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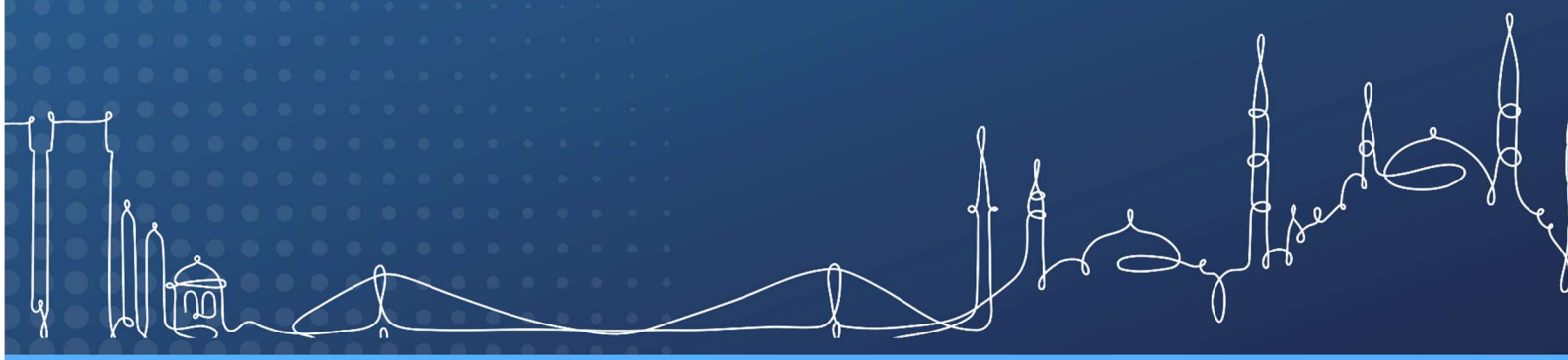
BAĞCILAR BELEDİYESİ

CPMA CENTRAL PROJECT MANAGEMENT AGENCY

Bağcılar Municipality

Sustainable Energy and Climate Action Plan (SECAP)

Final Draft
August 2022



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CONTRIBUTORS TO THE STUDY

Bağcılar Municipality

Hilal YILMAZ
Betül TOMBUL
Esra YÜCE
Selçuk TANIŞ
Faruk ŞİT

CPMA Experts

Daiva MATONIENE
Mantas MARCİUKAİTİS
Mindaugas STONKUS
Katrin KEIS
Ali KORAKAN
Arif KÜNAR
Zeynep Pınar ÖĞRETMEN
İpek TAŞGIN
Simay KESKİN
Stefano SALATA

Consultants and Technical Experts: Demir Energy

Dr. Baha KUBAN
Esra DEMİR
Caner DEMİR
Oya TABANOĞLU
Melda KARADEMİR
Gonca AKGÜL

Technical experts and consultants involved in the preparation of the Bağcılar Sustainable Energy and Climate Action Plan are listed above.

PREFACE OF THE MAYOR

Mayor of Bağcılar Municipality

Abdullah ÖZDEMİR

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ABBREVIATIONS

Abbreviation	Description
BAU	Business As Usual
BEI	Baseline Emission Inventory
BTI	Information Communication Technologies
CDP	Carbon Disclosure Project
cm	Centimeter
CH4	Methane
CO2	Carbon Dioxide
CoM	Covenant of Mayors
DSI	State Hydraulic Works
ESCO	Energy Service Company
GW	Gigawatts
Ha	Hectare
ICLEI	International Council of Local Initiatives
IEAP	International Local Government Greenhouse Gas Emissions Analysis Protocol
IFRC	International Federation of Red Cross and Red Crescent Societies
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Convention on Climate Change
İMM	İstanbul Metropolitan Municipality
IDKK	Climate Change Coordination Board
İSKİ	Istanbul Water and Sewerage Administration
JRC	Joint Research Center
kWh	Kilowatt-hour
m2	Square meters
m	Meter
mm	Millimeter
MGM	General Directorate of Meteorology
MWh	Megawatt-hour
N2O	Nitrous oxide
ÖTL	End of Life Tires
SECAP	Sustainable Energy and Climate Action Plan
NGO	Non-governmental organization
TAMP	Türkiye Disaster Response Plan
tCO2e	Tons of carbon dioxide equivalent
TurkStat	Turkish Statistical Institute
UNFCCC	United Nations Framework Convention on Climate Change
YMEP	Green Deal Action Plan

EXECUTIVE SUMMARY

The exponential increase in the use of fossil fuels, which started with the Industrial Revolution, escalated the fossil fuel-based harmful emissions at the same rate. For this reason, the effects of climate change have been causing negative consequences in the world since the 1990s. According to the Intergovernmental Panel on Climate Change (IPCC) Physical Science Basis of Climate Change Report (2013), warming in the global climate is certain. However, most of the changes observed in the climate since the 1950s are at a level that has never been seen before until the last millennium. Each decade of the past 30 years has been warmer on Earth than all ten-year periods of global surface temperatures recorded since 1850. Starting with the industrial revolution, it has been proven that carbon dioxide emissions from human activities, particularly due to fossil fuel consumption, are increasing much faster than the oceans and forest areas can absorb. It is foreseen that the continuation of the existing habits of the societies will have serious consequences on climate change, which will lead to great environmental destruction and possible mass deaths, as well as related humanitarian disasters.

