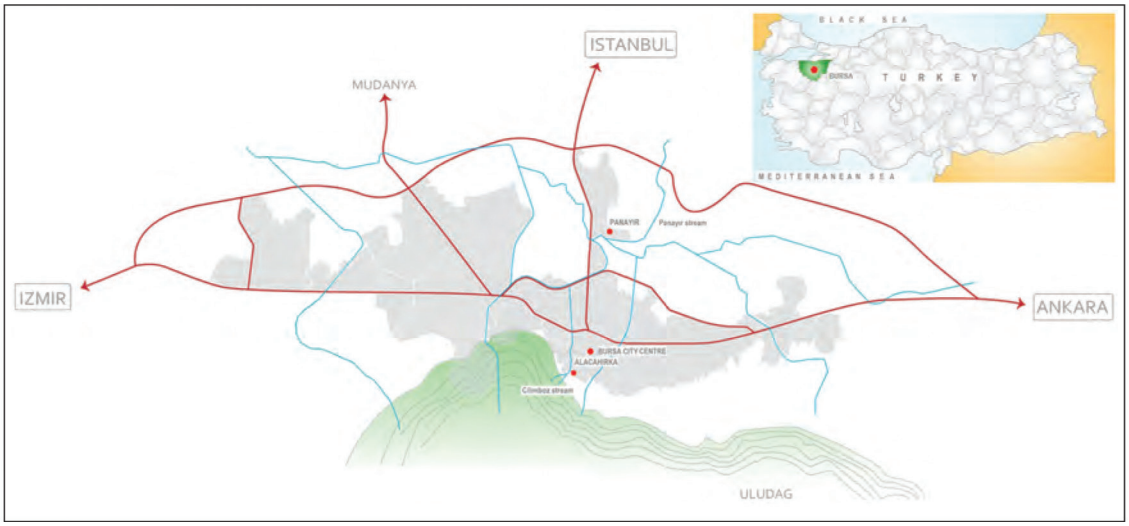


Figure *4-11:* Bursa urban scale showing Alacahirka and Panayir areas[12]

12 Murat Tas¸ and Nilüfer Tas, p:477, Flood disaster vulnerability in informal settlements in Bursa, Turkey

The most critical and important point is the association of the river beds that pass through the city center to the green area. A green corridor needs to be created, both for the public and for reducing climate change impacts, by creating a blue and green relationship.

The adverse impacts of climate change on water resources can be uncovered by comparing rainfall amounts. The changes occurring in precipitation will be effective both in the underground waters and in the surface waters[13]. In addition to the flows, the change in precipitation which also affects the hydrological cycle, is analyzed by Bursa.

The decrease of green areas in urban centers, increase of concretion has significant adverse effects on water absorption during precipitation. Precautions against increasing surface flow are not always sufficient. While incorrect or inadequate practices cannot prevent overflows, precipitation is unable to feed groundwater reserves. The prospect of a likely drought in the future may be due to the decline in groundwater levels.

There is no direct study on the effect of climate change on water resources in Bursa. However, given the relevant literature, it seems possible to list the impacts of climate change on water resources as follows:

- Significant trend changes in both stream flow and flow rate.
- Variations in stream flow rate and filling time of groundwater caused by precipitation change.
- Depending on snow melts, the stream flow rate is low in summer and in autumn, and high from spring to winter.
- Together with the increase in water temperatures changes in organisms living in water affect water quality.
- An increase in flood frequency and flood amount.
- Increase in water demand with increasing global population.
- Urban settlements with no management system related to water resources are affected more by climate change.
- Unexplored situations and uncertainties cause various difficulties in the management of water resources[14].

When we examine the effects of climate change and analyze it in terms of Bursa, it would be correct to state that these effects are occuring in Bursa. In Bursa, which is known as a city of water, it is necessary to consider the issue of water management from the climate change perspective and to develop strategies within the framework of adaptation to climate change.

Considering the mid-long term rainfall regime change projections in Bursa and the development of the city, possible drainage problems and flood-overflow area management plans were prepared by taking into account the existing river/stream corridors and the urban water pattern. At present, the General Directorate of Water Management has been established and this directorate is responsible for water strategy management. The provincial organization is not yet established. BUSKI and DSİ (Directorate General for State Hydraulic Works) participated in the Water Management meetings and the Climate Change Report was prepared. All institutions are obliged to formulate a strategic plan. However, it is speculated that a budget for this will not be realized. At this stage all opinions are received. However, it is not possible to prepare a single report with the cooperation of all institutions. Hence, each institution is preparing its own strategic plan.

4.3 Public Health

We can evaluate the impacts of climate change on human health under two main headings as direct and indirect. The hot weather fluctuations, air pollution and allergies that will occur with climate change directly affect human health, indirectly, infectious diseases and natural disasters. and infectious diseases and natural disasters indirectly affect the human health.

Heat waves can cause cardiovascular diseases and this leads to an increase in sudden deaths and sudden deaths. Air pollution also affects cardiovascular health and at the same time causes an increase in COPD diseases. Allergens can also cause asthma as a result of the reaction of the body at the moment of contact, inhalation, or if swallowed.

Adverse effects which occur as a result of global climate change, such as; floods, tornadoes and storms can result in injuries and deaths. The destruction of homes and the damage to the infrastructure systems resulting from these catastrophes are contributing to the spread of communicable diseases. The catastrophes that cause economic loss also cause the poverty to deepen. In addition, drought caused by climate change negatively affects agricultural production and the supply of water.

Between the years 2002-2011, 4130 natural disasters have occurred in Turkey. Out of 80% of the natural disasters, 45% is caused by storms and typhoons, 36% is caused by floods and 12% is caused by heat and cold airwaves.

Table 4.4 presents the risk index for 173 countries developed by the UN University - Institute for Environment and Human Security (UNU-EHS) as of 2014.

13 Kürsel Isınma, İklim Değişikliği ve Sosyo-Ekonomik Etkileri, Ed: Prof. Dr. Hayriye Atik, Nobel, 1st Edition, 2017, May p.208
14 Kürsel Isınma, İklim Değişikliği ve Sosyo-Ekonomik Etkileri, Ed: Prof. Dr. Hayriye Atik, Nobel, 1st Edition, 2017, May p.208

No.	Country	Risk %
1	Vanuatu	36,50
2	Philippines	28.25
4	Guatemala	20.68
5	Bangladesh	19.37
7	Costa Rica	17.33
15	Guinea	13.75
73	India	7.04
78	China	6,90
107	Turkey	5.34
127	USA	3.88
128	Russia	3.85
147	Germany	3.01
152	France	2.69

Table 4-4 Risk values of countries selected from 173 countries according to the risk index developed by UNU-EHS.[15]

Due to global climate change, the increasing natural disasters and qualities are undergoing a change. For this reason, developed countries have taken measures against climate change such as reducing fossil fuel consumption, reducing greenhouse gas emissions, and reducing economic risks. In this context, there is a need for agreements involving ecological approaches that reduce environmental inequalities, such as Kyoto, aimed at mitigating climate change impacts. In addition to these, ozone and particulate matter that are formed as a result of climate change negatively affect human health. The study showing the cases of skin cancer due to ozone concentration is expressed in figure 4.12.

According to the research, skin cancer cases for those residing in the middle and high latitudes have a tendency for substantial increase. Table 4.5 shows the effects of diseases caused by the increase of solar rays.

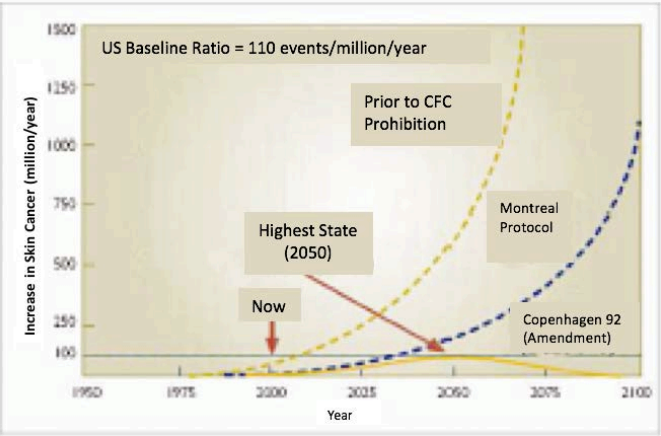


Figure 4-12 Rate of skin cancer increase due to climate change[16]

Effects on Skin	Malignant melanoma
	Non-skin cancer tumors
	Sun burns
	Chronic sun injuries
	Photodermatoses
Effects on Eyes	Konjivit
	Corena droplets related to climate
	Sticking of thickened conjunctival layer on the cornea
	Corneal cancer and conjunctivitis
	Cataract
	Uveal tumors
	Retinal damages
	Macular degeneration
Infectious Diseases and Their Effects on the Immune System	Suppression of the immune system
	Increased sensitivity against infectious diseases
	Infectious diseases with no decline in immune system
Other Diseases	Osteoporosis associated with vitamin D deficiency
	Hypertension, Tuberculosis, Prostate cancer, Breast cancer, Schizophrenia
	Change of general feeling of well-being
	Seasonal confusion
	Mood
Indirect Effects	Impacts on climate
	Impacts on food supply
	Infectious diseases caused by blood absorption
	Air pollution
	etc.

Table 4-5: Possible Effects of Solar Ultraviolet Radiation on Human Health[17]

It is known that the effects of climate change are more common on vulnerable groups such as children, elderly people and people with disabilities. In recent years, the reporting of diseases such as West Nile Virus, Lyme disease, hantavirus infection, Crimean-congo hemorrhagic fever have been increased due to climate change[18].

As a result, humidity, temperature, the rise in sea level, changes in weather events directly affect mankind. As a result of these effects, changes in water and food quality, ecosystem, industry, transportation, settlements, and economy are observed. Thus, causes human health to be directly exposed to climate change.

When we look at Bursa, in particular, it has been observed that the issue of public health has not been addressed in terms of climate change. Since studies have not been conducted in this regard, it has been determined that there is no statistic to relate to climate change and public health in the Bursa region. As there is a lack of committee to investigate the impact of climate change on public health, a platform for institutions, universities and NGOs to share their data also doesn't exist.

15 Kürsel Isınma, İklim Değişikliği ve Sosyo-Ekonomik Etkileri, Ed: Prof. Dr. Hayriye Atik, Nobel, 1st Edition, 2017, May p.188 Ahmet Soysal 2015, taken from the article on the effects of global climate change on human health.
16 Küresel İklim Değisikliği ve İnsan Sağlığına Etkileri, Seyfullah Celik, Hayreddin Bacanlı, Hüsnü Görgeç, Telecommunication Sub-Director November 2008 p: 22
17 "Küresel İklim Değisikliği ve İnsan Sağlığına Etkileri,", Seyfullah Celik, Hayreddin Bacanlı, Hüsnü Görgeç, Telecommunication Sub-Director November 2008
18 Kürsel Isınma, İklim Değişikliği ve Sosyo-Ekonomik Etkileri, Ed: Prof. Dr. Hayriye Atik, Nobel, 1st Edition, 2017, May p.188 Ahmet Soysal 2015, "Küresel iklim değişikliğinin insan sağlığı üzerine etkileri"

4.4 Green Areas, Biodiversity, Green Corridors

Bursa is a city with a high potential for green areas and biodiversity due to its vegetation, water resources and geographical location. Viewed on a European scale and across Turkey, it is seen that Turkey hosts a lot of species in terms of biological diversity. In addition, the land use distribution of Bursa, which is covered with forest areas by 45% is shown in Tables 4-6. Despite the high ratio of forests and agricultural areas, it is known that these rates are decreasing due to pressure on urbanization and population increase.

In addition to this, although there are many important water and forest areas in an urban scale, especially in recent years the species living in their habitats and natural resources are at risk.

Therefore, some areas are protected under biodiversity, aimed at ensuring diversity and transfer of natural resources to future generations. In this context, organizations ranging from a global scale to local scale work together and in partnership with local and national institutions to remove the elements that threaten biological assets.

Land use status	Area (ha)	Total Ratio to Land (%)
Agricultural land	340.912,50	31,3
Forest and shrubbery	484.067,10	44,5
Pasture	24.345,20	2,2
Water surfaces	55.291,60	
Natural lake	50.595,60	
Lagoon	684,80	5,1
Dam reservoirs	2.545,20	
Rivers	1.466,00	
Diğer	184.021,60	16,9
Total	############	**100,00**

Table 4-6 Bursa province general land use distribution, 2015[19]

Within the scope of the studies conducted throughout Turkey, Uludağ in Bursa has been identified as an IPA (Important Plant Areas). "IPA is a natural or semi-natural area that contains rich populations of plant species that are rare, endangered and/or endemic (not naturally grown elsewhere in the world) and/or extraordinarily rich and valuable plant cover varieties."

In order for an area to be identified as an IPA, scientific and international conformance criterias are sought. Endemic plant species, habitats, and specimens living in IPA are rare and endangered all over the world. A study conducted by WWF, Figure 4.13, marks the Important Plant Araes located within Turkey.

In addition, BirdLife International and its partners initiated a series of studies for "Key Biodiversity Areas (KBA)" that the Nature Society presented in 2004 with a team of scientist. From the year 2014 onwards, the approach which defines the geographies with particular importance and ensures the preservation of sensitive and unique natural areas on earth was accepted as an international standard by the International Union for Conservation of Nature (IUCN)[21].

Uludağ, Uluabat Lake and Iznik Lake in the province of Bursa were evaluated within this scope and were identified as KBA. Uludağ, which is within the scope of both KBA and IPA, is defined as natural protected area.

Other protected areas are Kocaçay Delta Wetland, Sadağı Canyon Nature Park, Suuçtu Nature Park, Karacabey Karadağı Ovakorusu Wildlife Development Area.

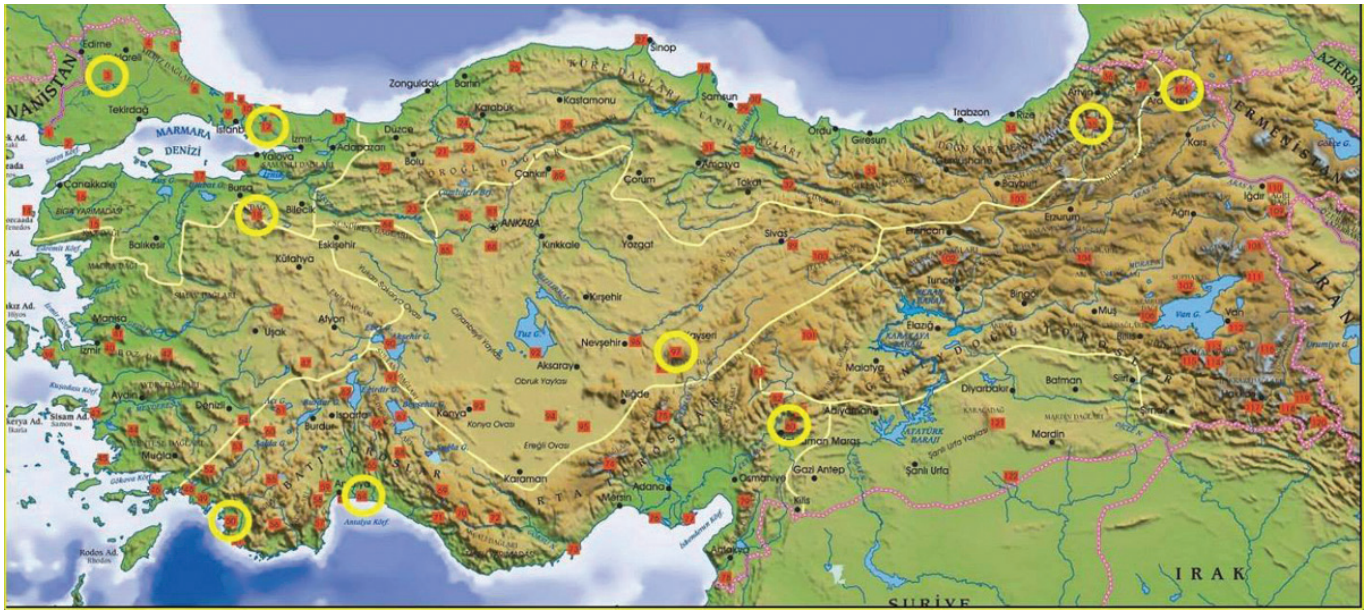


Figure 4-13: Turkey's Important Plant Areas (IPA) Map [20]

19 2015 Bursa Provincial Environmental Status Report, Ministry of Environment and Urbanization, 2016
20 http://obanettr.org/i/turkiyenin-obalari-harita.jpg, access 09/27/2017
21 http://www.dogadernegi.org/onemo-doga-alanlari/, 27.09.2017

	The size and percentage of land cover classes in the satellite image							
	Size ha 1984 dated	%	Size ha 1995 dated	%	Size ha 2003 dated	%	Size ha 2014 dated	%
Urban	2.970,45	4,01	5.874,57	17,75	13.156,26	17,75	18.247,24	24,60
Agriculture	52.413,48	70,69	49.914,35	58,32	43.230,35	58,32	39.012,27	52,60
Forest	18.762,34	25,30	18.328,64	23,93	17.742,24	23,93	16.874,62	22,80
Satellite image area ha.	74.229,34	100,00	74.229,34	100,00	74.229,34	100,00	74.229,34	100,00

Table 4-7 Bursa Land Cover Change (1984-2014)

Within the boundaries of Bursa, there are 30 grade 1, 10 grade 2 and 27 grade 3 natural site areas. Most of these natural site areas are located within the city center boundaries.

However, with the pressure on urbanization, continuous immigration, constant evolvement of agricultural activities as well as the industrial sector are posing a serious threat to the natural resources and natural areas of the city. The values in Table 4-7 show the land use change of Bursa over the years.

It has been observed that the population in 1984 and 2014 increased by two and a half times. In parallel with this, it is seen that the urban area grew six-fold hence creating a decrease in agriculture and forest areas.[22]

Increased population and economic activities in Bursa, the opening of the plains to structuring as well as other areas that need to be protected (streamside) has created an adverse effect on the quantity and biodiversity potential as well as the habitats in an urban scale. This adverse effect also comes to light as the impact of climate change.

Accordingly, we can see large plains and small plain beings throughout Bursa city. These areas, which can be described as agricultural areas and wetlands, are the most important areas that constitute the geographical and natural features of Bursa. Figure 4.14 shows the large plain and small plain areas throughout the province. The four plains in the province of Bursa were declared as a large plain protection area in 2017 by the decree of the Council of Ministers. (Bursa, İnegöl, Karacabey, Yeni-şehir Plains - Official Gazette, June 2017)

Especially the settlements on plains around the city center is causing a destruction on natural areas as well as a decrease in biological diversity and green areas. This situation, which also increases the impact of climate change, is one of the most important problems of Bursa.

According to the European Green Capital Application Form, prepared in 2017, the green area per capita for Bursa was the highest in Orhangazi with a total area of 13,91 m2 and the lowest in the Gürsu district with a value of 1.92 m2.