The presence of harmful gases that cause climate change and the increasing rates in the atmosphere highlight the necessity of taking decisions at the global level on this issue. The general framework of cooperation against climate change was first drawn up by the United Nations Framework Convention on Climate Change (UNFCCC) which was first published in 1992. The Paris Agreement, which was adopted in 2015 and entered into force in November 2016, on climate change, in which intensive international studies have been carried out since this date, is a turning point. Today, it has become necessary to evaluate the production and consumption activities carried out in cities on the scale of climate change and to include them effectively in the rational planning and strategy determination processes for energy saving. Since 2016, the agreement has been signed and ratified by nearly 200 countries. Türkiye ratified the Paris Agreement on 7 October 2021.

Türkiye will take an important step towards low carbon development to reach the 2 ℃ target on a global scale by reducing its greenhouse gas emissions by 21% in 2030. Türkiye has the necessary plans and policies to fulfill its intended national contribution:

1. Eleventh Development Plan
2. Climate Change National Strategy and Climate Change Action Plan
3. Industry Strategy Document
4. Energy Efficiency Strategy Document
5. National Recycling Strategy and Action Plan
6. Legislation on Monitoring, Reporting, and Verification of Greenhouse Gases
7. National Intelligent Transportation Systems Strategy Document (2014-2023) and Action Plan (2014-2016)

Also at the national level, National Climate Change Action Plan (2011-2023) and the National Climate Change Adaptation Strategy and Action Plan (2011-2023) are approved. Concerning these plans, İstanbul Metropolitan Municipality has prepared an implementation-oriented İstanbul Climate Change Action Plan. The projection of this inventory for the years 2030 and 2050 has been the main source of current national policies. In the calculation, it is assumed that the population of Istanbul will reach 21.3 million in 2050. Since İstanbul continues to grow especially in terms of population, it

is observed that its emissions will not peak until 2050. According to the results, it is estimated that thecity's carbon footprint will be 84.7 million tCO2e in 2030 and 117.9 million tCO2e in 2050 according to the the basic scenario. It is understood that these figures can be reduced to 57.1 million tCO2e in 2030 and 76.1 million tCO2e in 2050. This calculation corresponds to a reduction of 27.6 million tCO2e (33%) for 2030. This "reduce from increase" approach coincides with the target defined by Türkiye as 21% for 2030 in its national declaration of intent and is considered an ambitious reduction target for İstanbul considering the rapid growth dynamics of the population and economy. This goal will be achieved through projects such as energy efficiency in buildings and industry, renewable energy, waste management, and 1,100 km of metro lines.

To adapt to the changing climate, İstanbul will reduce disaster risks and recovery times. Climate change adaptation is a matter of risk management and good governance and is local and tailored. Istanbul's compliance strategy is based on risk and vulnerability analyses made on a sectoral basis. An analysis of critical infrastructures was made to strengthen the most fragile elements of the city's ecosystem, infrastructure and socio-economic systems. Cities that are resistant to climate change depend not only on the correct construction of the urban infrastructure, but also on increasing the knowledge and competence of the relevant institutions, the resilience of their industrial and commercial assets, and raising public awareness. Reducing vulnerability is possible with properly planned and managed processes. İstanbul, which has the highest population in Türkiye is located in an ecologically sensitive region, has a dense urbanization rate and is the lifeblood of the country in terms of economy, will be less affected by possible extreme climate events, and will gain a structure that will heal its wounds more quickly and effectively.

SECAP Process

The Sustainable Energy and Climate Action Plan has been prepared under the CoM methodology set out by JRC documents and used by all other cities for preparing SECAP. The following basic steps were followed in the process carried out following the SECAP reporting template of the Covenant of Mayors and the accompanying method report:

a) Preparing the greenhouse gas emissions inventory and evaluating the current situation, defining actions to reduce greenhouse gas emissions
b) Determination of climate adaptation for sectors affected by climate change with risk and vulnerability assessment

Greenhouse Gas Reduction

Bağcılar's Sustainable Energy and Climate Action Plan creates a roadmap to reduce emissions from energy consumption and waste management in different sectors to determine both the stakeholders' participation. This roadmap was first started by calculating the 2018 greenhouse gas emissions inventory of the Bağcılar district. The inventory was created by the International Council of Local Initiatives (ICLEI) based on the IPCC guidelines and was prepared within the framework of the general principles and philosophy of the International Protocol for the Analysis of Local Government Greenhouse Gas Emissions (IEAP), which is valid for every local government.

a) Key Findings

In 2018, the total energy consumption of Bağcılar district, excluding industry, was 5410,1 TWh (industry added 413 GWh) and its greenhouse gas emissions amounted to 1,851,712 tCO2e. According to the inventory, 57.5% of emissions come from the fuel and electricity consumption in

buildings, 30% of emissions belong to the transportation sector, and 12.5% are waste and wastewater emissions. With the sectorally targeted reduction measures, it has been determined that Bağcılar's per capita emissions can be reduced by approximately 40% in 2030 compared to 2018. With Bağcılar's BAU (Business as Usual) scenario, predictions made by different institutions regarding population and sectoral growth were evaluated and 2030 emissions were calculated as 2,211,992 tCO2e according to this scenario. It is predicted that the population will reach 752,084 in 2030.