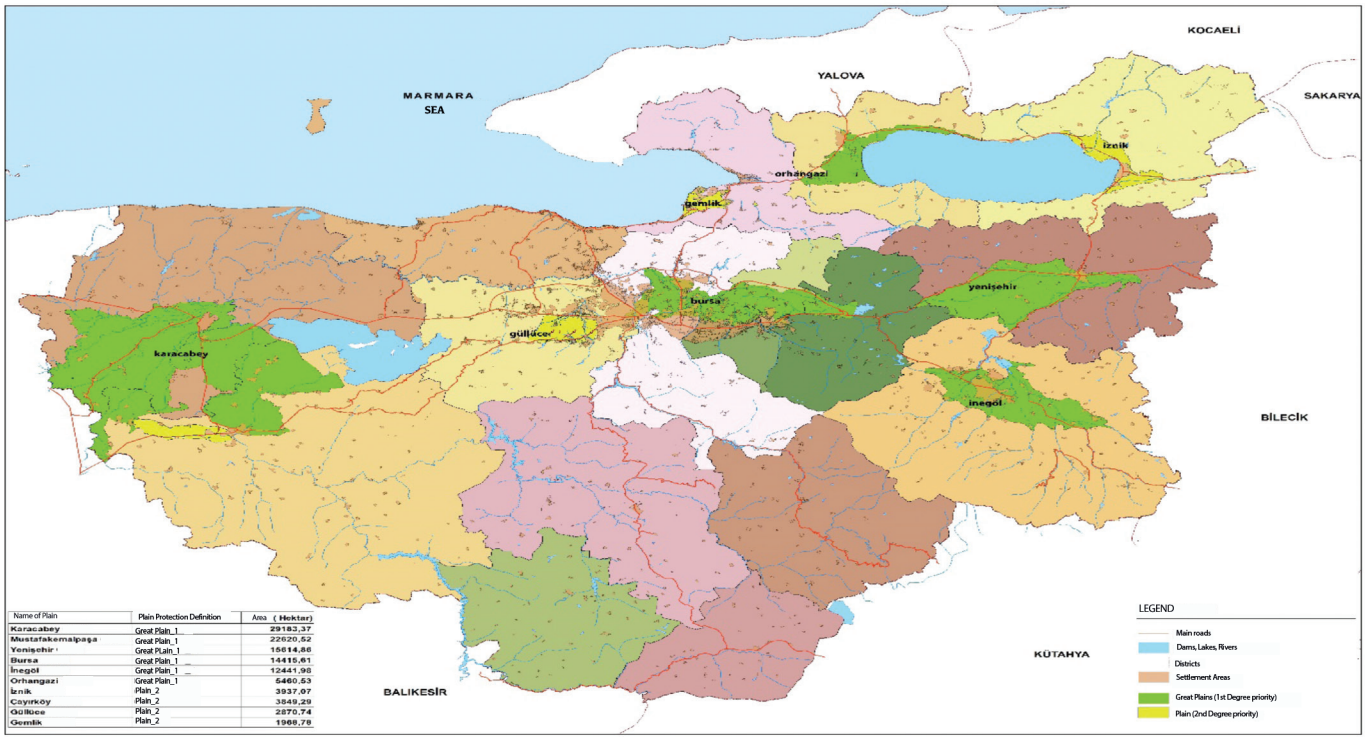


Figure 4-14 Bursa large and small plain areas (constructed using Bursa Environmental Planning Plan report)

22 Bursa Örneğinde Kentsel Büyümenin Yerel İklim Değişikliği Üzerine Etkisi, Mortaza Moradi, Nilgün Görer Tamer, Gazi University Faculty of Architecture, Department of City and Regional Planning, Ankara, Planning 2017

The highest value in the central districts is seen in Nilüfer with 6.39 m2, the second highest value in Osmangazi with 4.88 m2 and the lowest value in Yıldırım district with 0.93 m2. The sports area per capita in the province is 4.23 m2.

There are large open green areas such as Soğanlı Botanical Park, Resat Oyal Cultural Park, Merinos Park, Atatürk City Forest, Hüdavendigar Park (51 ha), Mihrablu Park, Beşevler Regional Park (41 ha) in Bursa city center. It is observed that active green areas within the city center should be increased. Figure 4.15 shows the comparison of the Bursa districts on the basis of the green area amounts.

Figure 4.16 shows the green and open areas in the city center at present. The passing of the Nilüfer River and its bayous through the city center and the rehabilitation works executed so far can support the idea of a green corridor in Bursa center.

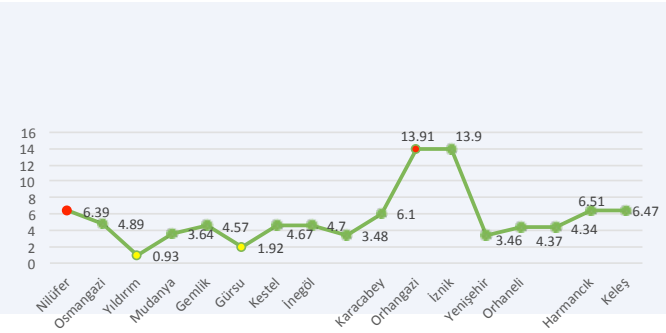


Figure 4-15: Comparison of Green Area Amounts Per Capita by Provinces[23]

However, due to the settlement problems, the fact that rehabilitation projects are not carried out within the expected efficiency, insufficient integration of water and green, and the inefficient establishment of transportation links makes this potential in the city center insufficient.

4.5 Adminstrative Organization and Planning

Literature studies show that climate change related activities cannot be realized by market mechanism[24]. "These activities can be carried out largely by the public sector. In other words, state intervention is inevitable to reduce climate change and to take measures against its negative impact and consequences."

One of the most important reasons for this is; most of the measures are under the responsibility of the public administration (the prevention of overflow risk, the planning of green areas, the popularize public transport, etc.). Another important reason is that most of the measures necessary to combat climate change do not create profit, but in addition require the use of additional resources.

Combating climate change is a multi-dimensional and complex process. For this reason, centralization requires the efficiency and participation of the administrative units at all levels. Various reasons for local governments' to combat climate change can be listed as follows.

- Local governments are the closest administrative units to the population and the places that will be affected by possible disaster events due to climate change.

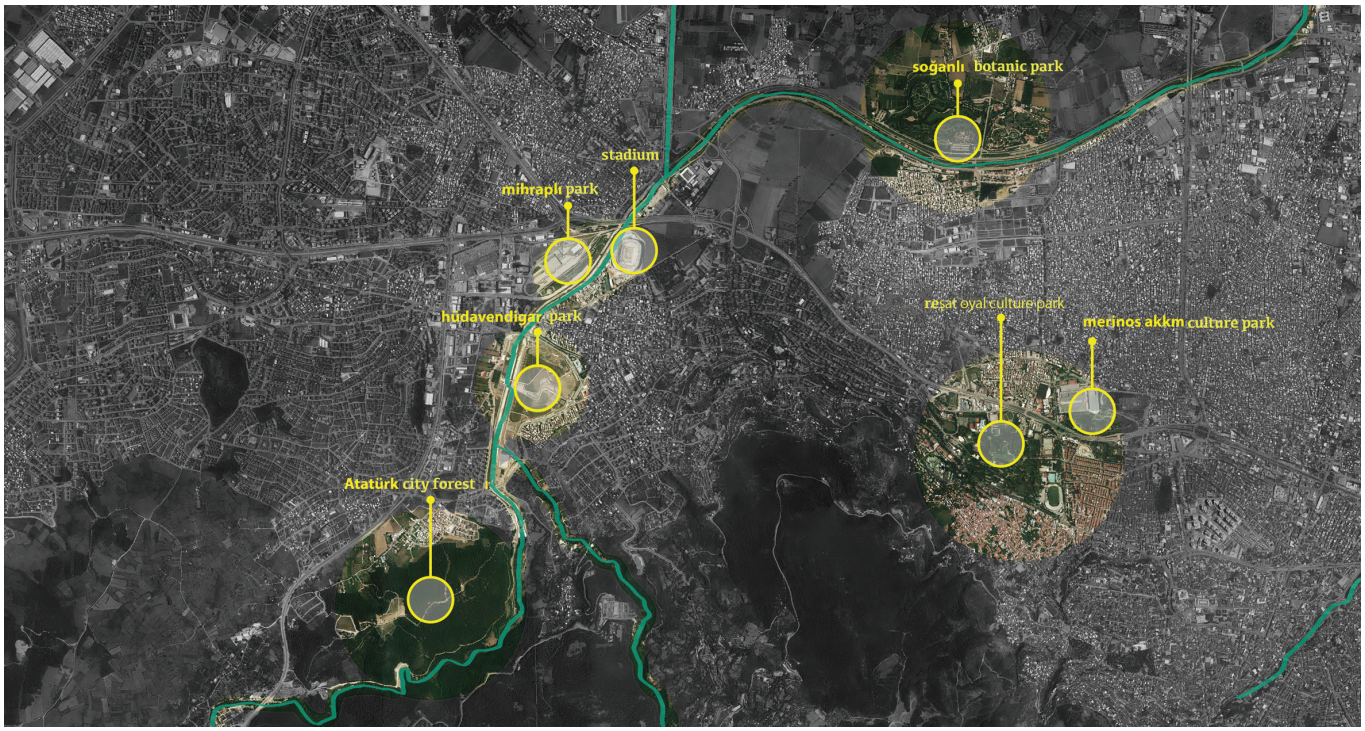


Figure 4-16 Green areas in the city center and its relationship to Nilüfer River

23 2017 European Green Capital Contest Application Form, 2014
24 Balaban, O .; "İklim Değişikliği ile Mücadele'de Kamu Sektörünün Rolü: Türkiye Üzerinde Bir İnceleme", Journal of Public Administration, Volume 43, Issue 3, September 2010

- local governments; implement and supervise the service areas that directly affect the vulnerability level of cities such as land use, urban infrastructure, building construction.
- local governments are the closest administrative units to the public. Not only by producing services, they can also create climate-friendly cities by changing citizens' attitudes and behaviors towards risks and dangers.
- The economic feasibility of urban low-carbon policies due to their size and scale is extremely high.
- Cities can serve as a laboratory by practicing innovative climatic policies that help national politics and even attract attention.

An effective and successful struggle process requires cooperation and coordination between different institutions and sectors. For example, the emission reduction targets set by the central government can only be achieved by implementing them at a local level. On the other hand, the lack of certain coherence between the practices and policies of different management units will increase the risk of resetting the awareness created by a positive implementation of one management unit whilst there is a negative implementation by another unit.Therefore, there is a need to develop cooperation and coordination between different management units and institutions in order to ensure consistent implementation of policies aimed at combating climate change, as well as the transfer of good practices between units and mutual learning.

Vertical cooperation should be enhanced by two-way cooperation between all the management units within the central administration. Horizontal cooperation, on the other hand, refers to the mutual work and information exchange between management units at the same level but in other contexts. More precisely, horizontal cooperation is defined as cooperation between regions and city governments in the same or different countries.It is possible to broaden this definition further and incorporate cooperation and coordination between different sectors (such as energy, transport, construction) and different segments (such as civil society, state, academia, private sector). In this context, the various grant schemes opened by the European Commission are of great importance in terms of cooperation and learning processes between different countries (eg Horizon 2020 calls, etc.)

In addition to the problem of ownership, the inadequacy or lack of coordination between administrative units and public institutions on the horizontal and vertical distribution of work and creates policy and enforcement gaps between institutions, as well as inconsistencies and contradictions.

Although the city of Bursa has reached its current borders and the population increase about 2.5 times since the period after the 1980s together with the spread of settlement area into the plains, the city's history reveals how relevant these decisions are made regarding the planning of the city. Since the 1970s, when the city started to become a base for automotive industry, investments in the industrial infrastructure, placed Bursa Plain under pressure of structuring.

1/25000 Scale Master Plan for Bursa and its Environs prepared in 1976 has been a step for protecting agricultural areas and the elimination of this pressure. The Master Plan, which proposed the development of the city from the eastern axis to the western axis began to change after the declaration of Bursa in 1987 as a Metropolitan Municipality. The inclusion of the villages in the Bursa Plain into the municipalities and the expansion of the municipal boundaries with the establishment of three central districts, Yıldırım, Osmangazi and Nilüfer, also supported the fringe development of the city. When the Master Plan was completed in 1984, the tendency of linear growth along the Ankara - İzmir Highway to the western eastern axis of the city left created a fray-like growth. In this direction, as a planning decision, new industrial areas along with the settlement of approximately 500.000 people settle along the road between Izmir and Mudanya were envisaged.The inclusion of zoning expansions and slum areas into the development area and the revision of master plans of 1/25000 and 1/5000 scale in 1990 will determine new development areas in terms of housing uses, especially in industrial areas.

Connections of Görükle district with the city center increased, the city began to spread to the west side.

After the 1/100.000 scaled Environmental Planning Plan was prepared, the revision of the master plan was put back on the agenda in 1995.The establishment of a natural gas conversion plant in Ovaakça in 1996, the relocation of the bus terminal on the Yalova road in 1997, port decisions along with the planning decisions for industrial/residential areas, are decisions which have led to climate change and effected investment and land use decisions that has triggered the physical growth of the city, leading to a change in land cover.

As a result of these plan decisions, the importance of the Yalova axis has increased steadily due to the harbor activities to the north of the city. As a result of the urban development that could not be prevented on the plain in 2001 with the application of TOKI mass housing area, the Plain Conservation Protocols were reviewed.

Between 1997-2001 period, one-third of the plain area was lost.[25].

As a result of the second amendment made to the municipality borders in 2004, the urban area was further enlarged with the inclusion of Gemlik, Mudanya, Kestel, and Gürsu districts to the central district. With Bursa entering Istanbul's influence area and the improvement of its connections in the transportation network has also accelerated the development of the city to the north and east direction (Eryılmaz et al., 2008, Mutlu, 2015).After 2000, the urban sprawl in the north was almost encouraged with the construction of the beltway.

25 Bursa Örneğinde Kentsel Büyümenin Yerel İklim Değişikliği Üzerine Etkisi, Mortaza Moradi, Nilgün Görer Tamer, Gazi University Faculty of Architecture, Department of City and Regional Planning, Ankara, Planning 2017

After 2000, the urban sprawl in the north was almost encouraged with the construction of the beltway. The Law No. 6360 in 2012 regarding the decision to extend the borders of the Bursa Metropolitan municipality to the provincial borders and the whole provincial metropolitan management model practice, includes incentives that can lead to rapid changes in urban fringing and land cover.This will make the negative effects on climate data more perceivable in the coming years. In the relation between regional and urban planning action with climate change and urban growth pattern, as it is the case with Bursa, spatial planning has turned into an intermediary that increases the city's vulnerability to climate change. In short, it should be emphasized that spatial planning decisions affect the climate, hence, planning urban development according to climate change sensitivity is an important tool.

Currently, climate change studies are carried out within the Waste Management Branch Office. In the process of implementation and monitoring of climate change mitigation and adaptation studies, it is necessary to develop a team related to this issue and communication and cooperation with different stakeholders should be increased in an urban scale, especially within the related units in the municipality.

The team must have leadership skills that can take initiate, highly motivated with persuasion skills along with the ability to see and evaluate problems that may arise. There is a need to establish a superstructure that has the authority to coordinate and direct various units, institutions, and organizations.

In addition, training and awareness-raising activities should be carried out at parliamentarian and mayor level, in order to direct decision-makers to work with a climate-sensitive perspective. In this context, the Ministry of Environment and Urbanization, which coordinates the national climate change studies, should develop the necessary support and incentive mechanisms for local governments.

In addition, Bursa city has an important social capital since 1995 in terms of both with the civil society structure and the city council structure. Within the framework of climate change studies, these structures should be utilized especially for the participation of the people as well as in the education and awareness building activities.

The tasks of the unit with authority and mobility that will enable all these institutions to work in coordination when necessary can be listed as follows.

- To monitor and evaluate the results of mitigation measures implemented in the city;
- To conduct communication and popularizing activities aimed at increasing awareness with good practice examples;

If local governments do not have sufficient human and financial resources, it may not be possible to establish a separate unit. Another option is to form a team of people selected from the relevant units within an organization in the leadership and management of a particular unit. In such an organization, it is important that the assignment is made to ensure that the team does not neglect working groups among their day-to-day work and that the activities carried out within the working groups should be included in the official job descriptions of the team.

- BUSECAP çalışmalarının belirli periyotlarla güncellenmesi;
- Belediye içinde uygulamaya geçilen ve örnek teşkil edebilecek projelerin geliştirilmesinin organize edilmesi (belediye binalarında enerji etütleri, yenilenebilir enerji fizibiliteleri hazırlanması, uygulanması, enerji verimliliği önlemleri alınması, iklim uyum önceliklerine göre gerekli çalışmaların yapılması, ulaşımda yukarıda da bahsedilen önlemlerin alınması, vs);
- Eylem Planı doğrultusunda dış paydaşların geliştireceği projelerde yol gösterici olmak, çeşitli paydaşları buluşturmak, teşvik, finansman olanakları geliştirmek konularında çalışmalar yürütmek;

5 Bursa Climate Change Adaptation Strategy and Action Plan

5.1 Self Evaluation

During the first part of the Bursa Climate Workshop held with the participation of local stakeholders on October 12, 2017, Bursa Metropolitan Municipality and city stakeholders were asked to evaluate the readiness of the city under thematic titles. in terms of climate change adaptation. Adaptability to adverse effects of climate change is one of the most important qualities of cities that are known to be "resilient". In terms of local governments, the capacity to adapt to climate change is, of course, very closely related to the preparations of very different local and national institutions and organizations and medium to long-term strategies. Therefore, it should be noted that the city's stakeholders' view of the city is an assessment of this multi-actor and complex subject, is not limited to local government. The self-assessment was placed on a radar diagram as averages of responses to a series of questions prepared for each theme. In the questions, the experts ranked the current situation of the city regarding climate adaptation, from "less prepared" to "highly prepared". For variables named Beginning, Development and Advanced Phase, the lowest score is 1, the highest score is 9. The following diagram generally reflects the assessment for each title.

The questions help create the radar diagram are included in the appendix of the report (Appendix 2).

As shown in the radar diagram, only the 5th thematic area, namely "Administrative Organizing and Planning", was determined to be at the beginning of "Development Phase", "Urban Waters and Rivers" was close "Development Phase" and the remainder of the titles were "Beginning Phase".

Especially, the headings Public Health and Urban Heat Island Effect, have shown that the city's climate change preparation in these areas has scored poorly. Therefore, in general, it can be said that Bursa is in the early stages of becoming a "resilient" city.

Starting from shortcomings in the areas of health and quality of life that directly affect the urban population, proposals for long-term strategies to adapt to the effects of the city's climate change were sought during part 2 of the workshop.

Self-assessment, evaluations made in each thematic area, and diagrams summarizing the evaluations based on actions are provided in the same annex of the report.

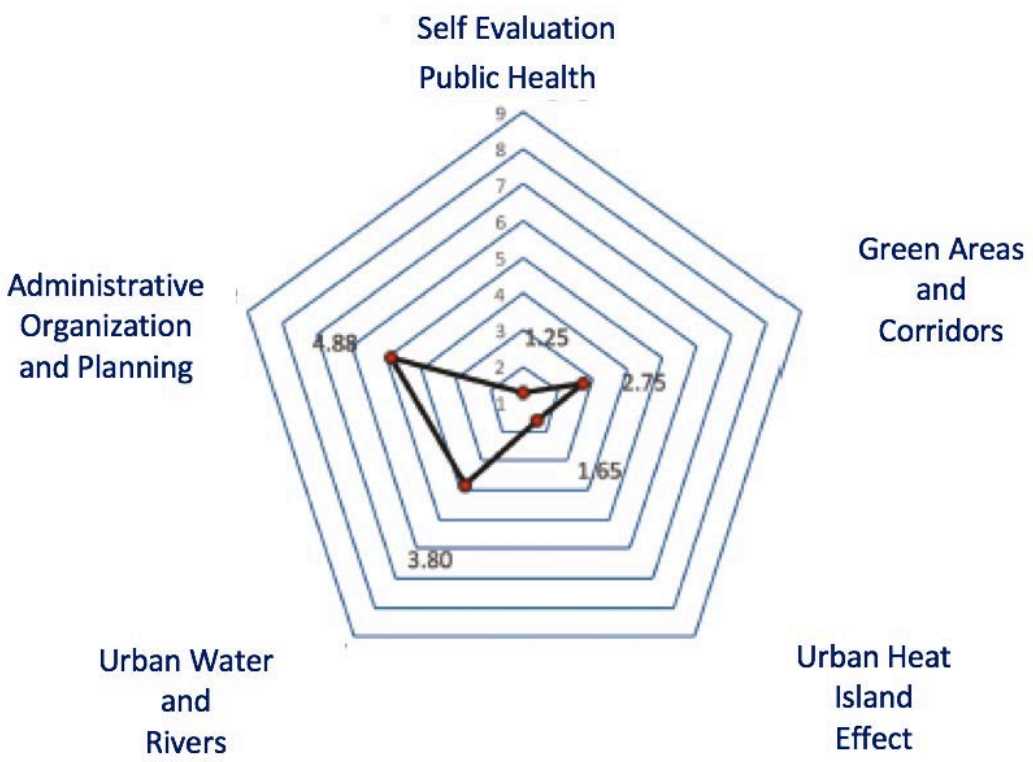


Figure 5-1: Radar Diagram of Bursa's Self-Assessment (Current Situation)

5.2 Bursa Climate Change Adaptation Strategy Action Plan Stakeholder Predictions and Recommendations

In this section, the opinions, suggestions and predictions of participating stakeholders regarding the issues that were organized under the five different themes in Bursa Climate Change Adaptation Strategy Expert Workshop are included.

5.2.1 Strategies on the Reduction of Urban Heat Island Effect

As it is known, urban heat island effect (UHI), is not directly linked to the adverse effects of global climate change, however, it is known that it is metropolitan areas in Turkey where the adverse effects of climate change will be experienced most intensely. With intensive and unplanned construction, high building islands and wind/air circulation obstacles, severe green area deprivation in urban centers and transportation intensity, the vector effect of heat island effect is increasing. In Bursa city center, allowing for the prediction that strong effects of this problem are being seen.It is determined that the medium term significant temperature increases predicted in the climate change scenarios made for Bursa poses a serious threat especially on vulnerable community sections (elderly people, children, patients, low-income residents).

The leading regions where UHI is thought to be the most severe in Bursa is determined as Altıparmak, Heykel, Şehreküstü, City Square and Doğanbey. The high and dense construction, impermeable, asphalt, concrete coatings, heavy traffic and intensive air conditioning use in the workplaces have caused this region to be regarded as one of the UHI affected areas by experts. It is already possible that similar problems will arise in the new settlement areas (eg Özlüce region). However, due to the rapid growth of the city and the fact that the OIZs remain in residential areas leads to the determination that especially around NOSAB and DEMIRTAŞ OIZs will be UHI problem areas in the future. Potentially problematic regions are emerging in urban transformation areas, due to irregular intensity and height.

The existing and possible effects of the current and future impacts of UHI on public health was discussed during the discussions with the institutions and at the related workshop. Experts agree that various adverse health effects are actually occurring in the present. Opinion exchanges conducted during the workshop with the Public Health Desk have shown that the increased frequency of psychological problems such as depression, aggression and the increase in respiratory symptoms, especially in heart diseases for vulnerable community members, may be due to IAE at an unknown rate.In addition to these effects, increasing allergies in parallel with the prolonged pollen periods, emerging disease patterns (Nile Fever, the return of malaria, etc.) parallel to the extended periods of high temperature and heat waves, increased air pollution problems with increasing temperatures are among the negative impacts.

One of the important shortcomings is that the subject is not measured in detail based on scientific methods. As it is known, techniques that confirm satellite temperature determination methods with geodesy provide the safest results. It has been determined that such measures, in cooperation with local and national institutions should be taken as soon as possible.

On the other hand, in the regions where the most intensive UHI impacts are expected to take place, different proposals have been developed for short to medium and long-term.Reduction of transport intensity and the need to create large green-cool zones in previously identified central UHI regions were emphasized and it was stated that the proposal on Heykel-PTT pedestrian area recommended by the BMM Transportation experts will be an important step in this regard. This design is expected to be actualized before 2030. Again with regard to the same and neighboring districts, it has been suggested that with parking prices and restricted access policies private car access should be dramatically reduced and rail transport system should be concentrated on. Green walls, green roof requirement and incentives that "cool" the buildings heat surfaces have been discussed in the same context. In urban transformation regions, besides regional planning including UHI (green areas), structural designs which will not block air passages were proposed, which is an important opportunity for urban transformation, but these opportunities have not been evaluated yet.

During the organization phase, a significant part of the proposals included the establishment of coordination committees at every level, to ensure coordination, actualizing of a very serious informative process and measurement of statistics on the effects of public health, disaster plans for vulnerable community groups and institutional cooperation.

In the light of the opinions of the experts who participated in the group study, it was emphasized that the subject should be presented with scientific methods and the following aims and actions in terms of heat island area were developed.

Objective UHI1: Identification of risk areas and taking UHI mitigation measures

Action UHI1.1: Identification of risk zones and determination of public health impacts in these zones

- Firstly, the scientific measurement studies related to the positioning of the UHI, the introduction of sensitive areas.
- Determination of short to long-term effects of public health with the benefit of national and international scientific findings, to carry out modeling studies.

Action UHI1.2: Popularizing "green-cool" areas in risky regions

- The creation of large and green cool area with pedestrianization in the Heykel-Altıparmak-Fomara triangle in the city center which is determined by experts as the riskiest region of Bursa in terms of UHI. In this regard, the actualization of the pedestrianization in this area to be carried out BMM as quickly as possible.
- Designing and actualizing incentive mechanisms for green roofs and corridors in all risky areas, particularly in the above-identified region.

- To increase the number of green spaces in sensitive areas.
- To obligate structural designs to add UHI into account in urban transformation regions.
- The construction of large urban parks where the majority of the population in the city can access thru short distances.
- The health protection band to be actualized in the OIZs, and the green roofing practices to be encouraged in the OIZs.

Objective UHI 2: Reduction of Heat Island Effect at Planning Level

Action UHI 2: Consideration of Heat Island Impact in scale plans and in all projects

- To include building density, green equipment and UHI in the upper scale plans, Development and Environmental plans.
- Adopting an approach that considers the UHI, especially in urban transformation projects.
- Preparation of Environmental Plans and Master Plans in a way to include ecological analysis and long term climate change scenarios.

Objective UHI3: Reduction of IAE due to transportation

Action IAE 3: Taking necessary measures to reduce traffic intensity

- Urgent action to reduce traffic intensity in the most risky areas, to reduce private car usage, particularly by pedestrianization, and by means of public transport incentives.
- In general, to rapidly reduce the entrance to the city center by measures such as parking pricing.
- Use of environmental friendly fuels in public transport.

Objective IAE4: Awareness and Organization

Action IAE4.1: Interinstitutional Coordination

- Establishment of an Provincial Coordination Council for Climate Change.
- The establishment of a coordination unit and the capacity of the coordination unit should be improved.
- Establishment of the monitoring board for compliance and mitigation of climate change at each level of local governments.
- Establishment of incentive and prize mechanisms by the Ministry of Environment and Urbanization for leading municipalities in this area
- Climate change, public health relationship to be determined by scientific studies and ensuring public awareness.

Action UHI4.2: Training and activities on awareness

- To point out the effects of heat island in all education stages, to include it in the curriculum. For City Council to provide support to the educational activities at schools, the handling of many different issues related to climate change in these activities, such as energy saving, renewable energy, etc.
- Preparation and popularizing the Guidelines on Preventive Measures.
- Good practices in cities should be given priority and awarded.
- The results should be submitted to the environmental working group of municipal council members.

The Role of Institutions in Implementing the Solution Recommendations

The intercommunication and data collection processes of institutions appear to be very important for the solution recommendations. Decreasing the effect of the Urban Heat Island, determining the problematic and potentially problematic areas is very important in terms of taking into account the urban plans.

In order to formulate strategies and policies, it is necessary for the relevant units of metropolitan and district governments to work in coordination. If institutions are to work in collaboration, the following indicators will guide them to determine both the effectiveness of the applied harmonization strategies and the quality of life of the citizens.

Affectibility Indicators	Unit
The number of days/nights in which extreme cold or hot weather is experienced (compared to a reference year or seasons night/daytime temperatures)	number/year
Number of days/nights of excessive rainfall (compared with reference year or season rainfall/night time)	number/year
Number of consecutive days/nights without rain	number/year
Monthly / yearly average temperature changes	% / year
Current per capita energy consumption and projections for the years 2020/2030/2050	MWh
Warm/cold wave frequency	month/year average
Monthly/yearly temperature changes	%
Monthly / annual average precipitation changes	%
Number of days without rainfall (nonstop)	No. of days
Number or percentage of public/residential/service buildings affected by extreme weather conditions/events	%
Percentage of gray/blue/green areas affected by extreme weather conditions (heat island effect, flood, landslide, forest/terrain fires)	%
Number or percentage of Infrastructure / Energy / Water / Waste / Information infrastructure affected by extreme weather conditions/events	%
Shadow effect and corresponding changes in the percentage of heat island effect in the city	%
Residential/commercial / agricultural/industrial / tourist areas with risk of flood, drought, hot weather, forest/land fire	%
Public housing and service buildings renovated/restored for adaptation purposes	%
Transport / Energy / Water / Waste / Information infrastructure restored / restored for adaptation purposes	%

5.2.2 Strategies for Urban Water Areas

As the city is located within three basins, it is necessary to evaluate the situation from both an upper scale (macro basin) and a lower scale (micro basin) while forming the strategies. Several institutions and units have studies regarding basins, but it appears that an integrated basin conservation approach is needed with the collaboration of the institutions.

Water is one of the most important identity values of Bursa. However, the joint opinion of experts and municipality units and other public institutions revealed that there are some deficiencies in nature-based climate adaptation solutions in the rehabilitation of urban streams and waters. Figure 5-2 shows the distribution of water patterns, lakes and urban spots on a provincial scale. It is observed that the Nilüfer Stream and its bayous spread throughout Bursa, passing through the center and providing a continuity throughout the city. In this context, it is noteworthy that this integrity is not perceived and continuous throughout the city.

For Bursa, which bears flood-overflow risks, and was affected by floods in the past periods, it is necessary to take very serious precautions for such disasters and to evaluate the factors such as rainfall regimes and flood risk which will be changed by climate change. In addition, it is necessary for the institutions to jointly work out a strategic plan to be included in the development plans related to this topic.

It has been seen that water management planning in Bursa does not go beyond traditional flood/overflow calculations when the negative effects of climate change on the water cover are considered. Although innovative approaches such as green infrastructure are known, an integrated strategic planning process has not been the subject. Lack of cooperation among institutions is regarded as the biggest problem.

When other examples of green cities on a world scale are examined, it can be seen that water areas such as creeks and streams that pass through the cities are integrated with green areas and are open to public use (eg Madrid Rio, Hamburg Elbe River, Vitoria Gasteiz, Heidelberg River). In Bursa, however, it is observed that the rehabilitated creeks and rivers were not well planned in relation to green areas and have residential structuring in its close vicinity. In addition, nonpermeable surfaces used in rehabilitation projects are a problem. It is considered necessary to intervene to these applications which increase flood and overflow risk and are not suitable for climate adaptation strategies. Such structuring needs to be avoided in development plans and the strategies to be developed.

Another issue addressed during the workshop was the effort to create a sponge city. It has been stated that the creation of "sponge area" in Bursa, as in China, is required in order to integrate blue and green and keep flood-overflow risk to a minimum level. Rehabilitation projects, particularly in the city center were found to be inadequate in some places and shortcomings related to adaptation to the environment were observed.

It is observed that the pressure on urbanization in Bursa province and irregular structuring, threaten natural resources and create problems in infrastructure systems. Planned growth and strategies need to be developed to prevent unplanned growths that cause in inadequate drainage systems.

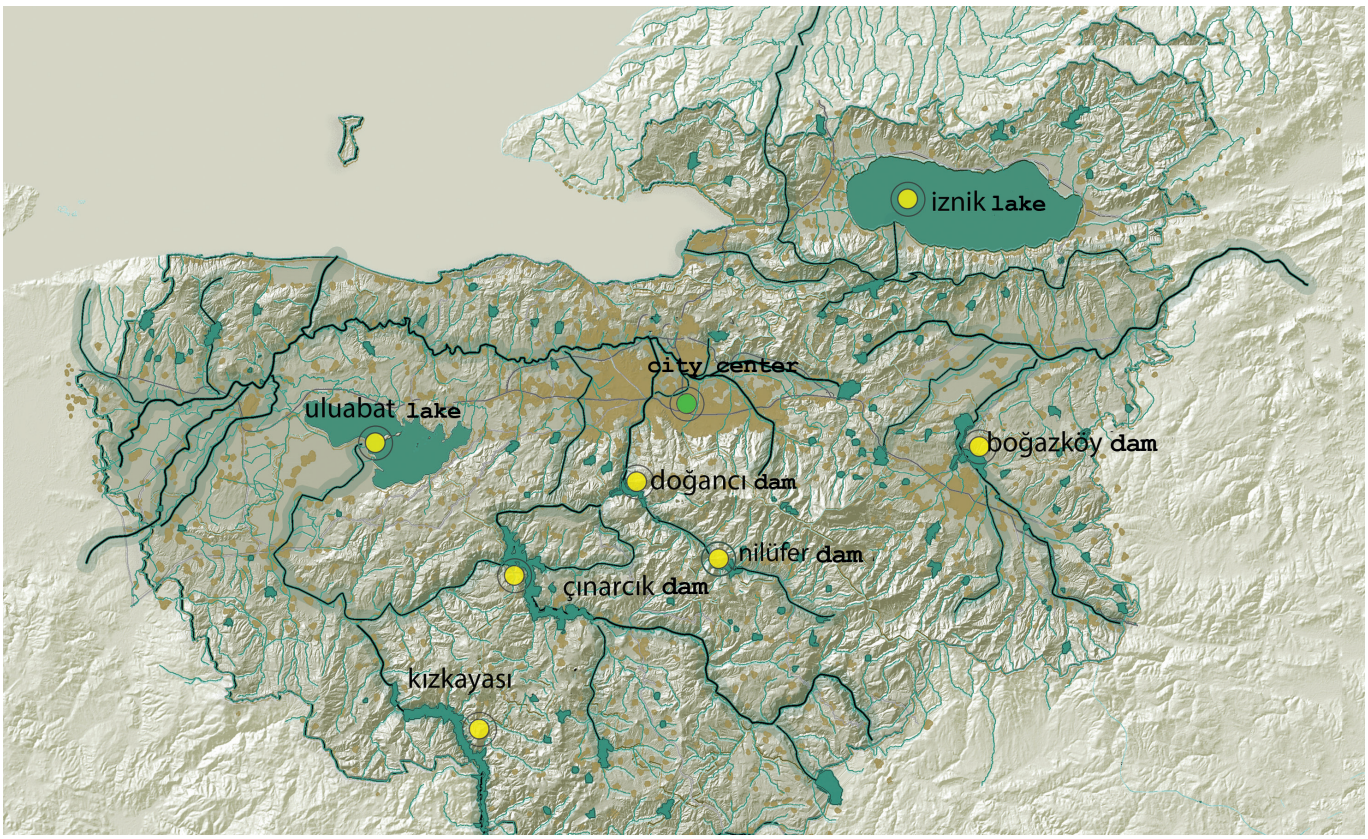


Figure 5-2: Bursa Settlement Areas and Water Map (created by using GIS data obtained from BMM)

Problems such as the frequency of the use of impermeable surfaces in the green area projects, wrong project planning, applications other than local needs, not converting to intelligent building systems should be taken into consideration whilst drainage system and rainwater management strategies are being developed.

Various suggestions were made by participants regarding the protection of water areas of Bursa city. It was emphasized that the structuring near the creeks/rivers mentioned at each stage in the workshop should be avoided by promoting green areas. It was expressed that it is necessary to take measures to protect wildlife within the scope of this issue which is also important for natural life and biodiversity. It was stated for a healthier coordination between public institutions the rehabilitation plan sections of stream beds should be processed in existing plans.

It is also stated that the damages to nature (such as wastewater discharge to Uluabat and İznik lakes) could not be prevented enough as the capacities of treatment plants in the province of Bursa are not sufficient. In this context, BUSKI has important studies and it has been revealed that the capacities and numbers of the treatment plants should be increased and that there is a need to establish control mechanisms by applying serious sanctions on wastewater. In addition, participants indicated that the waters were not sufficiently purified due to the inadequate capacity of the treatment plants in Bursa. It has been stated that the Panayır Stream was polluted due to the inadequacy of the Yeşil Çevre water treatment plant. Pollution in this area is also of capital importance because it is the main branch of Nilüfer Creek.

The creation of a green corridor and water and green infrastructure has been discussed as one of the most prominent proposals in the workshop. Considering the water and green potential of Bursa, it was determined that such actions would have a serious impact on the adaptation to climate change. However, it has been stated that there are serious shortcomings in the protection of water resources within the city as well as throughout the city. It has been found that natural species have reduced in the polluted rivers and lakes due to inadequate waste disposal.

It was emphasized that detailed researches in Bursa against the impacts of climate change necessitate pilot studies in universities. It was stated that in order to learn new concepts and examples like "Sponge city", it is necessary to determine the existing, vital problems in order to develop solution focused projects and determine the pilot areas and implement these projects.

The objectives and actions determined for Urban Water Areas are listed as below.

Objective SA1: Implementation of adaptation of water patterns (especially river/creek corridors) focused on climate change at regional, city and local scale, considering the current planning, project/investment and urbanization practices

Action SA1: Preparation of integrated plans through cooperation among institutions which is one of the important shortcomings in the province of Bursa

- For BUSKI, DSİ and local governments to form the Bursa Urban Water Management Strategic Plan jointly.
- Bringing public institutions and OIZ managers together, increasing communication between the executors and landowners.
- Especially the processing of water areas in the Zoning Plans and forbidding structuring.
- Processing of rehabilitation sections of stream beds in zoning plans for effective intervention.
- Development of appropriate urban zones at the beginning of climate adaptation.

Objective SA2: Effective flood/overflow management

Action SA2: Taking measures in risky areas against flood and overflow risks that may arise as a result of climate events

- Producing long-term solutions by considering the city's growth projections.
- Preventing illegal structuring on the rivers/streams.
- Establishment of urban green belt(s) by designing the sides of rivers/streams as green areas.
- Selection of permeable materials in urban surface coatings.
- Thinking about the passage of animals in the area to protect natural life.
-
- Placing emphasis on river rehabilitatıın and pollution control.

Objectie SA3: Effective Rain Water Management

Action SA3: Saving water using rainwater for various needs

- Reconstruction and adaptation of green area designs where there may be an excessive amount of impermeable surfaces
- Conducting work on the use of rainwater in the building complexes (eg the requirement of using rainwater for green area irrigation)
- Increasing rainwater harvesting, forming water reservoirs in the city
- Instead of raising the sidewalk for the trees and similar greenery on the pavements, to drop the elevation in order to both use area as green area and to ensure that the rainwater flows to the ground

- Formation of hobby gardens with urban expropriation. To necessitate hobby gardens in urban transformation areas.
- Application of natural urban coverings as mainly stone, soil etc., avoiding base pavement which prevents the feeding of groundwater.

Objective SA4: Awareness and Consciousness-raising Activities

Action SA4: Raising awareness among the residents of Bursa on events such as floods and overflows, drought and saving issues

- Addition of water management training, besides earthquake, to trainings related to disasters. Creation of simulation rooms for overflows.
- Demonstration of good practice examples in urban areas with applications to public institutions areas (collecting rainwater, increasing green/permeable areas).
- Ensuring correct positioning in product selection for rural areas, maximum consideration of water management.
- Encouragement and awareness raising in the use of purified/distilled water.

The Role of Institutions in Implementing the Proposed Solutions

It is clear that the climate adaptation plans and actions to be undertaken for Bursa need a very strict local/national cooperation and coordination, as the urban waters and streams are not bound to administrative boundaries. Due to the necessity of starting a basin planning scale and establishing a close cooperation with all relevant authorities in this area, the inventory of the present situation should be conducted by DSİ, BUSKI, Bursa Metropolitan Municipality, district municipalities through joint efforts.

In all regional and local plans, long-term climate scenarios should be modeled and accounted for. Whilst working in collaboration, the institutions should monitor the following indicators, not only to observe the effectiveness of the applied adaptation strategies but also to examine what way the quality of life of the citizens has changed.