With the actions detailed under the title of 3.3.2 Contents of Actions, it is aimed to reduce greenhouse gas emissions by about 58 % in total, including 525,717 t CO reductions in the buildings sector, about 48% or 267,151 tCO2e in the transportation sector, and about 60% or 138,649 tCO2e in waste and wastewater sector by 2030.

Since it is not possible to talk about absolute emission reductions with the growth rates in Türkiye, it would be correct to express greenhouse gas emission reduction targets as emissions per capita. According to the BAU scenario, emissions per capita are expected to increase from 2.52 tCO2e in 2019 to 2.94 tCO2e in 2030.

The buildings sector in 2018 consumed 3.340 GWh of all types of energy of which 96 percent came from electricity and gas. Energy efficiency and renewable energy measures are needed to meet the targets set for 2030 and reduce energy consumption in the buildings sector by 42% or 1.425 GWh. Achieving a breakthrough in renovation will require significantly higher investment. According to preliminary calculations to achieve the SECAP targets, by 2030 an average of 1.100.000 m2/year of buildings will be needed to renovate the building stock 300 million EUR/year.

Also, significant investment into renewables especially solar PV will be needed till 2030. Around 210 MW of new PV installations on the ground and on buildings should be installed to generate 284 GWh of electricity annually and to save 143 735 tCO_2. To achieve this is a target investment of 210 million EUR or 21 million EUR/year will be needed.

The transport sector in Bağcılar Municipality consumed 2 070 GWh of all types of energy of which 8is 3 % in the form of diesel. All measures will reduce the energy consumption of 1GW by 2030. The electrification of the sector will require significant inverter establish charging infrastructure and purchase electric vehicles. By 2030 around 32 000 electric vehicles should be bought by citizens of municipality require investments of around 960 million EUR in total or about 140 million/year.

b) Summary of Actions

Mitigation actions have been created separately for buildings, energy, transportation, and other sectors to reduce energy consumption and greenhouse gas emissions. The resulting total amounts of GHG reduction on a sectoral basis and their comparison against BAU and the base year are given in Table 1.

The risks faced by the district of Bağcılar in the context of climate change, the effects of climatic events, and adaptation actions are revealed because of a participatory process by using scientific evaluation methods and taking expert opinions. In this direction, the main climatic parameters of the district were investigated, and risk and vulnerability assessments were carried out. This assessment covers the areas of infrastructure systems, transportation, green infrastructure, waste management, water management, public health, and disaster management.

Table 1: Summary of BEI, 2030 BAU scenario emissions, and total emissions with measures in 2030

Sectors	2018 (BEI) (MWh)	2018 (BEI) (tCO2)	Emissions in 2030 - BAU (t CO2)	Emissions in 2030 with measures (t CO2)	Reduction against 2018 %
Buildings, equipment/facilities	3340222	1064616	1275120	538899	49.4
Transport	2070679	555440	690230	288289	48.1
Waste and wastewater	n.a.*	231656	246642	93007	59.9
Renewable energy generation	0	0	0	-143735	n.a.*
Industry	*412849*	*150698*	*n.a.**	*n.a.**	*n.a.**
Total excl. industry	**5410901**	**1851712**	**2211992**	**776460**	**58.1**

*n.a. – not applicable

It has been revealed that the district is at risk of climatic hazards such as heat and cold air waves, excessive precipitation, storms, drought, flood, and sea-level rise. Especially the sustainability of water resources seems to be at high risk due to increasing temperatures and drought. Another important issue is that almost all sectors are at high risk of flood hazards that may occur due to sudden rains. It is stated that the district, which is also affected by storms and strong winds, may also be indirectly affected by sea-level. The earthquake, which is a great risk for Istanbul, although it does not occur as a climatic, environmental, social, economic, and institutional capacities will be adversely affected, along with major damage to urban infrastructure and public health in the event of an earthquake disaster. For this reason, it is emphasized that adaptation actions aiming to be prepared for climate hazards should be handled in an integrated manner with emergency action plans for earthquake disasters.

The adaptation actions determined against the situation of Bağcılar regarding risk and vulnerability are defined as short, medium, and long-term in terms of implementation. In addition, actions' priority status and implementation capacity were also revealed. Within the scope of adaptation actions, basic issues such as harmonization of infrastructure systems reduce the district's risks in terms of climate change risks, increase active green areas, increase adaptation efforts by paying more attention to neighborhoods with fragile population density, and ensure water management were emphasized. In addition to this, the necessity of detailed analyzes and cost studies has emerged. The importance of working in cooperation with the central government, the metropolitan municipality and neighboring municipalities on issues exceeding the district municipality's administrative capacity of the was emphasized. Moreover, it was stated that universities, commercial institutions, educational institutions and non-governmental organizations should work together on climate change adaptation, which is one of the most important requirements in combating climate.