Affectibility Indicators	Unit
Coastline/river affected by extreme weather events	%
Regions near elevation or sea level	%
Projections for current per capita water consumption and the years 2020/2030/2050	m^3
Change in the amount of water removed from the well or any other source	%
Change in water loss (eg leakage in water distribution systems)	%
Change in rainfall accumulation for reuse purposes	%
The overflow of rainfall due to soil leakage	%
Collected/recycled/stored/burnt solid waste changes	%

5.2.3 Public Health Strategies

There are no studies or statistical information about the possible effects of climate change on public health in Bursa. As there is no committee to investigate the impact of climate change on public health it also seems that there is no platform for institutions, universities, and NGOs to share their data. It is also emphasized by specialists that the data to be collected should be brought together in an efficient, accurate and reliable manner and shared with the relevant units.

Climate change and climate change-related environmental problems are expected to affect the most vulnerable groups of the city (elderly, children, pregnant women, people with chronic illnesses, poverty, etc.). For this reason, the health problems that exist in these disadvantaged groups are predicted to increase even more.It is the opinion of both of the representatives of the institutions interviewed during the study and the experts of the workshop that increase in skin cancers and fungi due to temperature increase and UV exposure, increase in rheumatic diseases, emergence of diseases such as West Nile Fever which has never been seen in our country, spread of allergies and diseases caused by allergies due to prolongation of pollen season, increase in respiratory system diseases particularly asthma and COPD, increase in plague and malaria due to the increase in the number of flies and rodents, increase in diseases transmitted by vectors, are among the most frequently encountered diseases as a result of climate change and related environmental problems.

The short-medium-long term solutions related to these problems were discussed in the workshop. It was emphasized by participants that it was necessary to carry out training and informing activities in this regard by giving priority to determine precisely the causes and effects of the target diseases. Another important issue is the restriction of the use of fossil fuels in the short run, the conversion to renewable energy sources in the mid-term, and the removal of fossil fuel use in the long run. In addition to these, it is emphasized that the biggest factors that cause climate change are to increase environmental awareness in the industry sector, to support environmentally friendly production techniques, and to apply environmental penal sanctions as well.

In the last part of the session, it was decided that the examination of the effects of climate change on public health, the collection of data, the evaluation and sharing of these data is very important to form a certain strategy and plan. It has been stated that a monitoring committee to address climate and health effects should be established and that data should be collected periodically. The gathering of data on a portal for all relevant institutions to have access to was one of the solution recommendations. It was elaborated that following academic and technical support the effects of climate change on health, quality of life and air pollution and the size of the threat, should be delivered to the public and an awareness should be established.

It was stated that with the necessity of cooperation between institutions for climate change, the establishment of climate change coordination in each institution would also enable a detailed preparation of the studies.

The objectives and actions identified in the area of public health are listed below.

Objective HS1: Creation of environments that will mitigate Climate Change Impacts

Action HS1.1: Creating Healthy Environments in Buildings

- Application of heat insulation in residential and commercial buildings. The local government to undertake an encouraging and supervisory role.
- Establishment of anti-allergenic ventilation systems in the buildings and ensuring the necessary inspections.
- Urban planning features to include the prevention of vector reproduction and taking into account the air currents.

Action HS1.2: Establishing a healthy environment in public spaces

- The use of natural materials that will not produce pollutants and absorb heat in areas such as parking lots and playgrounds.
- Restricting the use of fossil fuel consumption in short-term, which is one of the most important factors causing air pollution. In the medium term, the conversion to renewable energy resources and the ending of the long-term use of fossil fuels. As it is seen in many cities in Europe, to announce that after 2025 and 2030, diesel and gasoline vehicles will not be allowed in the city center.
- Use of electric vehicles in public transportation.
- Increasing environmental awareness in the industrial sector, supporting environmentally friendly production techniques and implementing strict public inspections in this regard.

Objective HS2: Execution of informative and monitoring activities regarding the effects of climate change on health

Action HS2.1: Statistics data collection and monitoring

- Following academic and technical support, the effects of climate change on health, quality of life and air pollution and the size of the threat, should be delivered to the public and an awareness should be established
- Adequate data collection in the first phase to determine the impact of climate change on public health and air pollution levels. Periodic collection and monitoring of data by establishing a monitoring committee to address climate and health effects.
- Identification of health problems related to climate change.
- Following the development of identified diseases, conducting awareness and communication studies on the subject.
- Collection of Air Pollution and related data on a portal by the Health Directorate Statistics Unit and Quality Unit that is accessible to the public.
- Collection of fertilizer and disease statistics and audit data from the Provincial Directorate of Agriculture, Food and Livestock Ministry.
- Identifying the Institutional Carbon Footprint and taking mitigating measures to set an example.

Action HS2.2: Public awareness and information

- Regularly informing about diseases that may be due to climate change and informing on how to prevent and fight such diseases
- Informing about the causes and effects of diseases.
- Making public awareness activities against the increasingly harmful effects of UV rays.
- Development of methods for safe use of indoor cooling systems and to reduce the adverse effects of climate change enhancement.
- Monitoring of existing air pollution quality monitoring studies by considering "climate change" and updating by adding relevant interventions.
- Scientific determination of climate change to public health relationship and public announcement.

Objective HS3: Reduce the impact of extreme weather events on human health resulting from disasters

Action HS3: Ensure minimum exposure to extreme weather events

- Development of early warning systems.
- Ensure that trained teams are prepared to intervene in such situations.
- To ensure health facilities and coordination units are prepared for extreme weather events.
- In case of extreme weather events, systematic information gathering of those applying to the health institutions and preparing for future precautions.

Objective HS4: Taking measures related to Drought, Nutrition and Food Safety

Action HS4.1: Ensuring water and food quality

- Providing and maintaining water quality in extraordinary situations.

- To realize basin management and integrated control, to ensure not every product is produced in every basin.
- To ensure control over agriculture - irrigation methods which has become problematic in climate change.
- Increase good agricultural practices.
- Identification of adverse effects of climate change on plant and animal breeding, creating awareness on measures.

Action HS4.2: Fight against water and foodborne diseases

- To take measures against waterborne diseases
- The effects of plant development on drought, new diseases due to drought or excessive rainfall, the increase of frost and frost damage, effects of existing plant pattern, determination of irrigation water shortage and taking necessary precautions

Objective HS5: Reduce the vulnerability of vulnerable groups to the minimum

Action HS5: To ensure vulnerable groups are not adversely affected by climate change

- To identify fragile parts of the city, including address based population registration systems, with the absolute cooperation of the Ministry of Health, Bursa provincial organizations and local government units,
- Making preparation plans for emergency and non-emergency interventions and carrying into effect the protocols of the inter-institutional cooperation.

The Role of Institutions in Implementing the Proposed Solutions

The intercommunication between institutions and data collection process appear to be very important for the solution proposals. It is considered necessary to establish an effective sharing network among local governments, Provincial Directorate of Health, Provincial Directorate of Environment and Urbanisation, Provincial Directorate of Food and Agriculture and Livestock, Provincial Directorate of Forestry and Water Affairs, BUSKI, DSİ, NGOs and the relevant units of the Provincial Executive Boards with the aim of establishing the relation of climate change with the public health and to form strategies and policies.

Affectibility Indicators	Unit
Number of injured/relocated/evacuated persons due to extreme weather conditions (hot/cold air fluctuations)	Number/year
Number of casualties due to extreme weather conditions (hot/cold air fluctuations)	Number/year
Number of hazard/problem situations for water quality	Number/year
Number of danger/problems situations for air quality	Number/year
Agricultural land lost due to extreme weather conditions (drought/water shortage, erosion)	%
Domestic animals and plants that are affected by diseases that occur due to extreme weather conditions	%
Annual harvest percentage and change in grazing area	%
Change in percentage of harvest amount due to adaptation	%
Change in water consumption in agricultural irrigation	%

In the fields considered necessary for public health, working groups should be formed where all institutions are represented and studies related to data gathering, monitoring of data on a common platform, and making suggestions about solutions are carried out. Emergency and non-emergency interventions and elimination strategies aimed at extreme weather events, heat waves, floods and overflows that may be experienced more severely due to climate change should be revealed through institutional collaborations, fire and earthquake trainings in the form of announcements and simulations must be realized.

Whilst working in collaboration, the institutions should monitor the following indicators, not only to observe the effectiveness of the applied adaptation strategies but also to examine what way the quality of life of the citizens have changed.

5.2.4 Strategies for Green Areas, Biodiversity, Green Corridors

Limiting the water system and the green area network to the urban spot makes it necessary to include the wetlands, forest areas and agricultural areas within the city fringe into the discussion due to the characteristics of the sink area. In spatial studies, it is important to draw the boundaries of It is observed that the city of Bursa has a very high potential in terms of biodiversity, green area and water.

However, with the implementations and urbanization pressures, it is seen that the existing potential is not utilized, the green areas are inadequate, biodiversity is in danger, and the capacity of existing water resources becomes debatable.

It is observed that there are serious differences between the amount of green area per capita in Bursa compared to exemplary cities (eg Stockholm 80 m2, Hamburg 39 m2). It is seen that the amount of green area per capita in Bursa (the highest figure being Ormangazi with 14 m2) is substantially different from other exemplary cities.In addition to the lack of green areas, accessibility also emerges as a major problem. Compared to the other cities, according to the required amounts, the amount of green space per capita in Bursa seems to be far behind its potential.

Figure 5-3 shows the existing green areas in the city center. Given the green area distribution, it can be said that the access to parks is very limited (brown stains cover residential, social and commercial areas).

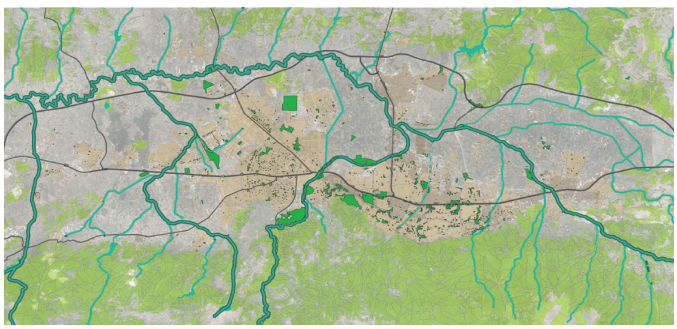


Figure 5-3 Green areas existing in Bursa city center (created using GIS data, obtained from BMM)

In the light of these determinations, actions to be taken are to improve the existing areas by creating active green areas in order to increase the amount of green area per capita.

It can be said that transportation projects should be re-evaluated within this framework. Green road sections and bicycle roads must be put into practice to provide accessibility to the green areas and to create integrity.

These proposals, which are considered to have an effect to reduce greenhouse gas effects, will also influence the urban afforestation efforts, contribute to biodiversity and greening activities for the public sector and increase the quality of the air and thus decrease diseases related to air quality.

The workshop, held on 12 October 2017, highlighted the lack of eco-innovation and emphasized the need to strengthen R&D activities supported by universities, public sector, the private sector and NGO partnerships. In this sense, it has been pointed out that studies related to climate change should be deepened in particular for Bursa and new R &D centers oriented towards solutions may create employment opportunities.

Activities related to the green area infrastructure were also discussed at the workshop. Many subjects such as green area infrastructure, parks, waterways, urban forests, rehabilitation projects, green transportation projects, integration of existing transportation projects with green, materials used for green infrastructure, afforestation and planting studies, amount of green space per capita were defined. It has been detected that there are problems in these activities and services throughout Bursa. Inadequate integration of green to rehabilitation activities of water channels passing through the city and spreading all over Bursa and the use of impermeable surfaces within the scope of the rehabilitation projects has been emphasized to cause not only a negative impact on climate change adaptation but also problems in the urban green space infrastructure of the city.

One of the most important problems expressed at every stage of the workshop was the problem of accessing the green areas. It has been stated that according to the distribution of residential areas, as it is difficult for residents to access green areas/parks, people end up having to drive to access green areas/ parks/ playgrounds. CO2 emissions are therefore increasing and contributing to transportation density. In order to prevent such vehicle usage, it was emphasized that public transportation should be developed and access to green should be ensured.

It has been stated that in the areas where residential buildings are being renovated in the process of urban transformation and in the new development areas, large pavement sections (such as park roads) and bicycle paths should be planned jointly. In addition, it was emphasized that efforts should be made to improve the sensitivity of Bursa Metropolitan and district municipalities on the planning of climate-sensitive neighborhood units and implementation of new housing environment models within the scope of urban transformation projects.

It was emphasized that especially the city of Bursa in Turkey has a significant importance in terms of biodiversity. The region where Bursa is located has become prominent in terms of its hundreds of endemic plant species within its boundaries, the population of animals in danger of extinction, natural resources and unique geographical features. Participants have often made upper scale approaches and suggestions for biodiversity. Although concrete examples at a city center scale were not included, a corridor could be achieved by creating blue-green harmony with the stream rehabilitation projects passing through the city. It has been emphasized that the rehabilitation projects with green infrastructure should be of a quality that will increase biodiversity with the necessary vegetation studies. The parks in the city center which were stipulated to form the corridor, particularly the Soğanlı botanical garden, enhance biological diversity. The need to develop, popularize and protect these areas were highlighted.

In the sustainable energy action plan prepared for Bursa, future plans have been developed by presenting important information from the current situation. CO2 emissions reduction rates as a result of transport activities, strategies to reduce greenhouse gas emissions, mitigation activities related to energy resources, and indicators related to waste management were presented. In line with these indicators, it has been emphasized that projects related to transportation should be developed and targeted values should be reached.

Green integration of the tram line operating in the city center of Bursa (green section will be created and CO2 reduction will be provided), the development bicycle network and connecting it the regional parks, pedestrianizing of certain roads was expressed as the primary projects to be carried out. In relation to the noise problem and its solution discussed at the workshop, it was revealed that the noise barrier along the Balat Highway is inadequate. In this context, the 3500-meter noise barrier n the city of Hamburg in Germany to mitigate noise pollution between the highway and the city, as well as the continuity and accessibility of the green corridor surrounding the city, which is integrated with the Elbe River can be shown as an example.

As a result of the workshop, it was understood that projects integrating the existing transportation projects with green areas, projects increasing the use of bicycles, projects encouraging the reduction of vehicle usage and the projects to develop public transportation should be reassessed. In addition, it was emphasized that a green corridor should be formed in absolute terms by taking into consideration the urban water and green areas.

The objectives and actions identified within the area of Green Areas, Biodiversity and Green Corridors are listed below.

Objective YA1: Increasing the amount of green space per capita in a balanced manner to ensure accessibility for all citizens

Action YA1: Preventing structuring on existing green areas and the creation new green areas

- Preventing green areas and plains from opening up for structuring
- The spread of the green system into the city through the network of street trees.
- Prevention of housing on historical sites and greening, use of green noise barriers (Heykel, Altıparmak, Setbaşı)
- Creation of a green belt from Althınşehir to Batıkent in the Nilüfer District, and an accessible urban park.
- Improvement bicycle network and creation of links to the corridors and the city.
- To ensure the parks are integrated with green and soil infrastructure, to bring benefit to the emission reduction by establishing solar-powered walkways
- Reforestation of playgrounds, popularizing of green roofs, especially in public areas.
- Establishment/increase of city gardening zones
- Protecting green areas in Bursa (which is 45% forest) and ensuring that the citizen consciously make use of the green areas by exploring active use possibilities
- Realization of sustainable green assets within the city's residential areas by applying real estate tax reductions in constructions that have limited tree entities and building floor space.
- Establishment pedestrianization projects on boulevards (such as Atatürk Street, Cumhuriyet Street)

Objective YA2: Air pollution management by means of green areas
Action YA2: Taking related measures in areas where air pollution is high while planning green areas

- Application of retaining walls as green retaining walls for required places, increase of green surfaces by applying in residential areas besides roadsides as well.
- Based on the examples in the USA, activation of idle underground viaducts for public use by greening
- The use of permeability base material on the rehabilitated streams and the green integration of the water channels.
- Actualizing vertical gardens (vertical gardens) as a solution for noise and air pollution
- Installing turf on tramway routes (İzmir - Barcelona examples).
- Construction of noise barriers for highway noise pollution (between Altınşehir-Ertuğurul metro stations) To reconstruct Balat highway noise barrier as it is not high enough
- Creation of projects that link green bicycle paths with open large and small public spaces, development of green bicycle paths, the creation of green roads using paved roads instead of asphalt roads in promenades.
- Assessing the current situation by relating transportation systems to green - Removing adverse effects by producing solutions.

Objective YA3: Conservation and increasing biodiversity

Action YA3: Take various measures to prevent biodiversity decline

- Development of activities for the conservation of wetlands, which are of great ecological importance as sinks.
- Performing rehabilitation work in the creek beds, using plants that help to clean the water (biofilter) at the same time. Thus, contributing to the protection of biodiversity on this issue.
- Creating awareness to avoid invasive fish, reptiles, tree species applications that may cause to mix with the natural flora and fauna (eg avoiding the use of invasive plant species in afforestation in open green areas).
- Precautions should be taken on high voltage lines which are on bird migration routes to prevent bird deaths
- Establishment of wildlife bridges in Mezitler area on the road of Bursa İnegöl, preventing the death of wild animals on the highway.
- Creation of corridors to connect the protected areas (Uludag-Uluabat Lake Wetland, Kocaçay Creek Wetland). Placing transitions between areas of natural habitats, especially in areas with highways
- Implementation of pilot regions for the use of vetiver plants.
- Establishing edible gardens, giving weight to organic food or creating awareness
- Distribution products such as small-sized seeds which can easily be planted, looked after in home gardens.
- Promoting the production and use of worm-fertilizer, thus the reduction of household waste

Objective YA4: Educating and Awareness

Action YA4: Raising awareness of citizens about biodiversity, conservation areas

- Increase the employment opportunities associated with R & D and green-eco-innovation.

- Increase training and awareness-raising activities regarding the protected areas
- Conducting awareness-raising activities by creating a center that provides education on ecological based nature ethics (Nature education in nature)
- Child traffic training tracks should be built and these tracks can also be used for bicycle training
- Project design by including citizens under the name of green area design award project

The Role of Institutions in Implementing the Proposed Solutions

As it is in the case with urban waters/streams, the cooperation of local government units and national institutions is valuable. The Green-Blue integration, continuity, and linkages required to be integrated and planned as a whole with urban stream management. The strategy of the local government to transform the city into a pedestrian and bicycle -friendly city and to transform urban transport should be considered together with green-blue integration in a similar way.

Therefore, it is important that the upper-scale planning of the BMM (with the contribution of transportation, landscape and development units) should be executed jointly with the cooperation of institutions such as Provincial Directorate of Environmental Planning, DSİ, BUSKI.

Whilst working in collaboration, the institutions should monitor the following indicators, not only to observe the effectiveness of the applied adaptation strategies but also to examine what way the quality of life of the citizens have changed.

Affectibility Indicators	Unit
Protected (ecologically / culturally sensitive) areas and forest covered area	%
Soil erosion, land with soil quality problem	%
Habitat loss due to extreme weather conditions/event	%
Livestock destroyed due to extreme weather conditions/events	
Percentage of change in forest composition (transitions / losses between tree species)	%
Decrease in number of animals due to extreme weather events	%
Livestock lost due to pesticides and pathogens	%
Disappeared forestry due to pesticides and pathogens	%
Change in interconnected green & blue surface areas	%
Change in the combined green-blue areas	%
Impermeable surfaces and change of soil moisture percentage	%
Designated shoreline as a result of basal slip	%
Protected species and salvaged habitat	%
Saved / rehabilitated forest land	%
Coastal/creek/river/shore areas	%
Decrease in domestic species	%

5.2.5 Strategies for Administrative Organization and Planning

As already mentioned, an effective and successful fighting process requires close cooperation and coordination between different institutions and sectors. Various proposals have been developed taking into consideration the opinions of representatives from non-governmental organizations, professional chambers, metropolitan municipalities and district municipalities as well as representatives from public institutions and institutions on how administrative organization, planning and governance mechanisms should be set up in terms of Bursa Climate Change Adaptation Strategies.

Because the administrative organization and planning topics include the governance tools and mechanisms mentioned in the other topics, the results of this session should be addressed not only within themselves but also with other compliance strategy headings.

When questioned in what areas of the social, economic and environmental scope the adaptation strategies to urban climate change can be effective and beneficial and in which the thematic strategy areas can be realized in order to realize the possible benefits; waste management plans, sustainable energy action plan, transportation master plan, disaster risk reduction plan, the necessity of integrating environmental planning, corporate strategy plans and contingency plans is critical and must be taken into consideration.

The requirements for sustainable governance within and between organizations can be grouped into four sub-headings by centralizing individual-institution interaction. Participation in adaptation to climate change needs to be established by using innovative methods (eg playing, experience sharing). It should be emphasized that the inclusion of civil society is critical. Beginning with the individual, communication is one of the most important parts of the sustainable management of climate harmony. Establishment of a solution-oriented knowledge bank, effective utilization of technology support for informing purposes, making public information publicly available and establishing effective announcement channels should be given importance.In order to increase individual/community support for adaptation to climate change, it is especially important to support capacity development of NGOs in a financial direction. In this group, suggestions related to education as the last sub-title stand out. It is suggested that education will serve to develop ideas and spread to the society in general at various scales and sizes. In addition, units such as "Environmental Awareness Offices" must be in the municipal organization in order to improve the contribution at the local level in the organizational sub-heading and to establish a continuous flow.

In the last part of the workshop, a discussion was held on what is needed to develop in regards to monitoring climate adaptation and evaluation systems, and each participant then created their own proposal by entering topics, users, and data as subheadings. The information provided in these areas reflects a need program in which a monitoring system that can monitor real-time results of the results of adaptation to climate change, including what should be the priority.

Accordingly, the participants requested to monitor city-specific environmental data (eg air pollution) and performance (eg green area distribution). It has been pointed out that the management panel needed to be developed in terms of the use of various user groups (NGOs, public institutions, local residents). In addition, the qualities such as acquiring data in a participative method, including estimations and projections, information containing about upper and threshold values and real-time representation were emphasized.

The following were summarized in order to improve the environmental, social and economic benefits of Urban Climate Adaptation Strategies (eg green employment) and to match them with other thematic strategies and areas.

In order to increase these environmental, social and economic effects, it is important to integrate the Climate Harmonization Strategy with other existing or planned plans listed below in the province of Bursa.

- Waste Management Plans,
- Sustainable Energy Action Plan,
- Transportation Master Plan,
- Disaster Risk Reduction Plan,
- Environmental Plan,
- Corporate Strategy Plans and
- Emergency Plans should be benefited from.

The idea of sustainable governance, starting from the individual, in the implementation of the Climate Harmonization Strategy in order to ensure the sustainability of the organization and its institutions, was discussed using the onion ring model and ideas were produced. Proposals on participation, communication, financing/procurement, training and organization were presented.

Participation

- In order for comprehensive and active participation to take place, it should be ensured that all parts of the society are reached and encouraged through interesting methods.

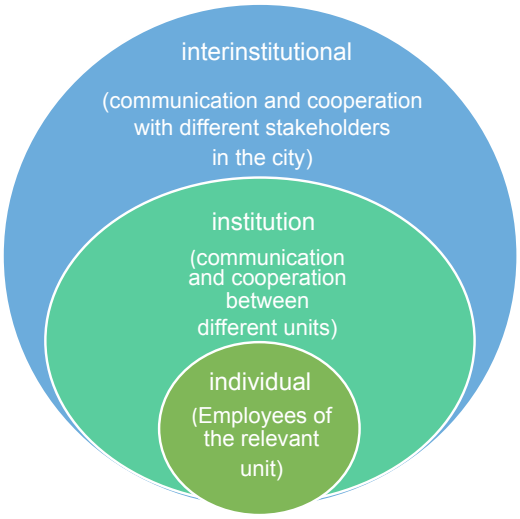


Figure 5-5: In-house and inter-institution communication model where the individual is in the center

- Collaborative projects with non-governmental organizations should be developed for the implementation of climate adaptation.
- Regular domestic and international visits to different groups should be organized to ensure participation and enhancement. Examples of strategies should be observed on site.

Communication

- The developed physical, organizational, etc. solution set should be shared within an online solution database between the organizations.
- Institutional access to new technologies should be made absolutely available, and internet-supported access points (eg kiosk) should be created.
- In public areas of the city, digital information panels where the effects of climate change can be traced, maps of dried river-river beds, maps showing habitat diversity, information panels about what climate change means and how results should be available.
- Banners, billboard type high publicity tools should be in people-intensive areas such as public transportation, shopping malls.

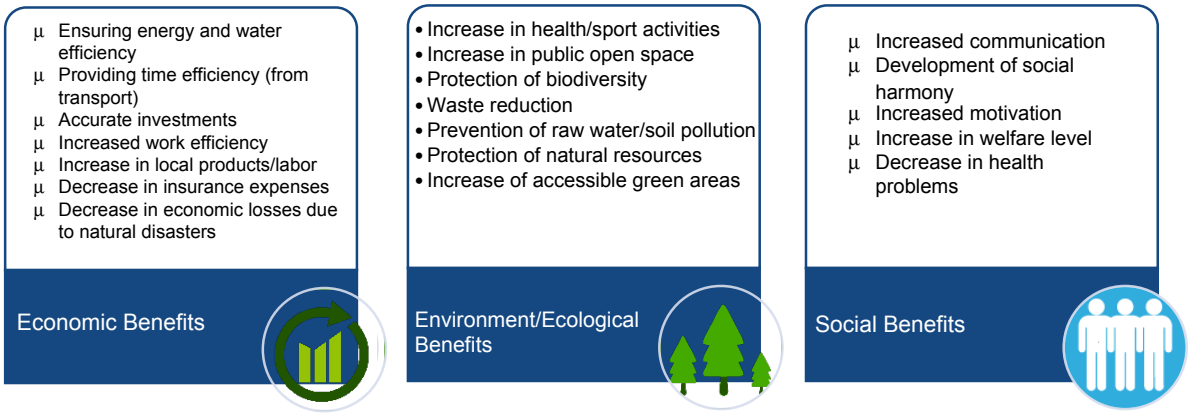


Figure 5-4: List of possible benefits that can be achieved with the Climate Adaptation Strategy

- Projects related to climate adaptation within the institution should be carried out in coordination from an R & D point of view.
- All kinds of communication channels should be used to reach every age group and opinions should be taken.
- For requesting, suggesting, complaining notifications, a common web interface should be available across Bursa and it should be open to all institutions and the public.

Financing/Procurement

- Private sector organizations and NGOs should be included during the execution phase of the projects and the co-financing should be provided.
- On financing; national (eg Ministry, Agency support) and international (eg EU support) resources that may be relevant to climate change issues should be investigated and provided.
- NGOs who are enthusiast about working in climate adaptation should be supported and encouraged to work with local governments.

Training

- Students should be given practical lessons on climate change adaptation (eg geography), information on practical knowledge that can be used in everyday life, and legislation reduced to rights and responsibilities
- Raising awareness on mitigating climate change and adaptation through in-house trainings
- Protocols should be developed for inter-agency cooperation (eg university-municipality) in the framework adaptation to climate change
- Intra-institutional, in-house, regional and neighborhood-based project competitions should be held in the field of climate adaptation
- A certain region/area should be selected and sample applications should be carried out with the participation of institutions and the public.

Organization

- Environmental awareness bureaus should be established
- Data monitoring-statistical-follow-up center should be established
- Plan monitoring and a supervisory board should be established.

Objectives and Actions related to administrative organization and planning are listed below.

Objective AO1: To formulate proposals for the tools and mechanisms that should be formed in the transition process of urban climate adaptation strategies, ie spatial planning/ design processes (eg green infrastructure plan, guidebook, handbook, biodiversity plan, green infrastructure implementation action plan)

Administrative tools and mechanisms that can be used during the transitioning to climate adaptation strategies have been addressed in a variety of fields that can be grouped from physical means to institutional collaboration, from legal and administrative regulation to education/awareness studies.While attention should be paid to the need for prioritization of training/ awareness studies on these topics, the lack of institutional collaboration culture and the need for coordination structures (eg Consultative Committees, Strategy Management Center) have been determined. The awareness and feasibility of the mechanisms that will allow the operational activities, such as the green infrastructure plan, guidebook, handbook, biodiversity plan, green infrastructure implementation action plan, exemplifying what contributions may contribute to climate change adaptation to the spatial planning and design process, should be analyzed. Some suggestions for singular solutions of structure and reinforcement scale are provided under the physical means subheading.

Action AO*1.1:* Physical Means

Public Open Spaces

- To be attentive to use local materials and the ecological footprint that is created in the selection of urban furnishings in public open spaces.
- Establishment of implementation guidelines on issues that affect climate change such as social appropriateness, transportation, infrastructure, urban heat island effect during the designing phase of recreation areas
- Segregation and creation of green areas taking into account the increasing population and migration while planning social areas in city centers.

Building Groups

- Emphasis on the use of heat pumps in air conditioning.
- The use of renewable energy sources in municipal and institutional buildings and increasing the number of green building systems (eg panoramic museum). Encouraging private properties in this regard.
- Storing and efficient use of rainwater

Environmental Systems

- Effective methods for disposal of city wastes, both energy and waste heat utilization, and fertilizer production.
- Increase the efficiency and the spread of public transport systems.

Action AO1.2: Establishment of the province-wide organization through institutional cooperation

- Establish an effective advisory body with NGOs.
- Taking the necessary coordination decisions in order for the results of the climate adaptation strategy to enter into operational programs and be added to institutional action plans.

- Establishing inter-agency joint projects for climate adaptation.
- Integration of climate alignment strategy with Provincial Disaster and Emergency Plans.
- Informing and creating awareness for managers and decision-makers, making necessary duties on this subject and carrying out sustainable working in practice
- Establishment of Strategy Management Centers.
- Establishment of an executive organization for all institutions and climate adaptation plan on behalf of the city (eg under the governorship).
- To make regular inter-institutional meetings, to follow the progress of the studies and to see if there are any new studies.
- Establishing an implementation guide to coordinate the basic principles for the determination of the collective strategies of the District Municipalities and the Metropolitan Municipality.

Action AO1.3: Legal - Administrative practices

- Establishment of technical infrastructure works to ensure compliance with BMM Zoning Implementation Regulation and the strategy, regulation studies, provision of transitions between applications and establishment of a supervision mechanism
- Ensure public participation in local government regulations aimed at climate adaptation
- Conditions and application tools towards climate adaptation strategies to become a set of criteria and become the conditions of construction in tenders
- Establishment of infrastructure/conformity by specifying rules for incentive instruments / penal sanctions for climate adaptation (eg supervision of industrial zones).

Action AO1.4: Education / Awareness

- To transfer the training work (play) conducted by the Bursa Provincial National Education Directorate on energy efficiency to other institutions as an example of good practice
- Scientific Technology Center to introduce informative games about the climate
- Prepare billboards, banners, and brochures to raise awareness about climate change, and prepare advertisements for broadcast on television channels
- To effectively relay the strategies developed by institutions on climate change adaptation to individuals and institutions via local media (specialized TV, radio programs, press releases, etc.), theater plays, short films, etc.
- Organizing seminars and workshops for informing individuals and institutions within the context of the Urban Climate Adaptation Strategy
- Periodic measurement of the feasibility of Emergency Action Plans and sharing of results with relevant institutions
- Experts to conduct awareness-raising activities on global warming and climate change, especially starting from primary schools
- Coordination of local administrations to adapt school education to climate change in everyday life
- Explaining the economic and environmental benefits provided by green building systems to developers and users in urban transformation applications and to distribute it as handbooks.

Objective AO2: Creating a Climate Adaptation Dashboard (green dashboard)

Action AO2: Real-time aggregation, modeling and reporting of critical data, mapping and evaluation of ecosystem services, identification of work to be done to build knowledge base and planning and management work. Compilation of user and administrator information

The Climate Adaptation Dashboard was deemed appropriate to be summarized by the proposals as under three main headings

Topics

- Demonstration of quality information of water resources (pollution, wastes, diversity etc.)
- Detection of the condition of the stream beds (stream bed protection area,
- flood-overflow risks)
- Green area distribution and usage/user profile setting
- Demonstration of natural building components (basin, plains, and natural habitats)
- Providing traceability of infrastructure work
- Monitoring of environmental pollution indicators, meteorological data, ground survey results
- Calculation of carbon footprint for consumed products (electricity, etc.)

Users

- Public, institutional experts, Identification of NGOs

Data

- Determination of dynamic traceability of data such as daytime, weekly, monthly, yearly of transportation and meteorology
- Modeling and displaying boundary and threshold values
- Ability to create forecasting and projection based scenarios based on various parameters
- Ability to conduct comparative analyzes

Figure 5-6: List of suggestions for the Climate Adaptation Dashboard

The Role of Institutions in Implementing the Proposed Solutions

The theme of administrative organization and planning addresses the physical cooperation of the institutions and their relations sharing at various levels. In the context of the current Report, while the Climate Adaptation Strategy is directed towards the Bursa Metropolitan Municipality, the necessity to develop a national plan and approach in term of the central government is still continuing.

The need to include this National Plan in Turkey's Climate Strategy and Adaptation Plan is quite apparent. Nevertheless, It would be appropriate for the metropolitan municipality's existing upper-scale planning to include climate-harmonization considerations, which has already been initiated to close the gap.

As can be seen in the above proposals, in terms of Administrative Organization and Planning, the tools and mechanisms that should be established locally in the transition process of urban climate adaptation strategies, in other words, suggestions about spatial planning/design processes are being addressed.

Whilst working in collaboration, the institutions should monitor the following indicators, not only to observe the effectiveness of the applied adaptation strategies but also to examine what way the quality of life of the citizens have changed.

Affectibility Indicators	Unit
Current population and 2020/2030/2050 projections	Number
Population density (compared to country population density), person/km2	Person/m^2
% shares of sensitive population groups (over 65 and under 25, lonely people, low-income or unemployed people)	%
Population living in areas with risk of flood, drought, heat wave, forest/land fire	%
Areas not accessible to ambulance / fire department in case of emergency	%
Number of days of service interruption (energy, water supply, health, civil defense, emergency service, waste)	Number/year
Number of hours of service interruption (energy, water supply, health, civil defense, emergency service, waste)	Average hour
Intervention of police/ambulance/fire brigade due to extreme weather conditions/ incidents	Minute
Change in tourist flow and activity	%
Budget allocated for adaptation studies / surveys by the city and other stakeholders	Euro/year
Investment value in education, health emergency systems	Euro/year
Length of highway/railway in areas with risk of flood, drought, heat wave, forest fire (via planning/map)	km
Direct economic losses (commercial/agricultural/industrial and tourism sectors) based on € due to extreme weather conditions	Euro/year
The amount compensated annually on the basis of € (insurance etc.)	Euro/year
Number of awareness-raising activities focused on citizens and local stakeholders	Number/year
Number of training aimed at the team	Number/year
Number of direct beneficiaries involved in decision-making for the adaptation processes	Number/year

6 Climate Change Adaptation Plan Solution Proposal for Bursa City Center

This chapter will be covered under two main topics. In the first part, the kinds of strategic approaches the cities have developed for the struggle against climate change and how they are addressed with current trends will be emphasized. This chapter will give clues for basic approaches that can be put forward for the Bursa City Center. In the second part, Bursa City Center's approach to climate change adaptation will be evaluated and inferred in terms of planning-design systems in the first part.

The new process, in which human-shaped environments are dominant, has brought forward environmental problems posed by industrialization, urbanization and dense population movements. According to the UN population projections, it is reported that our country will be the 19th most populous country in the world in 2050 with 96 million people (UN, 2017). Therefore, if the tendency of urbanization continues as it is, the increasing pressure of urbanization on the climate system will become a major problem. There are three main reasons for this situation:

Urban areas, with a population density of millions of people, are the areas that are most affected by the impacts and threats that arise as a result of climate change. These effects and the dimensions of the threats depend on the city's location, demographic structure, socio-economic structure, physical infrastructure, quality of built environment, preparedness against disasters and institutional structure.

Urban areas are responsible for 75% of natural resource consumption and 80% of global greenhouse gas emissions.

Due to the population increase in the cities, it is estimated that the amount of built-up area will triple by 2030 in developing countries and 2.5 times in developed countries.

The impact of climate change on cities will emerge due to changes in extreme events and changes in averages over many years. In this context, the occurrence hydrological hazards (such as overflow-sudden overflow, extreme winds/ coastal floods, mass movements-rock falls, landslides, wreckage), meteorological hazards (such as hurricanes), climatic hazards (extreme temperatures, drought, fire) are likely to increase. As for the effects that may emerge over time, it will affect the built environment (floods, heat island), infrastructure (water, sewerage), human health, biological diversity, air quality and socio-economic structure.

Within the strategies to combat climate change effects, we can refer to two basic approaches: (1) mitigation (2) adaptation. In an urban context, these combating strategies should be supported by sustainability and durability, which are urban resource conservation strategies (Figure 6.1, Figure 6.2).

Azaltım stratejisi Bursa için hazırlanmış olan “Sürdürüle-

The mitigation strategy, as seen in the "Sustainable Energy Action Plan" prepared for Bursa, is based on the direct reduction of carbon emissions, which is the main source of climate change, and includes practices such as carbon storage and sinks, reduction of energy demand, reduction of vehicle demand by providing opportunity for recreation in the city and its vicinity, and enabling food production in the city and its immediate vicinity. The adaptation strategy aims to mitigate the effects of climate change and, thus, improve the quality of urban life. The adaptation approach focuses on managing high and suddenly changing temperatures, managing water resources, reducing flood and soil erosion, and reducing coastal floods. In the urban struggle with climate change, it is important to establish a sustainable and durable city structure against long-term and sudden effects.

Hence, it is possible to make cities more resistant to shocks such as climate change by providing sustainability through long-term mitigation and adaptation strategies that can respond to sudden changes. As cities take mitigation and adaptation strategy actions with resource conservation logic, it will be possible to enable a transformation process that provides an integrated perspective on tackling climate change (Figure 6.3).

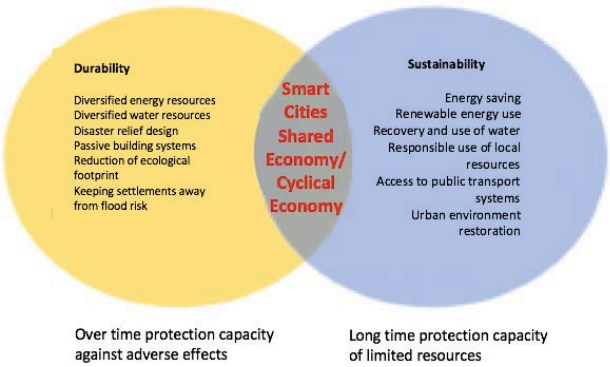


Figure 6-1: Urban resource conservation strategies

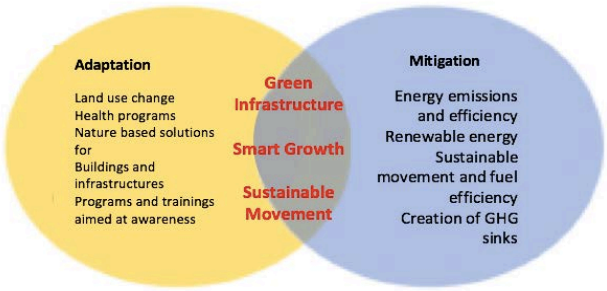


Figure 6-2: Climate change combating strategies

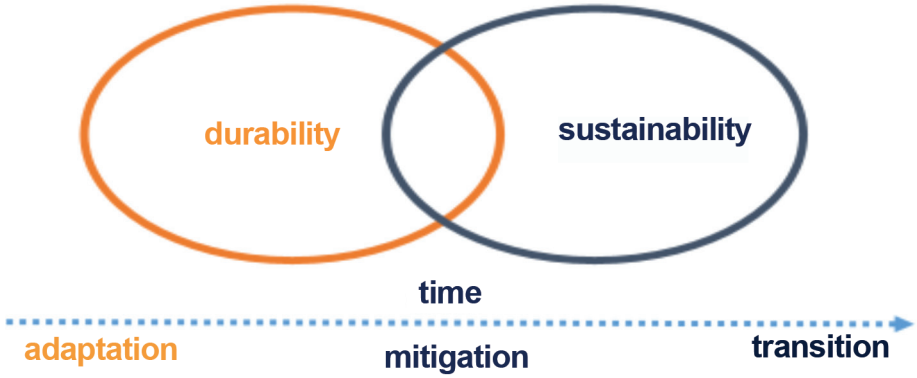


Figure 6-3: Integrated approach framework for climate change combating strategies

In this study, it is very important to benefit from the experiences of world cities in the theme of adaptation to climate change summarized under five main topics and to develop new strategies consistent with Bursa:

The first heading includes the long-term implementations in terms of reducing the effect of urban heat island, decreasing intensity in urban areas and reducing pressure. Especially for urban areas such as Bursa, with ongoing rapid urbanization and dynamic development, it is necessary to reduce the damage to the environment created by growth and to improve the comfort of the citizens by reducing the heat island effect resulting from the excessive intensity of the cities.The development strategies of urban anti-fringing that are developed within the control of growth and development in the world can be evaluated in this sense.