1. INTRODUCTION

At the beginning of the 21st century, it is now definitively stated by climate scientists that global warming occurred due to carbon dioxide and equivalent greenhouse gases caused by the intense use of fossil fuels. It is predicted that continuing the current consumption habits of societies will significantly increase the negative consequences of climate change, resulting in huge environmental destruction, mass deaths and other human disasters. These results can be observed with the increase in extreme natural events we encounter today. It has been proven that since the industrial revolution, carbon dioxide emissions from human activities, especially due to fossil fuel consumption, have increased much faster than the oceans and forest areas can absorb.

Local governments have become increasingly involved in this problem, which is very closely related to people's quality of life and health. Unlike the decision-making process of governments, local governments' dominance in solving regional problems and their ability to evaluate the advantages of being local in process management have made the position of local governments indispensable in the face of the negative effects of climate change. They have shown that by setting further targets, they can begin to take important roles in the fight against climate change.

Bağcılar Municipality is a signatory to the Covenant of Mayors (CoM), established by the European Commission to encourage and support urban reduction plans to reduce greenhouse gas emissions from cities and to encourage the use of clean energy sources. In this context, it undertakes to implement the steps stated for reducing greenhouse gas emissions by at least 40% in 2030 compared to 2018, the base year. Bağcılar Municipality has taken an important step in reducing the negative effects of climate change and preparing the district for possible climatic changes by preparing a Sustainable Energy and Climate Action Plan (SECAP) under the leadership of the Environmental Protection and Control Directorate in coordination with local stakeholders.

1.1 STRUCTURE OF THE REPORT

“Sustainable Energy and Climate Action Plan” basically consists of five parts.

Chapter 1 “Introduction”: This section presents, an overview of the SECAP process; It also sheds light on the target and strategy areas of national and local plans on sustainable energy and climate change adaptation. In this context, a relationship is established with SECAP prepared for Bağcılar district.

Chapter 2 “Climate Change”: In this section, climate change scenarios, climatic disasters as well as global, national and local climate change policies are examined. Climate change scenarios and climatic disasters are examined in detail in a global, national and urban context. In the municipality’s strategic plan, the direct and indirect targets determined within the scope of reducing greenhouse gasses and reducing the negative effects of climate change are examined and presented as a summary table at the end of this section.

Chapter 3 “Climate Change Mitigation”: In this section where the inventory findings are given with the sectoral breakdown, there is information about the 2030 reduction target and projection. In the reduction section, there is information about the assumptions made using international standards and city data during the greenhouse gas inventory preparation stage, the process followed in determining mitigation actions, and stakeholder participation. While the reduction actions are given on a sectoral basis, the current situation of the sector and its place in national and city strategies are also mentioned. The actions that Bağcılar will take to reduce its current greenhouse gas emissions

are summarized. With the monitoring plan, improvement areas are detailed on a sectoral basis. The reduction part consists of the following headings:

- Buildings: Municipal buildings, Non-residential buildings, Residences
- Energy
- Transportation
- Waste

Chapter 4 "Adaptation to Climate Change": The current situation of Bağcılar regarding adaptation to climate change, the risk and vulnerability assessment against climatic events, the determination of adaptation strategies and actions in this context, and finally the adaptation monitoring part are evaluated in this section. In this context, compliance consists of the following topics:

- infrastructure systems
- green infrastructure
- water management
- waste management
- Public health and disaster management

Chapter 5 "Conclusion": In this section, the results obtained within the scope of SECAP are evaluated under two sub-headings mitigation and adaptation.

1.2 SUSTAINABLE ENERGY AND CLIMATE ACTION PLAN (SECAP) STEPS

Basically, six steps are followed in the preparation of SECAP. The process, which starts with the creation of the greenhouse gas inventory, is completed with the monitoring and reporting step after the action details on the reduction and adaptation issues. Within the scope of this study, the methods and standards adopted by the Covenant of Mayors are used. **Figure 1** shows the steps followed in the Sustainable Energy and Climate Action Plan preparation process.

Figure 1: SECAP process steps

a) **Preparation of Greenhouse Gas Inventory:** Collecting the greenhouse gas sources consumption data of Bağcılar district and determining the most greenhouse gas emission sources of the district
b) **Establishment of Greenhouse Gas Reduction Actions:** Creating actions on buildings and energy, transportation and waste and wastewater management in the greenhouse gas reduction part of the Sustainable Energy and Climate Action Plan prepared for Bağcılar
c) **Risk and Vulnerability Assessment:** For Bağcılar, the exposure and probability assessment according to various parameters for the impact areas of critical infrastructure

and built environment, transportation, biodiversity, waste management, water resources, public health, industry and disaster management regarding the risk of extreme weather events and floods, according to the five-point Likert scale and grading of the risk level. Set as low, medium and high.

d) **Implementation of Actions:** Implementation of the actions included in the Sustainable Energy and Climate Action Plan
e) **Monitoring and Reporting:** Monitoring and reporting of greenhouse gas emissions and energy consumption changes according to the determined base year.

1.3 BAĞCILAR DISTRICT GENERAL INFORMATION

Bağcılar district is located on the European side of Istanbul. There are military lands connected to Bahçelievler to the south, Küçükçekmece to the west, Başakşehir to the northwest, Güngören to the east, Esenler, Esenler and Başakşehir to the north. The district does not have a coast to the sea, and the elevation of the district, which spreads on a flat and wavy plateau formed by erosion, varies between 50-130 meters above sea level. The district is between E-5 and TEM highways, total area is 22 km². Bagcilar district receives İBBigration, and its population varies from year to year. The variation of Bagcilar municipality population in 2016-2020 as well as a projection for 2030 are shown in Table 2. According to the Table, the population of Bağcılar Municipality was 734,369 in 2018, slightly varied in recent years, and is foreseen to increase by 2% to 752,084 till 2030.