Figure 6-4: Green belt and wedge strategies applied during the growth control and renewal of cities

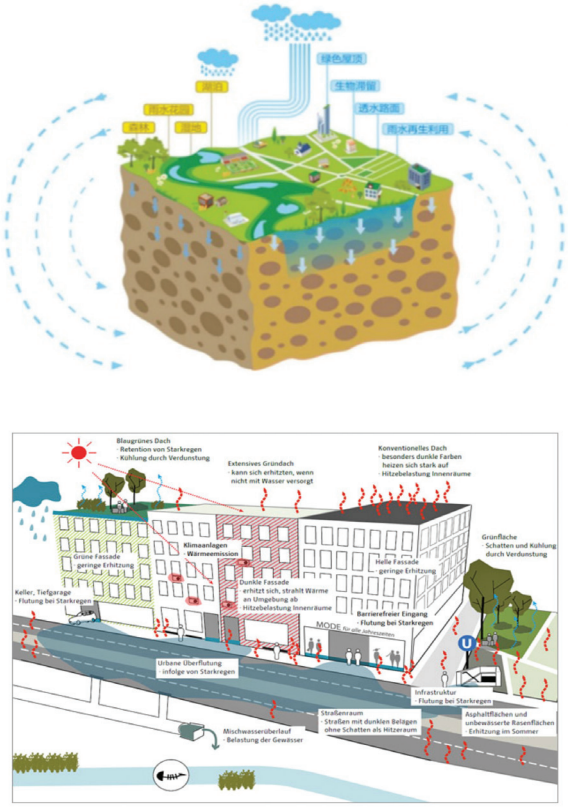


Figure 6-5: Sponge city approach to reduce flood-overflow risks and conservation of water cycle

Building urban green belts, controlling urban growth and urban service boundaries, encouraging low ecological footprint growth, creating green innovation practices in central areas where the city's heat island effect is felt most intensively, and pedestrian-cycling friendly public transportation are some of the development methods (Figure 6.4).

The water areas discussed under the second heading have an important place in urban climate change adaptation strategies. Design concepts such as water-sensitive urban areas (WSUD) are also developing in this direction. In water-sensitive urban areas; water management, conservation, management and protection of natural hydrological and ecological cycles are integrated with urban planning and design. Recent solutions of sponge city are being tested in cities where water-borne urban threats are experienced (Figure 6.5).

Underline Douglas Metrorail Station Before

Underline Bike Repair Kiosk After

Figure 6-6: Use of idle areas towards improving urban health, Miami Underline project

Public health, which is analyzed under the third heading, is one of the outstanding issues in terms of raising the quality of urban life in climate adaptation process. This can involve a number of practices, such as sustainable mobility solutions that can help improve the quality of urban life with the support of individual well-being, and the reuse of unhealthy areas in the city (Figure 6.6).

The fourth thematic area, green spaces, biodiversity and corridors, refers to what needs to be done in terms of human-nature adaptation, one of the most fundamental issues in the climate change adaptation process. Includes benefits such as; establishment of a green-blue network system for conserving and improving biodiversity, balancing the amount of green area, access and distribution, as well as the benefits of reducing heat island effect (Figure 6.7).

It is seen that the city of Bursa has a very high potential in terms of biodiversity, green area and water. However, with the implementations and urbanization pressures, it is observed that the existing potential is not utilized, the green areas are made inadequate, biodiversity is in danger, and the capacity of existing water resources is debatable.

Inferences for Bursa City Center

The administrative organization and planning addressed in this report and in the workshop held with Bursa city actors demonstrated that we must focus on how we can integrate the urban strategy tools outlined above and the strategic tools that stand out in climate adaptation.

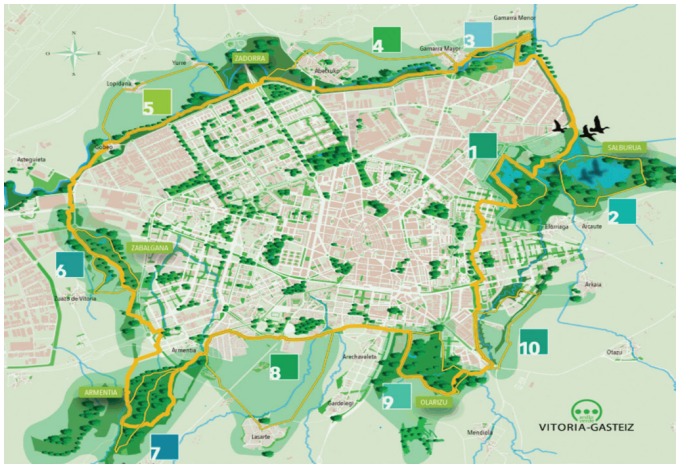


Figure 6-7: Vitoria-Gasteiz: Supporting areas such as biodiversity and public health with the green network system

Some of the lessons that can be drawn from here will serve as a guide for the green transformation of the Bursa City Center, which is referred inferences under this section.

From the point of view of the examples from around the world and from Turkey, the first inference is related to the responsibility of local authorities: "Climate should be owned locally as a urban common, natural constitutional components in the context of climate change adaptation should be prioritized in the identification and protection of urban identities".

Defining the topic of climate as urban common should be a fundamental task for cities, that are responsible for a significant part of climate change impacts. In this context, it is important that the mitigation and adaptation efforts put forward against the struggle with climate change are supported by the national and international networks and collaborations formed by the cities. At the national scale, Bursa being a member of "Turkish Healthy Cities Association" and on an international platfrom Nilüfer Municipality and Bursa Metropolitan Municipality being among the 13 settlement areas to sign the EU Covenant of Mayors, which has over 7,000 members, are important steps.

In addition, the preparations of the Bursa Metropolitan Municipality during the application process of the 'European Green Capital' and the efforts carried out by the influence of international environmental networks are significant achievements. In the results of the self-evaluation carried out within the scope of this study, the fact that the capacity of "Administrative Organizing and Planning" has passed the initial phase and is in the development phase verifies the process.In order to make these steps more concrete, the development of local networks as well as participation in national and international networks are important. Again in the expert workshop, suggestions made about local ownership and organization are shedding a light on the issue. For example; "Environmental Awareness Offices" are among the proposals developed for the inclusion of actors outside the local government within the context of local adaptation to climate change.

In the workshop, it was stipulated that the institutional capacity, which is determined to be at the beginning of the developmental stage, can make a breakthrough in a short period of time with the realization of proposals on training and awareness activities aimed at local ownership of the subject (such as playing, curriculum, information boards etc.).

Natural building components have a determining role in the formation of urban identity. The expression of Green Bursa or Evliya Çelebi's characterization of Bursa as a water city is an expression of identity (Figure 6.8). At the same time, urban ecological corridors formed in a long-term such as 'seven-hill' view of Istanbul, city parks like London Hyde Park and New York Central Park, natural waterways and park systems like Boston Emerald Necklace, besides being a natural heritage are the identity of the city, which symbolizes the city's unification with nature.

(1) ecological values are not considered as the basic component of identity in the formation of urban identity; (2) there are deficiencies in the inventories of natural systems and are not defined in urban identity components; (3) the inability to integrate open and green space system design, which has an important place in the formation of urban identity, into the existing spatial planning process are among the issues while addressing natural systems as urban identity. Sharing of the works prepared within the framework of adaptation to natural structure and climate change on the principle of "open data platform" will be the basis for localization and ownership process. In the workshop, actions, in order to achieve a development in this direction, was shared.

The second inference as a result of literature review in the process of Bursa City Center's adaptation to the climate change, institutional correspondences and workshops, were "a multi-scale approach to climate adaptation should be established in urban areas".

Cities are ecosystems that contain natural structures and systems, as well as the interaction of cultural and natural structures, besides being intensified areas of anthropogenic activity. The ability of cities to sustain their ecosystem functions in a balanced and healthy way may be possible through planning practices with an ecosystem perception. However, in the present case, the system which approaches with physical planning within a hierarchy such as the zoning plan, the master building plan, the environmental plan in terms of urban settlements, considerably excludes the ecological scale and concepts.

A form of understanding formed at different ecological scales will be a pioneer in the development of tools and mechanisms, that is one of the most fundamental deficiencies in the climate change adaptation process. In the thematic presentations within the scope of the workshop, bio-zone (basin, sub-basin-micro basin), ecological region (eco-zone / zone, ecocity/village), urban green network/infrastructure and nature-based solutions, appear to be key concepts to realize the multidimensional approach mentioned earlier. "Landscape Atlas" (eg completed in 2016 for Yesilirmak Basin), macro-evaluation based analyzes such as "Landscape Character Analysis and Evaluation on a Region-Sub-Region (Province) Scale", "Urban Pollution Maps" (air, water, soil, noise, light, radiation, thermal, radio spectral pollution etc.) which can serve as a guide for climate adaptation within the scope of city center, together with tools such as "urban climate maps / atlas", a greenhouse database, carbon/water footprint measurement maps that can be used in the mitigation process is critical to the sustainability of natural systems in the city. These issues should be carefully developed during the implementation of the Bursa Climate Adaptation Strategy.

In addition to the analysis and useful new tools mentioned above, there are also issues to be developed within the framework of climate adaptation strategies in the sense of urban design. In order to improve the sustainability and durability of the cities, different ecosystems (stream, agriculture, built environment, etc.), whether natural or artifactual, requires a good understanding of its function and need to be reflected in design decisions. In planning, basic criteria such as topography and hydrology, which constitute the main backbone of the city and are effective in acquiring an identity, are lost as they move towards sub-scale plans.

Cities will be more affected by the increase in extreme events as a result of climate change. In this context, parks and recreation areas for urban sustainability should be maintained as "critical infrastructures" in today's fragile and volatile urban environment.

Figure 6-8: Natural building heritage as an identity feature: Bursa İnkaya Monumental Plane Tree and Uludağ

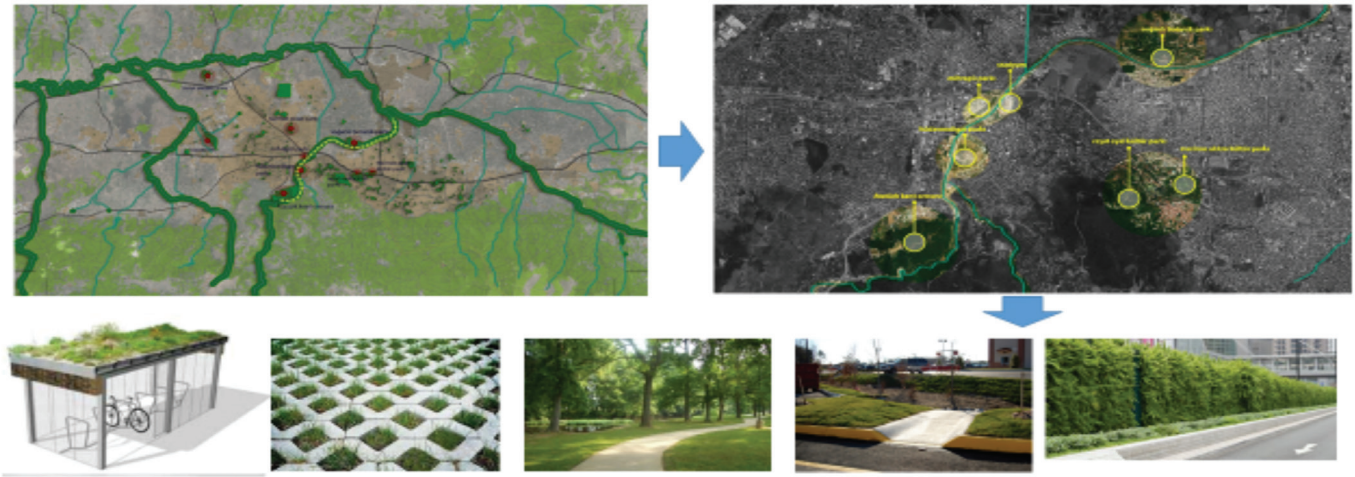


Figure 6-9: Multi-scale green corridor proposal for Bursa City Center

In this context, a green-blue network proposal was presented for Bursa City center based on a literature survey, institutional interviews and expert workshop results during the Bursa Climate Adaptation Strategy preparation works. This proposal was also evaluated and improved during the workshop (Figure 6.9).

Finally, "ensuring compatibility and simultaneous execution of thematic strategy plans and physical plans" was derived as a conclusion from the results of the study. Integration of ecological concepts into existing physical planning processes and at the same time integration of thematic/sectoral plans in terms of legal/ administrative, functional and design is a very important issue.

In this context, what is currently available and the topic of integration was discussed in the Bursa Expert Workshop at the administrative structure and organization table. In addition to the above-mentioned planning and design implementation tools that will make the Bursa Climate Adaptation Strategy operational, it was expressed that is necessary to utilize the existing Waste Management Plans, Sustainable Energy Action Plan, Transportation Master Plan, Disaster Risk Reduction Plan, Environment Plan, Corporate Strategy Plans and Emergency Plans. Integration with emergency and disaster plans should be defined as a priority, especially against sudden changes that may occur in the aspect of climate adaptation.

7 Conclusion and Evaluation

The Bursa Sustainable Energy and Climate Adaptation Action Plan (BUSECAP) fulfills two important functions; first, it provides a comprehensive mitigation strategy (Sustainable Energy Action Plan) for the reduction of urban-borne greenhouse gases that lead to climate change by recording Bursa's energy and greenhouse densities in a comprehensive manner. Secondly, it provides a basis for the Climate Adaptation Strategy (Climate Adaptation Action Plan) that will make the city resistant to the adverse effects of climate change that is already taking place.

Thus, an important step has been taken by the local government to realize the "Habitable, Productive and Resistant City Bursa" vision with participatory practices through studies carried out jointly with city stakeholders.

Urban greenhouse gas emissions, which emerge as a result of energy flows in various sectors, can be reduced by significantly as it has been shown with examples from world cities through correct physical and spatial planning practices, widespread institutional and individual behavior changes in energy efficiency, and advanced examples in energy production/use technologies. BUSECAP, based on the conditions of Turkey, provides a summary of the assessment of technical, institutional and financial options for the mitigation roadmap and addresses the different subcomponents of this strategy for the local government.

A detailed breakdown of Bursa urban greenhouse gas emissions for the reference year of 2014, which is included in the third part of the report (page 12), is a total of 13,209,620 tons of CO2e. The Covenant of Mayors provides the flexibility to exclude urban greenhouse emissions from the inventory for sectors which cannot be intervened by local authorities and/or is not in the jurisdiction. With this mitigation, urban greenhouse gas emissions of Bursa for the reference year is 6,902,669 tons of CO2e (excluding industry and agriculture, animal husbandry). 71% of Bursa's total carbon footprint emissions consists of fuel consumed in residential and commercial buildings and from urban vehicle traffic under Scope 1 category, 26% from electricity consumption under Scope 2 category, and 3% from other emissions such as solid waste and wastewater. Energy efficiency/renewable energy applications, especially in residential and commercial buildings, the planning and construction of new buildings and settlements in the city in a low energy consumption manner, as well as reducing the number of private vehicles in traffic by increasing the share of public transportation in transportation, together with setting an example for citizens through exemplary practices of the municipality, will be an important contribution towards mitigation.

BUSECAP has set out Bursa's BAU (Business as Usual) scenario using predictions of different institutions on population, sectoral growth and calculated 2030 emissions as approximately 10.9 million tons of CO2e. Due to the city growth rates in Turkey, it is not possible to discuss urban absolute emission reductions hence it would be more appropriate to express the emission reduction targets per capita.

For Bursa, per capita emissions according to the BAU scenario increase from 2.48 tons CO2e to 3.24 (31% increase).

As shown in detail in chapter 3.3 (page 52) of BUSECAP Report, with mitigation measures from all sectors, Bursa can achieve its development until 2030 with 22% less greenhouse gas emissions and in the case of per capita emissions, it can achieve a reduction of about 40% in 2030 compared to 2014.

The Climate Adaptation Action Plan included in the scope of BUSECAP based on historical data and the studies carried out, in the light of climate change scenarios of Turkey and Bursa performs an affectibility analysis and combines proposals for new planning practices with a perception that the city is an intensified area of anthropogenic activities as well as an ecosystem of natural and architectural interactions involving natural structures and systems. Because, in the current situation, the approach which addresses physical planning in the plan hierarchy such as development plan, master plan, environmental plan in terms of urban settlements, excludes ecological scale and concepts considerably. However, an understanding of different ecological scales will enable the development of tools and mechanisms which are one of the most fundamental shortcomings in the process of adaptation to climate change.The assumption that cities can sustain their ecosystem functions in a balanced and healthy manner through planning practices with ecosystem perceptions is the fundamental assumption of the Bursa Climate Adaptation Action Plan. In the thematic proposals presented by the participatory processes, the bio-region (basin, sub-basin-micro basin), ecological region (eco-region/zone, ecocity/village), urban green network/infrastructure and nature- scale approach has been identified as key concepts.In this context, in particular the proposals developed for the city center, "Urban Pollution Maps" (air, water, soil, noise, light, radiation, thermal, radio spectral pollution etc.) which can ensure climate adaptation together with "urban climate maps/atlas", the use of tools such as the greenhouse database, carbon/water footprint measurement maps which can be used in the mitigation processes, are critical to the sustainability of the city's natural systems. Again in this context, multiscale "Green-Blue Network Solution" proposal (Chapter 6 of the report) developed for Bursa City Center is the product of the approach outlined above.

Finally, due to the local ownership of climate as an urban common, it should be emphasized that the identification and preservation of the natural building components of Bursa as an urban identity is very important and that this ownership should be in the center of urban strategies for adaptation to climate change.

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ANNEX.1 Summary of Sustainable Energy Action Plan

	URBAN DEVELOPMENT - BUILT ENVIRONMENT				
	Objective B1: Energy efficient renewals in existing homes	Time Plan	Related Institutions	Energy Consumption Reduction (MWh)	2030 CO2e Reduction (ton)
RESIDENCE	Action B1.1: Heat insulation in existing homes	2017 - 2030	Home Owners, BMM, MEU, MENR, İZODER, INVERTER, Contractors, Finance Organizations, Urban Regional Planning, Architects, Application Companies, Insulation Materials, Lighting and PV Manufacturers	4.060.936	1.339.253
	Action B1.2: Renewable energy applications in existing homes	2017 - 2030			
	Action B1.3: Use of energy efficient lighting systems in existing homes (energy saving-LED)	2017 - 2030		*217.901*	*108.297*
	Action B1.4 Heating of about 100,000 homes with district heating	2020 - 2030		537.130	108.769
	Objective B2: Energy efficient planning of new settlement areas	Time Plan	Related Institutions	Energy Consumption Reduction (MWh)	2030 CO2e Reduction (ton)
	Action B2.1: Urban transformation in housing areas	2021 - 2030	Homeowners, insulation material manufacturers, implementing firms, IZODER, ENVERDER, professional organizations, financial institutions, MENR	643.195	158.461
	Action B2.2: Sustainable design practices in new settlement areas/new housing areas	2021 - 2030			
	Action B2.3: Conversion to natural gas from coal in homes	2021 - 2030			472.596
	Objective B3: Energy efficient renewals in existing commercial buildings (including public buildings)	Time Plan	Related Institutions	Energy Consumption Reduction (MWh)	2030 CO2e Reduction (ton))
COMMERCIAL	Action B3.1: Energy efficient renewals in existing commercial buildings (heat insulation)	2017 - 2030	Commercial and public building users, BCCI, MENR, Governorate, Provincial Special Administration, insulation material producers, implementing firms, financial institution	1.083.534	437.382
	Action B3.2: Energy efficient lighting in existing Commercial Buildings	2017 - 2030		235.166	116.877
	Objective B4: Energy efficient applications in municipality buildings	Time Plan	Related Institutions	Energy Consumption Reduction (MWh)	2030 CO2e Reduction (ton)
MUNICIPALITY BLDG.	Action B4.1: Energy efficient renewals in existing municipality buildings (heat insulation + lighting)	2017 - 2030	BMM, District Municipalities, ENVERDER, IZODER, MENR, financial institutions, various funds, development agencies	81.433	37.315
	Objective B5: Energy efficient street lighting systems	Time Plannı	Related Institutions	Energy Consumption Reduction (MWh)	2030 CO2e Reduction (ton)
LIGHTING	Action B5.1: Energy efficient street lighting system	2017 - 2030	ABB, District municipalities, special provincial administrations, energy efficient lighting producers, financial institutions, MENR, various funds, development agencies	141.356	70.254
	Action B5.2: PV integration into street lighting systems	2017 - 2030		9.047	4.496
	TOTAL			**7.009.698**	**2.853.700**

TRANSPORTATION

Transportation				
Objective U1: Public transport	Time Plan	Related Institutions	Energy Consumption Reduction (MWh)	2030 CO2e Reduction (ton)
Action U1.1: Increase of public transport usage rate	2017 - 2030	BMM, BURULAŞ, Ministry of Transport, Financial Institutions	1.157.260	305.897
Action U1.2 Providing connection to Bursa with high-speed train network	2020 - 2030		487.267	178.833
Objective U2: Pedestrian and bicycle use, integration into public transport	Time Plan	Related Institutions	Energy Consumption Reduction (MWh)	2030 CO2e Reduction (ton)
Action U2.1 Increase bike use from present <0.5% to 2.5%	2017 - 2030	BMM, Highway Authority, citizens, Universities, Schools, MOE, commercial buildings	456.813	120.749
Action U2.2 Increase of pedestrian access from current 42% to 47%	2017 - 2030		456.813	120.749
Objective U3: Alternative technology and fuel use	Time Plan	Related Institutions	Energy Consumption Reduction (MWh)	2030 CO2e Reduction (ton)
Action U3.1 Replacing public transport with energy efficient vehicles	2017 - 2030	BMM, Ministry of Transport, BURULAŞ, citizens	245.915	66.745
Action U3.2 Replacement of 80% of the municipal vehicle fleet by electric vehicles for the purpose of encouraging the use of electric vehicles	2017 - 2030		22.451	6.090
Objective U4: Traffic optimization regulations	Time Plan	Related Institutions	Energy Consumption Reduction (MWh)	2030 CO2e Reduction (ton)
Action U4.1 Low-cost traffic optimization arrangements	2017 - 2030	BMM, Citizens	873.870	289.797
Objective U5 Emission reduction from logistics and transportation fleets	Time Plan	Related Institutions	Energy Consumption Reduction (MWh)	2030 CO2e Reduction (ton)
Action U5 Emission reduction from logistics and transportation fleets	2017 - 2030	Industrial establishments, logisticsfirms, BMM, BCCI	691.298	187.628
Objective U6 Training in economic driving techniques (especially taxi, public transport, waste collection vehicle drivers)	Time Plan	Related Institutions	Energy Consumption Reduction (MWh)	2030 CO2e Reduction (ton)
Action U6 Training in economic driving techniques (especially taxi, public transport, waste collection vehicle drivers)	2017 - 2030	Industrial establishments, logisticsfirms, BMM, BCCI	230.433	62.543
TOTAL			**4.622.123**	**1.339.031**

RENEWABLE ENERGY

RENEWABLE ENERGY				
Objective RE1: Renewable energy applications	Time Plan	Related Institutions	Energy Consumption Reduction (MWh)	2030 CO2e Reduction (ton)
Action RE1.1: Renewable energy applications in the municipality and its affiliates	2017 - 2030	Metropolitan Municipality, farmers, agriculture associations, building owners	*25.000*	*12.425*
Action RE1.2: Installation of solar energy systems in agricultural irrigation	2017 - 2030		6.500	3.231
ActionRE1.3: PV applications on building roofing	2019 - 2030		600.000	298.200
Objective RE2: Energy from animal and agricultural wastes	Time Plan	Related Institutions	Energy Consumption Reduction (MWh)	2030 CO2e Reduction (ton)
Action RE2.1: Energy production from animal and agricultural wastes	2017 - 2030	Farmers, investors, financial institutions	383.200	77.598
Objective RE3: Energy output from wastewater mud	Time Plan	Related Institutions	Energy Consumption Reduction (MWh)	2030 CO2e Reduction (ton)
Action YE3.1: Energy output from wastewater mud	2017 - 2030	BUSKİ	22.205	3.208
TOTAL			1.036.905	**394.662**

SOLID WASTE AND WASTE WATER MANAGEMENT					
SOLID WASTE/ WASTEWATER	Objective AA1 Solid Waste Storage Areas	Time Plan	Related Institutionsr	Energy Consumption Reduction (MWh)	2030 CO2e reduction (ton)
	Action AA1.1 LFP waste and energy production from all solid waste areas	2017 - 2030	BMM, District Municipalities, financial institutions, companies generating energy from landfill gas		99.141
	Objective AA2 Separation of solid waste from its source	Time Plan		Energy Consumption Reduction (MWh)	2030 CO2e reduction (ton)
	Action AA2.1 Reduce greenhouse gas emissions by separating solid wastes from their source	2017 - 2030			
	Objective AA3 Wastewater treatment plants	Time Plan	Related Institutions	Energy Consumption Reduction (MWh)	2030 CO2e reduction (ton)
	Action AA3.1 Improving the operating conditions of all wastewater treatment plants	2017 - 2030	BMM, BUSKİ, District Municipalites		49.304
	TOTAL				**148.445**

AWARENESS CAMPAIGNS					
AWARENESS	Objective B1 Energy efficiency campaigns	Time Plan	Related Institutions	Energy Consumption Reduction (MWh)	2030 CO2e reduction (ton)
	Action B1.1 Creation of municipal information points	2017 -2030	BBB, District Municipalities, Citizens, Practitioners, Electronic Device Manufacturers, Financial Institutions, Consumer Associations	418.249	126.791
	Action B1.2 Organize energy saving activities throughout the city	2017 - 2030		199.387	75.327
	TOTAL			**617.636**	**202.118**

TOTAL	**16.131.416**	**5.928.358**

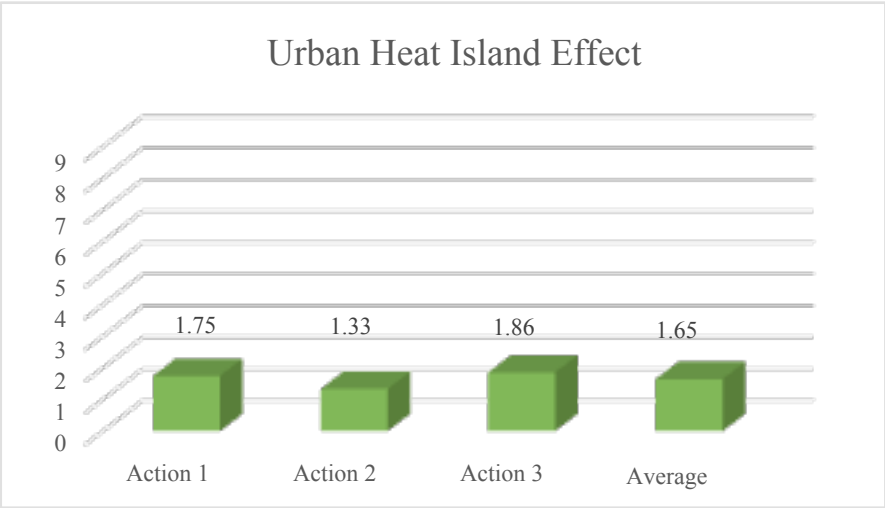
The total mitigated figure includes natural energy consumption (2.6 million kWh) and greenhouse gas emissions (0.0 million CO2e), which are expected to result in energy efficiency and technological improvements.

MITIGATION MEASURE TITLES	Energy Saving (MWh)	tCO2e Reduction
Urban Development-Built Environment	7.009.698	2.853.700
Transportation	4.622.123	1.339.031
Renewable energy	1.036.905	394.662
Solid Waste and Waste Water Management	0	148.445
Awareness Campaigns	617.636	202.118
Natural energy efficiency	2.845.055	990.402
TOTAL	**16.131.416**	**5.928.358**

ANNEX.2 Self Assessment Tables under Thematic Areas and Evaluation based on Theme Actions

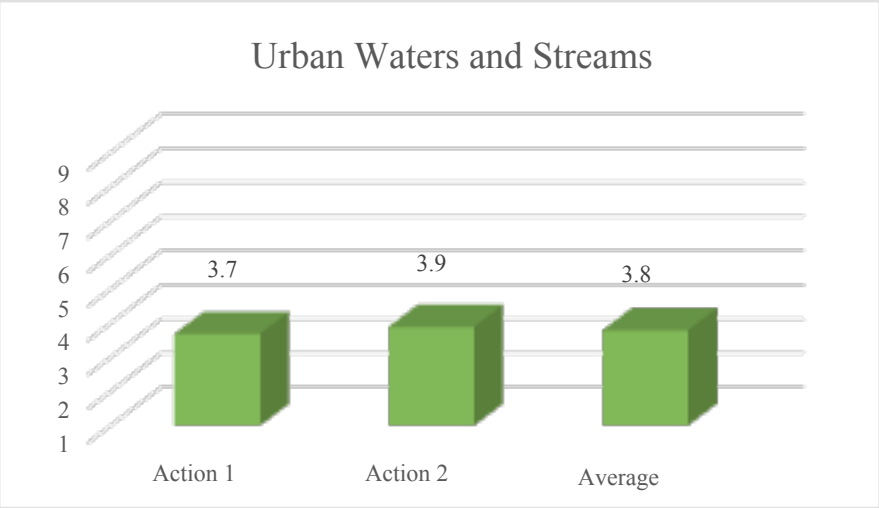
1. Urban Heat Island Effect

ACTION	BEGINNING PHASE			DEVELOPMENT PHASE			ADVANCED PHASE			OBSERVATIONS
1. Considering the medium and long-term climate change projections and urban development in Bursa, the focus areas that are prominent in terms of the effect of future heat waves are determined by GIS and ground measurements.	A measurement or determination of heat island effect (UHI) has not been conducted. There is no policy document or strategy on the effect of climate change on the city. However, the initial steps in adapting to climate change have been realized.			Possible UHI regions in the city have been identified, a measurement activity has been initiated and the need for strategy development based on the medium-long term importance of the project has been determined by the relevant institutions.			Current and future impacts on UHI effect have been confirmed by measurements, negative outcomes that may arise from this have been assessed and policies and strategies have been created. Some applications have been made and the cooperation and information sharing between related institutions has been realized.			
	1	2	3	4	5	6	7	8	9	
2. In Bursa, necessary scientific studies about the negative results of UHI effect were conducted, air pollution and public health effects were determined	The negative consequences of the UHI on urban life are unknown. There is no connection between the physical planning of the city and the negative effects of climate change.			The negative effects of the UHI on various areas of urban life have been identified. Both public health and urban pollution are investigated, but due to the lack of co-operation between the relevant institutions, there is no consistent and viable medium-long term planning and strategy activity.			The UHI's threat to urban life was identified by scientific projections and joint platforms were established for cooperation among related institutions. The planning and strategic thinking to overcome the medium and long-term negative effects of the UHI are at the center of all urban activities. Applications are being executed in this direction.			
	1	2	3	4	5	6	7	8	9	
3) In the physical planning of the city, the plans necessary for green area distribution, green corridors and rehabilitation of the waterways, areas where the UHI needs to eliminated exist and needs to be realized.	There is no information on what measures should be taken in order to eliminate UHI and there is no planning effort in this regard.			The necessary informing and awareness activities to eliminate UHI and the minimization of its negative consequences have been carried out. In this regard, the basic principles of medium and long-term planning, inter-institutional cooperation have been laid down but has not been realized..			From the most unfavorable outcomes of urban climate change, analysis of what is the most appropriate nature-based solutions for the elimination of UHI have been made and action plans have been realized.			
	1	2	3	4	5	6	7	8	9	



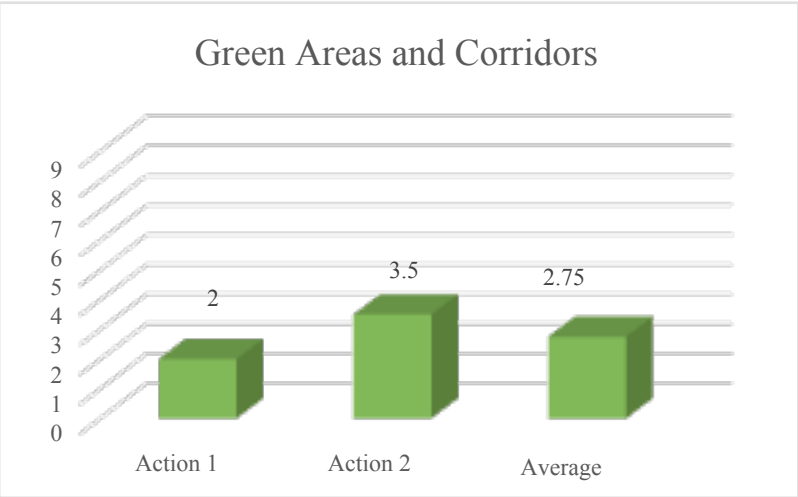
2. Urban Waters and Streams

ACTION	BEGINNING PHASE	DEVELOPMENT PHASE	ADVANCED PHASE	OBSERVATIONS (evaluation based on points, if available)
1.Mid-long term rainfall regime change projections and urban development in Bursa and the existing river / creek side corridors possible drainage problems considering the urban water pattern, flood-area management plans have been made.	Mid- to long-term precipitation regime projections due to climate change has not been taken into account in urban water management, and inventory is either nonexistent or lacking.	BASKI has been working with DSİ to establish strategic water management planning and analysis and inventory, which will contribute to the effects of climate change and precipitation regime changes, however, a strategic plan has not been included in the development plans.	The current and future impact of the Urban Heat Island Effect on water resources have been confirmed by measurements and the negative consequences have been assessed and policies and strategies for elimination have been formed. Collaboration and information sharing between relevant institutions has been realized and implementations are being carried out.	
	1 2 3	4 5 6	7 8 9	
2. In response to the adverse effects of climate change on water patterns in Bursa, water-based green infrastructural studies on creating a durable and flexible Bursa have been completed and strategic plans have been put forward.	It is not known how the urban water pattern in Bursa will be affected by climate change. Scientific studies have not been put forward in this regard. There is no connection between the physical planning of the city and the negative effects of climate change.	Water management planning in Bursa does not go beyond conventional flood/overflow calculations. While innovative approaches for green infrastructure are known, an integrated strategic planning process was not in question. While there are examples of exceptional "green stream rehabilitation", physical planning is not addressed first. Due to lack of cooperation between institutions, there is no coherent and viable medium-long term planning and strategy activity..	Within the context of Bursa's adaptation to climate change, a "Green Infrastructure" Strategy has been prepared and a close link between planning functions of institutions, civil society and local government has been realized. The adverse effects of climate change on water patterns are determined by scientific projections, and a durable and flexible urban vision is being realized. An innovative "nature-based solutions" approach on a global scale is the basis.	
	1 2 3	4 5 6	7 8 9	



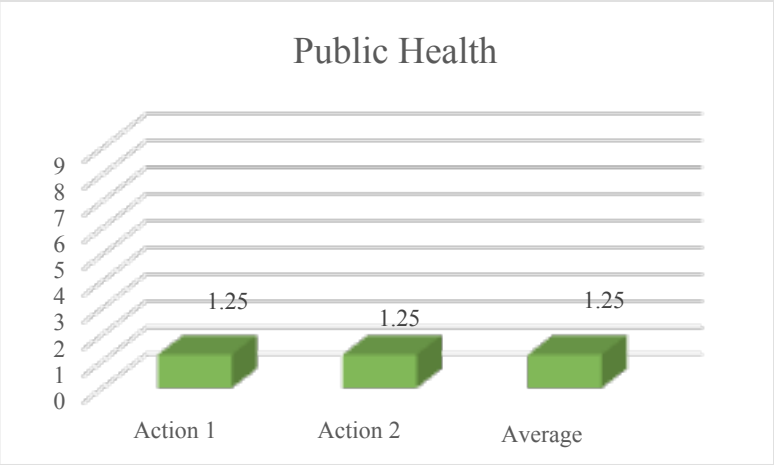
3. Green Areas and Corridors

ACTION	BEGINNING PHASE	DEVELOPMENT PHASE	ADVANCED PHASE	OBSERVATIONS (evaluation based on points, if available)
1. The potential for reducing the negative effects of climate change on the nature, continuity, accessibility, fair / balanced distribution of open green spaces in Bursa is planned by taking account of the long term development of the city.	For Bursa, heat island of green areas and effects of decreasing air pollution, increasing bio-diversity are not determined by scientific studies. While expressing the general desire to increase green spaces, rapid urbanization prevents the implementation of green-oriented strategies. In this sense, it is not possible to speak of the existence of a medium- to long-term viable strategy.	Within the framework of the "green city" theme, many activities that fall under the category of "action" can be observed. Main green spaces, connection zones, development of the corridor / generations, physical planning of the city and long-term climate change projections were evaluated.	Bursa "Green Infrastructure Strategy" has been prepared by adding the projections of medium-long term climate change to account and it is being realized. Long-term physical development of the city is subject to "green infrastructure" strategies. Protecting and expanding out-of-town green belts, green corridors and connections in the city have been established in synergy with relevant national and regional organizations and the civil society, policies and strategies have been established and practices have been developed.	
	1 2 3	4 5 6	7 8 9	
2. Strategies based on scientific studies ("Bursa Green Urbanization Strategies") were carried out in areas such as urban, green belt and protected green areas and air, water and noise pollution, biodiversity increase and low carbon transportation in Bursa and became part of planning.	Studies such as heat island, urban pollution, transportation sustainability and biodiversity and its direct relation to "Bursa Green Urbanization Strategies" have not been put forward by scientific studies.	The effects of the Bursa Green Urbanization Strategies on urban livability and the effects of long-term climate change are clearly revealed. On the other hand, there are difficulties realizing it to the lack of inter-institutional cooperation, the difficulties of medium / long-term movement in physical planning, and the difficulties of local decision-making authority.	"Bursa Green Urbanization Strategies" was created by minimizing the adverse effects of climate change and supporting scientific studies in all areas in order to maximize the quality of life of urban people with the definitions of international moderny cities. Civil society organizations and all the related institutions, sharing and cooperating with the "Strategy" is the future vision of the city with its stakeholders.	
	1 2 3	4 5 6	7 8 9	