***Table 2**: The population of Bağcılar district between 2016 and 2020 (TÜİK)*

2016	2017	2018	2019	2020	2030
751,510	748,483	734,369	745,125	737,206	752,084

"2017" made by the Ministry of Industry and Technology according to the results of the "Socio-Economic Development Ranking of the Districts", the ranking of the district of Bağcılar is given in the Table 3.

***Table 3:** 2017 socio-economic development index results of Bagcilar by Istanbul districts*

Year	overall ranking	Ranking by Province	Score	Level
2017	37	18	2,012	1
2022	33	19	2,346	1

[1]

Today, there are yarn weaving, food, stone and soil, metal and press industry diversification, small and large workshops, commercial centers and trade centers in Bağcılar District, which is one of the most important trade and industrial centers of Istanbul. The Matbaacılar and Ambalajcılar Sitesi, with 275 members, as well as Metro Grosmarket, Hayatpark and 212 shopping centers are located in Bağcılar. The district economy is engaged in small industry and trade. Intense industrial establishments operate in the Güneşli Region of Bağcılar District, in other words, across the Airport Road and İkitelli. Many large and small industrial establishments exist in other parts of the district. The printing houses and administrative centers of Hürriyet, Milliyet, Meydan, Dünya, Akit and Yeni

[1] *https://www.bebka.org.tr/admin/datas/ Sayfas/89/lce-sege-2017_1598265107.pdf*, Access Date: December 2021 and https://www.sanayi.gov.tr/merkez-birimi/b94224510b7b/sege Access date: June 2022

Asya newspapers, which are among the major press organizations of the country, are in Bağcılar[2]. There are many educational institutions in Bagcilar district.

The socio-economic level of cities is among the important indicators in studies on climate change. It is especially important for the "adaptation capacity" component used in climate change adaptation studies. Factors such as education level and income status are important factors for people living in the city to adapt to possible changes. The dependent population tends to be more affected by possible climate change effects, albeit in different figures and levels.

When we look at the education level of the population over the age of 6, the education level of university and above is around 8%. This rate is well below the Türkiye and Istanbul averages. The average education period was calculated as 6.8 years[3]. However, to increase the resolution a little more, it would be useful to make research at the neighborhood level. In a study conducted for the Istanbul Development Agency in 2016, the socio-economic structures of the districts were examined.

Population density is very effective on the climate change's level. Population density can also be considered as an indicator of the scarcity of permeable surfaces and building density. The urban heat island effect is important in terms of urban floods and the intensity of energy consumption. The average household size of Bağcılar district is 4.1 persons. Average household size in Türkiye is 3.3 persons. Figure 2 provides information about population densitiy of Bağcılar neighbourhoods in 2016.

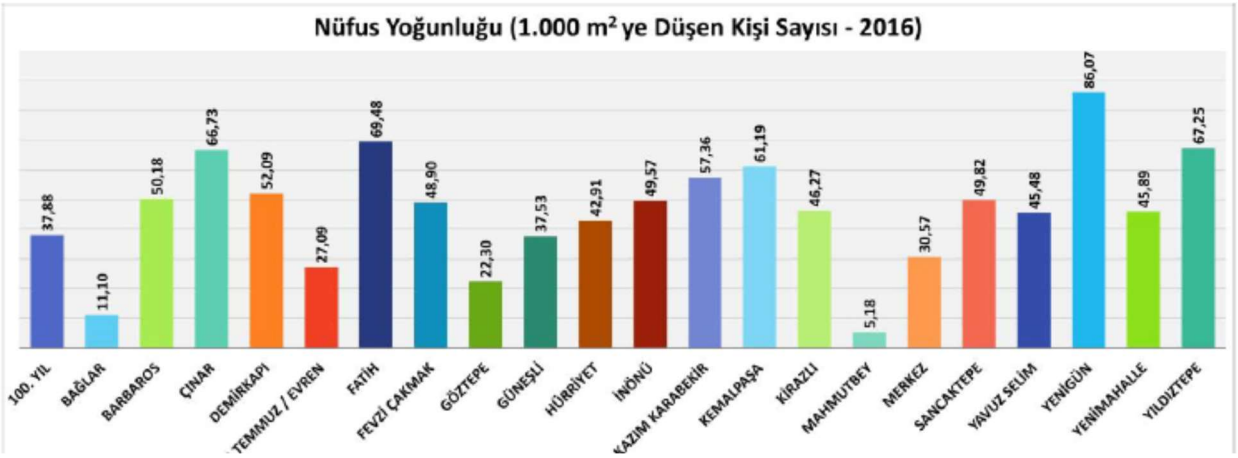

Figure 2: *Population density of Bağcılar neighbourhoods*

Bağlar, Güneşli, Hürriyet, Mahmutbey, Merkez and Sancaktepe neighborhoods have a socio-economic development index above 30, which is calculated by taking into account many parameters such as education, internet, access to health services, and income level. The values of other neighborhoods vary between 24-28. Considering the dangers of climate change, it can be said that their adaptation capacity may be low. The Socio-Economic Status (SES) indicator is one of the important indicators that give an idea about the socio-economic structure of citizens by evaluating different issues such as housing, possession of various goods and vehicles, shopping attitudes, use

[2]http://bagcilar.gov.tr/ekonomi

[3] *My Mahallem Istanbul, Istanbul University, December 2017, Innovative and Creative Istanbul Financial Support Program", supported by Istanbul Development Agency*

of technology, access to health services, and leisure time.[4]. Figure 3 shows both indices for Bağcılar neighbourhoods.

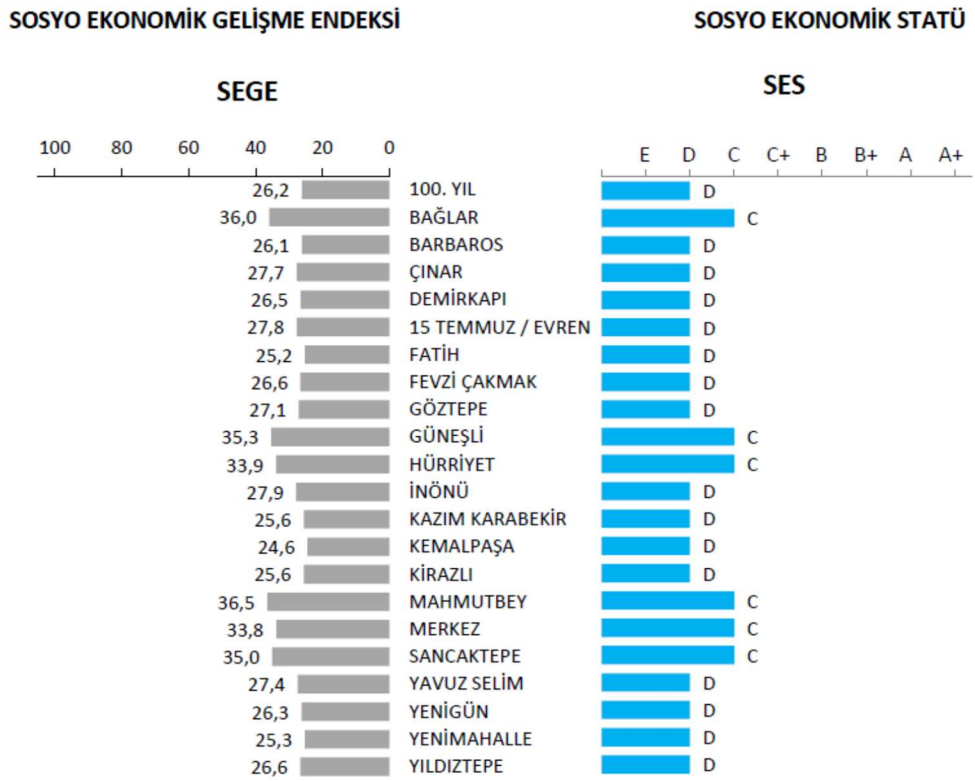

Figure 3: *Bağcılar neighbourhoods Socio-Economic Development (SEGE) and Socio-Economic Status (SES) indices*

[4]My Mahallem Istanbul, Istanbul University, December 2017, Innovative and Creative Istanbul Financial Support Program", supported by Istanbul Development Agency

2. CLIMATE CHANGE

In this section, in the context of climate change, climatic events occurring both at global, national and urban scale, current situation created by climate change and future scenarios based on projections are presented. Thus, the possible risks Bağcılar will face in the process of combating climate change are also pointed out. In addition to these policies which are implemented in the fight against climate change, important issues in international conventions, and steps to combat climate change in the national context are other important issues presented in the chapter.

Throughout the chapter, both international and national sources were used. In particular, important and up-to-date resources such as the Covenant of Mayors and the IPCC have been consulted in research on the global impacts and scenarios of climate change. The current situation and projection studies of Bağcılar district in the context of climate change were conducted by researching many data sources and compiling data at different scales. However, since the climate change studies based on districts are not sufficient, the necessary information has been compiled generally based on the borders of Istanbul. Therefore, valid international climate change reports, resources provided by Bağcılar Municipality, resources of the General Directorate of Meteorology were used.

2.1 CLIMATE CHANGE SCENARIOS AND CLIMATE DISASTERS

Especially in the 1990s, the severe deterioration of the earth's radiation balance and the increase in the speed of this deterioration in recent years, the greenhouse gas effect created by fossil fuels used for energy production is revealed by climate science. In addition, climate change, which occurs as a result of the production and consumption habits of societies, causes climatic disasters. Climatic disasters in the guidelines prepared by the Carbon Disclosure Project (CDP-Carbon Disclosure Project) for climate change are shown in **Table 4.**

In addition, the impact of the damage caused by climatic disasters on assets and service areas are shown in **Table 5**.**Hata! Başvuru kaynağı bulunamadı.** It should be said that these climatic disasters seen in various parts of the world cause negative effects in all critical areas and cause the normal flow of life to deviate. It is known that disasters caused by climate change cause environmental and social destruction as well as mass extinctions. For this reason, international authorities and climate experts put forward various climate change scenarios by addressing the past and current situation of the earth, emphasizing that the fight against climate change should spread rapidly and urgently to all areas of life.