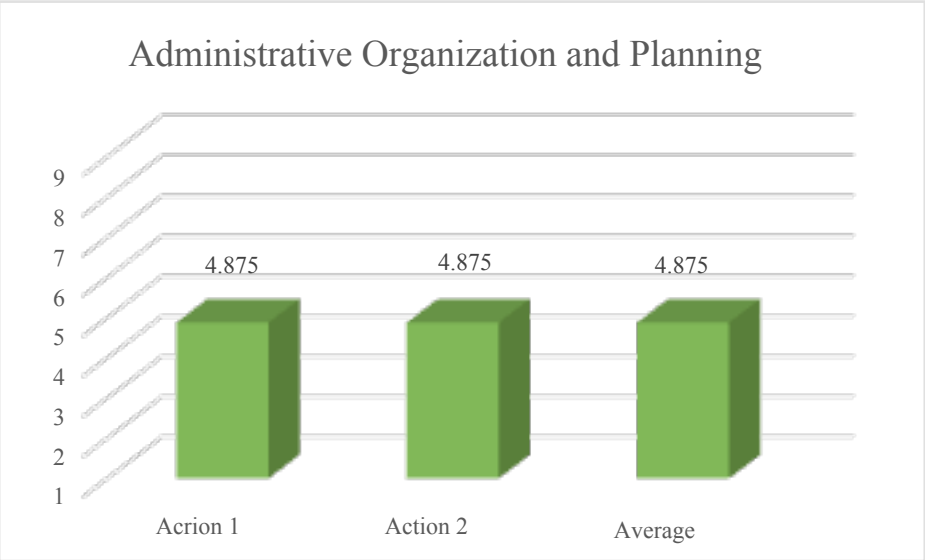
4. Public Health

ACTION	BEGINNING PHASE	DEVELOPMENT PHASE	ADVANCED PHASE	OBSERVATIONS (evaluation based on points, if available)
1. Scientific studies have been carried out on the effects of climate change on urban air pollution and public health, taking into consideration the medium to long term climate change projections and urban development in Bursa.	Although the negative effects of climate change on public health and urban air pollution are known in general terms, it is not known how these age groups, social strata, and health-related threats are directly affected by Bursa in this area. In this regard, there is no sharing or cooperation between the relevant institutions, there is no strategy or action plan to address it.	The effects of climate change on public health, urban and environmental pollution in medium and long-term are determined by scientific studies. With its medium-long term importance, the need for strategy development and coordination is expressed by the relevant institutions, yet an action plan is yet available.	It is known how public health and urban air pollution will be affected by climate change. The negative consequences of this phenomenon have been assessed and policies and strategies have been created to eliminate it. Cooperation and information sharing are carried out among the related institutions in coordination. Awareness and education studies are being carried out.	
	1 2 3	4 5 6	7 8 9	
2. The negative effects of climate change on public health and urban air pollution in Bursa have been determined, the solution proposals and relevant institutions that need to coordinate are identified, action plans were made starting from the most urgent and priority ones.	As there is no connection between climate change and public health and adverse effects on air pollution, measures to overcome this threat are not on the agenda.	Physical/spatial solutions and social organization possibilities have been determined against the predictions of climate change which negatively affect vital dimensions of urban life. Institutions which shall coordinate have been determined but a mid-long term strategy has not yet been developed.	In particular, BMM, city stakeholders and especially in the context of public health coordination-based task sharing with all relevant institutions have been carried out, the results of scientific studies have been put forward, and the nature-based solutions of the Adaptation Strategy are being fulfilled.	
	1 2 3	4 5 6	7 8 9	



5. Administrative Organization and Planning

ACTION	BEGINNING PHASE			DEVELOPMENT PHASE			ADVANCED PHASE			OBSERVATIONS (evaluation based on points, if available
1. Tools, working methods, inter-institutional cooperation mechanisms for "Bursa Green Urbanization Strategies" have been put forward and how to make it the focus of spatial planning and design has been determined.	The city's green infrastructure projects and the potential for reducing the medium-long-term negative effects of climate change have not been studied. Rapid and unplanned urban growth is disrupting the local government decision-making and implementation capacity. Sharing, communication and cooperation between the relevant local and national institutions are insufficient.			Tools, working methods, inter-institutional cooperation mechanisms for "Bursa Green Urbanization Strategies" have been put forward and how to make it the focus of spatial planning and design has been determined. In contrast, sharing, communication, and cooperation between relevant local and national institutions is insufficient and there are big problems in implementation.			Bursa "Green Infrastructure Strategy" has been created with participant planning methods and by adding projections of medium-long term climate change into account and is being realized. The means of implementation, the working methods, the inter-organizational cooperation mechanisms are put forward and how to make it the focus of spatial planning and design has been determined. Decisions on the future of the city are determined by the cooperation of the upper-level institutions and the mutual understanding of the local stakeholders and the local government.			
	1	2	3	4	5	6	7	8	9	
2. The environmental, economic and social benefits of Bursa's "Green Urbanization Strategy" have been determined through scientific studies, the aspects of participation, communication, education, organization, financing, green procurement and procurement for in-house and inter-organizational sustainability has been put forward and a "Green Urbanization dashboard" has been prepared to provide the transparency of the Strategy.	The advantages of the Strategy, which also includes Climate Adaption have been expressed and the first steps have been taken in this regard. On the other hand, there are difficulties realizing it due to the lack of inter-institutional cooperation, the difficulties of medium / long-term action in physical planning, and the difficulties of local decision-making authority.			Bursa's "Green Urbanization Strategies" clearly demonstrate the impacts on urban livability and the impacts of long-term climate change. On the other hand, there are difficulties realizing it due to the lack of inter-institutional cooperation, the difficulties of medium / long-term action in physical planning, and the difficulties of local decision-making authority.			The environmental, economic and social benefits of Bursa's "Green Urbanization Strategy" have been determined and aspects such as participation, communication, education, organization, financing, green procurement and procurement have been established. A "Green urbanization panel (green dashboard) is prepared.			
	1	2	3	4	5	6	7	8	9	



ANNEX 3 Bursa; Climate Change Adaptation Strategy Thematic Strategy Maps

URBAN HEAT ISLAND EFFECT

Habitable, Productive, Resistant City Bursa

Sustainable and Resistant Urban Development Perspective

In Bursa, the threats of Heat Island Effect on urban life which will escalate due to climate change have been determined and a common platform for inter-institutional cooperation should be formed, planning and strategic thinking to eliminate the threats will be at the center of all urban activities, and action plans for optimal nature-based solutions should be realized.

Urban/Citizen Perspective

- AIAE1 Determinaton of Risky Areas and Reduction of UHI Effect
- AIAE2 Reduction of UHI Effect on a Planning Level
- AIAE3 Reduction Transport Induced UHI Effect
- AIAE4 Awareness and Organization

Processes/ Application Perspective

- IAE1 Determinaton of Risky Areas
- IAE2 Paying attention to the UHI Effect in all Plans and Projects
- IAE4 Coordination
- IAE4.2 Awareness Activities in Edu.

Learning /Infrastructure Perspective

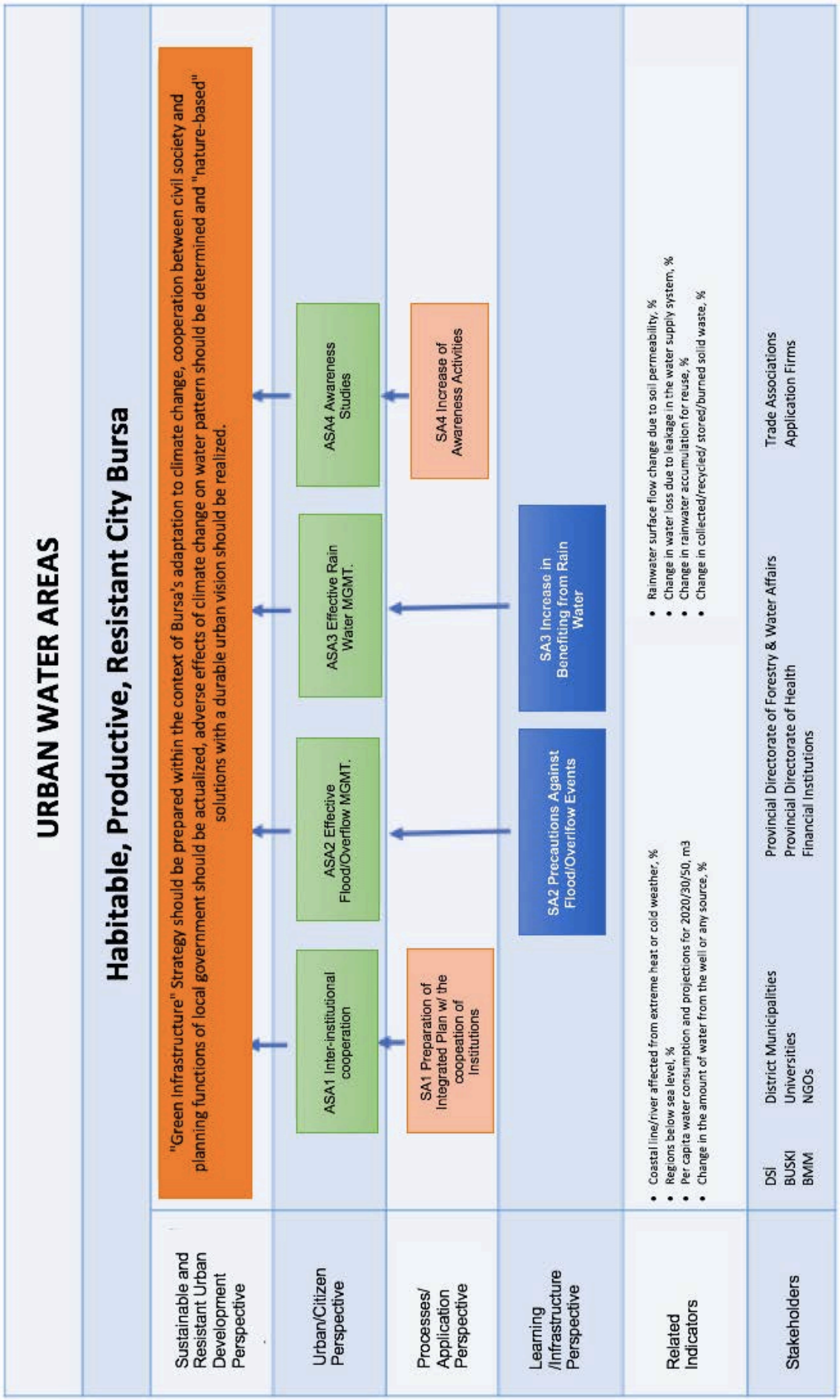
- IAE1.2 Popularizing "Green-Cool Areas" in Risky Areas
- IAE3 Taking measures to encourage public transportation and loweing traffic density

Related Indicators

- Number of day/night/year of extreme heat or cold weather
- The frequency of hot/cold air fluctuations
- The number of day/night/year of extreme precipitation
- Number of consecutive day/night/year without precipitation
- Monthly/yearly average temperature changes, %
- Monthly/yearly average precipitation changes, %
- Per capita energy consumption and projections for 2020/30/50, MWh
- Number of Bldgs. effected from extreme weather events, %
- Number of gray/blue/green areas effected from extreme weather events, %
- Transport. /Energy/Water/Waste/Informatics effected from extreme weather events, %
- Shadow effect and its change on the UHI effect, %
- Risky areas which could be affected by extreme weather conditions
- Renewed buildings for adaptation, %
- Renewed infrastructure for adaptation, %

Stakeholders

Zoning, Parks & Garden, Transportation related units of the BMM
Zoning, Parks & Garden, Transportation related units of District Municipalities
Universities
Trade Associations
NGOs
Bursa Chamber of Industry and Trade
Provincial Directorate of Health
Provincial Directorate of Environment and Urbanization
Application Firms, Financial Institutions


URBAN WATER AREAS
Habitable, Productive, Resistant City Bursa
Sustainable and Resistant Urban Development Perspective
"Green Infrastructure" Strategy should be prepared within the context of Bursa's adaptation to climate change, cooperation between civil society and planning functions of local government should be actualized, adverse effects of climate change on water pattern should be determined and "nature-based" solutions with a durable urban vision should be realized.
Urban/Citizen Perspective
ASA1 Inter-institutional cooperation
ASA2 Effective Flood/Overflow MGMT.
ASA3 Effective Rain Water MGMT.
ASA4 Awareness Studies
Processes/ Application Perspective
SA1 Preparation of Integrated Plan w/ the cooperation of Institutions
SA4 Increase of Awareness Activities
Learning /Infrastructure Perspective
SA2 Precautions Against Flood/Overflow Events
SA3 Increase in Benefiting from Rain Water
Related Indicators
Coastal line/river affected from extreme heat or cold weather, %
Regions below sea level, %
Per capita water consumption and projections for 2020/30/50, m3
Change in the amount of water from the well or any source, %
Rainwater surface flow change due to soil permeability, %
Change in water loss due to leakage in the water supply system, %
Change in rainwater accumulation for reuse, %
Change in collected/recycled/ stored/burned solid waste, %
Stakeholders
DSİ
BUSKI
BMM
District Municipalities
Universities
NGOs
Provincial Directorate of Forestry & Water Affairs
Provincial Directorate of Health
Financial Institutions
Trade Associations
Application Firms

PUBLIC HEALTH

Habitable, Productive, Resistant City Bursa

Sustainable and Resistant Urban Development Perspective

In Bursa, the negative effects of climate change on public health should be determined and measures should be taken to reduce them to a minimum, and these should be realized through task sharing of relevant local and national institutions.

Urban/Citizen Perspective

- AHS1 To Alleviate the Spatial Effects of Climate Change
- AHS2 Awareness about the Negative Impacts of Climate Change
- AHS3 Sudden and Extreme Weather Events
- AHS4 Food and Water Safety
- AHS5 Climate Sensetive and Fragile Groups

Processes/ Application Perspective

- HS2.1 Data collection/monitoring applications
- HS2.2 Public Awareness applications
- HS3 Reduce the effects of Extreme Weather events
- HS4 Taking Necessary Precautions
- HS5.1 Determination of Sensetive Groups
- HS5.2 Preparation of Intervention Plans

Learning /Infrastructure Perspective

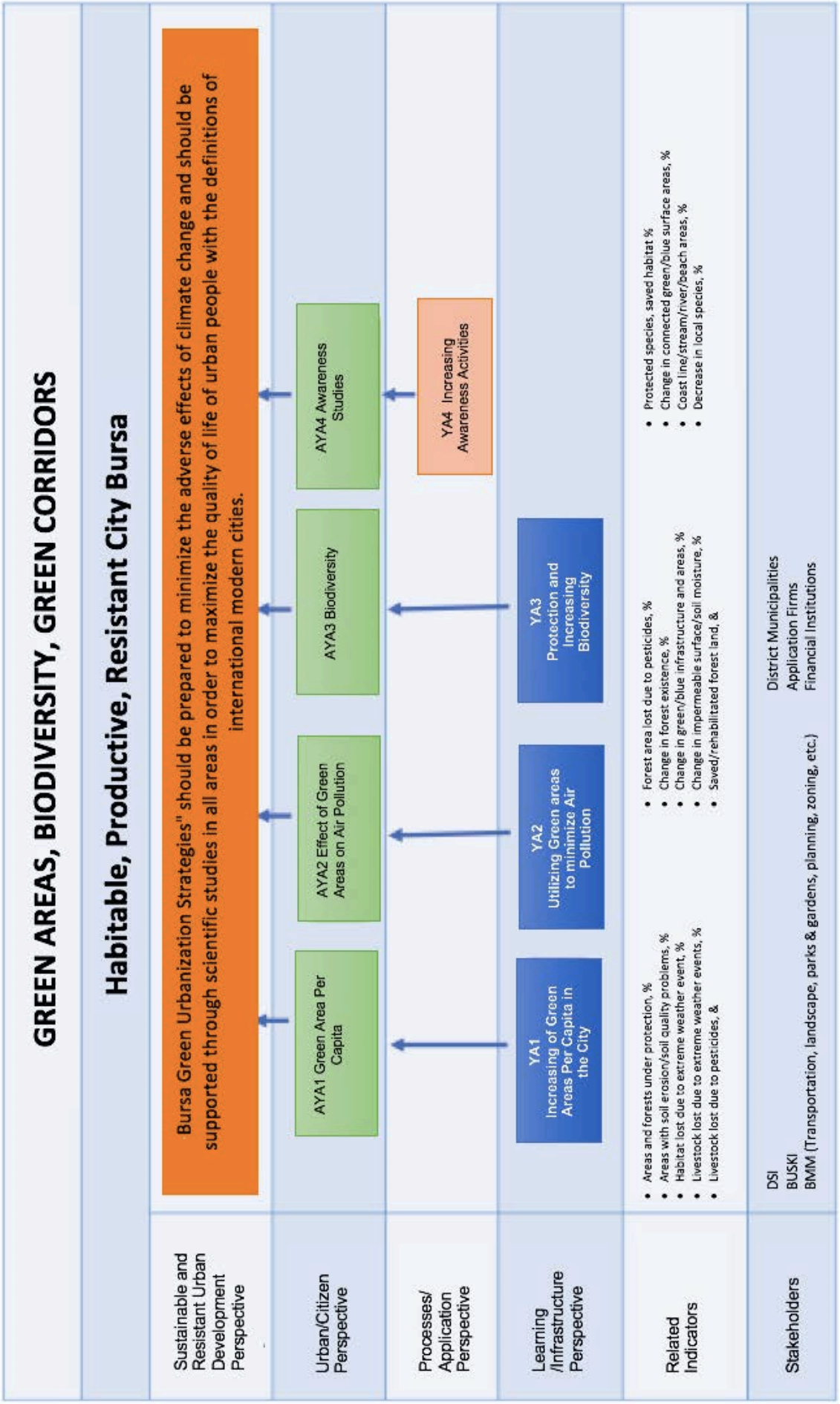
- HS1.1 Healthy Buildings
- HS1.2 Healthy Public Spaces
- HS4.1 Ensuring Water and Food Quality
- HS4.2 Tackling related Diseases

Related Indicators

- Number of people effected by extreme weather events/year
- Number of deaths as a result of extreme weather events/year
- Number of warnings related to water pollution/year
- Number of warnings related to air pollution/year
- Number of domestic animals effected by extreme weather events/year
- Change in amount of harvest as a result of extreme weather events, %
- Agricultural land lost due to extreme weather events
- % of annual harvest and percentage of pasture area change, %
- Change in the water consumption in agricultural irrigation, %
- Change in the amount of harvest due to adaptation, %

Stakeholders

Provincial Directorate of Forestry & Water Affairs
Provincial Directorate of Health
Provincial Directorate of Food, Agriculture and Livestock
BMM
BUSKI
District Municipalities
DSİ
Related NGOs
Universities


GREEN AREAS, BIODIVERSITY, GREEN CORRIDORS
Habitable, Productive, Resistant City Bursa
Sustainable and Resistant Urban Development Perspective
Bursa Green Urbanization Strategies" should be prepared to minimize the adverse effects of climate change and should be supported through scientific studies in all areas in order to maximize the quality of life of urban people with the definitions of international modern cities.
Urban/Citizen Perspective
AYA1 Green Area Per Capita
AYA2 Effect of Green Areas on Air Pollution
AYA3 Biodiversity
AYA4 Awareness Studies
Processes/ Application Perspective
YA4 Increasing Awareness Activities
Learning /Infrastructure Perspective
YA1 Increasing of Green Areas Per Capita in the City
YA2 Utilizing Green areas to minimize Air Pollution
YA3 Protection and Increasing Biodiversity
Related Indicators
Areas and forests under protection, %
Areas with soil erosion/soil quality problems, %
Habitat lost due to extreme weather event, %
Livestock lost due to extreme weather events, %
Livestock lost due to pesticides, &
Forest area lost due to pesticides, %
Change in forest existence, %
Change in green/blue infrastructure and areas, %
Change in impermeable surface/soil moisture, %
Saved/rehabilitated forest land, &
Protected species, saved habitat %
Change in connected green/blue surface areas, %
Coast line/stream/river/beach areas, %
Decrease in local species, %
Stakeholders
DSI
BUSKI
BMM (Transportation, landscape, parks & gardens, planning, zoning, etc.)
District Municipalities
Application Firms
Financial Institutions

Reference: Kaplan, R. S., Norton, D.P. 2006: Strategy Maps: Strategy maps: converting assets into tangible outcomes, [English Translation, Alfa Publishing, Istanbul].
Adapted by: "İzmir Bilgi Toplumu Temelli Kalkınma Stratejisi", Izmir Development Agency, 2013.

Bursa on its Way to Become Habitable, Healthy and Resistant

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