Table 4: *Climatic disasters according to CDP*[5]

Meteorological	Precipitation	Rain storm	Monsoon	Insects and micro-organisms
		Heavy snow	Snowstorm/blizzard	
	Wind	Severe wind	Dust storm/sandstorm	Flood, Chemical change
		Tornado	Extratropical cyclone	
		Cyclone (Hurricane/Typhoon)		Wave action
		Tropical storm		
	Lightning	Electrical storm	Lightning/thunderstorm, derecho	Wild fire
	Fog	Fog		
	Extreme temperature - Cold	Extreme winter conditions	Ice, hail, freezing rain, debris avalanche	Water scarcity
		Cold wave	Cold snap, frost	Subsidence
		Extreme cold weather	Cold days	Landslide
	Extreme temperature - Hot	Heat wave		Drought
		Extreme hot weather	Hot days	
Climatological	Water scarcity	Drought	Lack of precipitation and seasonal melt (snow, glacial)	Rockfall, Avalanche
	Wild fire	Forest fire		Subsidence
		Land fire	Bush fire, grass fire, pasture fire, scrub fire	Landslide
Hydrological	Flood	Flash/surface flood	Glacial lake outburst	Subsidence
		River flood		Insects and micro-organisms
		Coastal flood		
		Groundwater flood	Waterlogging	Landslide, Flood
	Wave action	Storm surge	Seiche	
	Chemical change	Salt water intrusion		
		Ocean acidification		
Geophysical	Mass movement	Landslide	Lahar, mud flow, debris flow	Chemical change
		Avalanche	Debris avalanche, snow avalanche	Flood
		Rockfall		
	Subsidence	Sudden subsidence (sinkhole), long-lasting subsidence		
Biological	Insects and micro-organisms	Water-borne disease	E.g. Cholera, Typhoid, Legionnaires' disease	Extreme temperature - hot
		Vector-borne disease	E.g. Malaria, Dengue Fever, Yellow Fever, West Nile Virus, Bubonic Plague	Flood
		Air-borne disease	E.g. Pneumonic Plague, Influenza	
		Insect infestation	E.g. Pine beetles, killer bees, termites	

Table 5: *Assets and services that may be affected by climate disasters according to CDP*[6]

Energy	Waste management	Trade
Water resources and sanitation	Information and communication technologies	Residential areas
Transportation	Food and agriculture	Education
Environment	Industry and industry	Public health
Society and culture	Laws and order	Disaster Management

2.1.1 Climate Change in a Global Context

The effects of climate change are observed differently on a global, regional, and local scale. Climatic events such as drought, unexpected extreme hot and cold weather, sudden and heavy rains that will cause floods and excessive hail are the results of the human-induced greenhouse gas concentration in the atmosphere, which disrupts the radiation balance of the earth. However, this deterioration

[5]Climate Risk and Vulnerability Assessment Methodology Climate Risk and Vulnerability Assessment (CRVA) Methodology, https://toolkit.climate.gov/tools

[6]Climate Risk and Vulnerability Assessment Methodology Climate Risk and Vulnerability Assessment (CRVA) Methodology, https://toolkit.climate.gov/tools

causes an increase in social and economic irregularities. In the studies prepared by the IPCC (2007), greenhouse gas emissions originating from agriculture, land use, industry, energy, and waste sectors increased to 70% between 1970 and 2004, leading to the earth's warming. After 2004, this increase accelerated, causing the temperature of the earth to increase by 1.1°C today.

With this warming, results that will directly affect people in various parts of the world have begun to occur. Precipitation pictures, which deteriorate with the change in temperature, cause floods disasters and droughts. The deterioration of ecosystem balances in glacial regions and the melting of glaciers cause negative consequences such as rising sea levels in these regions and the whole world. Moreover, the global crisis of access to safe food and the adverse conditions in coastal areas are other factors that reveal the global seriousness of the issue. For this reason, the fact that serious measures are not taken globally regarding climate change shows that these negative effects will intensify, cause great disasters and cause many people to lose their lives.

2.1.1.1 Climatic Disasters

Climatic disasters have been occurring with increasing severity, frequency, duration in recent years.[7] [8][OBJ]9According to the latest World Disaster Report published by IFRC to cover the year 2019 (2020)[10] in 2010 -2019, 2850 natural disasters caused the death of more than 10 people and affected more than 100 people. The majority of these were caused by climatic events such as floods, storms and heat waves with a rate of 83%, as in the 1998-2017 period. These disasters affected close to 1.8 billion people who lost their lives, were injured, became homeless or faced with livelihood problems in the ten-year period alone. In addition, the way in sustainable development has been interrupted due to disasters.

Within the scope of the report prepared by IFRC, it is seen that 308 natural disasters occurred in 2019 alone and 97.8 million people were affected by these disasters. The most common disasters in 2019 were floods, followed by storms, epidemics, earthquakes and hydrologically related landslides. Extreme heat waves, forest fires, and drought were less frequent, while volcanic activity was extremely rare (**Figure 4**).

[7]General Directorate of Meteorology, 2019 Meteorological Disaster Assessment Report, 2020.
[8]*UNISDR&CRED, Economic Losses, Poverty & Disasters 1998-2017, 2018.*

[10]*Freebairn, A., Hagon, K., Turmine, V., Pizzini, G., Singh, R., Kelly, T., Jaime, C., Scherer, N., Siahaan, K., Hartelius, J., Natoli, T., Lagdameo, DM, Bachofen, C., Emery, G., Swithern, S., & Fisher, D. (nd). World disasters report 2020: come heat or high water.*

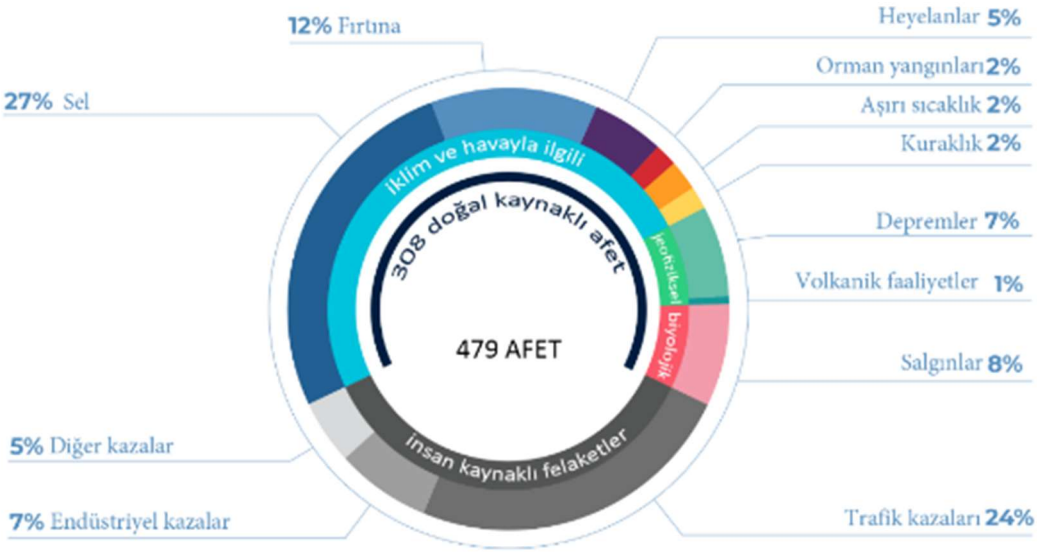

Figure 4: *Disasters in 2019*[11]

The same report states that since 1960, more than 11,000 disasters triggered by natural hazards have been recorded. While the total annual number of disasters was 33 in 1960, it is revealed that this number was 441 in 2000. Disasters due to geophysical and biological hazards, on the other hand, have increased since the 1960s and remained relatively stable after the 1980s. In addition, epidemic diseases have increased since the 1060s and reached their peak between 1997 and 2002 (**Figure 5**). The new Covid-19 outbreak, which started at the end of 2019, has not yet been included in these studies.

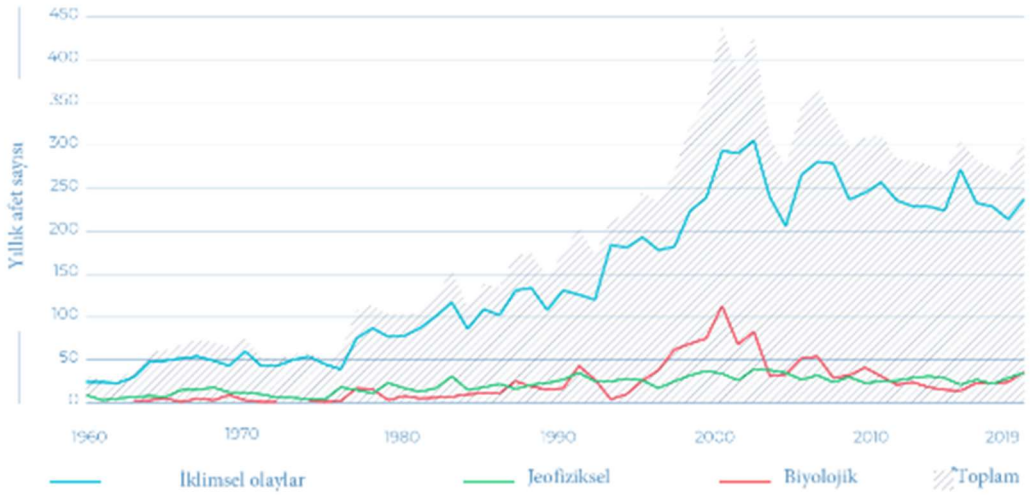

Figure 5: *Number of disasters between 1960 and 2019*[12]

Total number of disasters triggered by climate and weather events and marked increase since 1960 is shown in **Figure 6**. While 76% of the disasters reported in the 1690s were related to climate and weather events, this rate increased to 83% in the last ten years between 2010-2019.

[11]Translated into Turkish from EM-DAT, FAO/FEWS NET, Dartmouth Flood Observatory, ReliefWeb and IFRC GO.
[12]*Translated into Turkish from EM-DAT, FAO/FEWS NET, Dartmouth Flood Observatory, ReliefWeb and IFRC GO.*

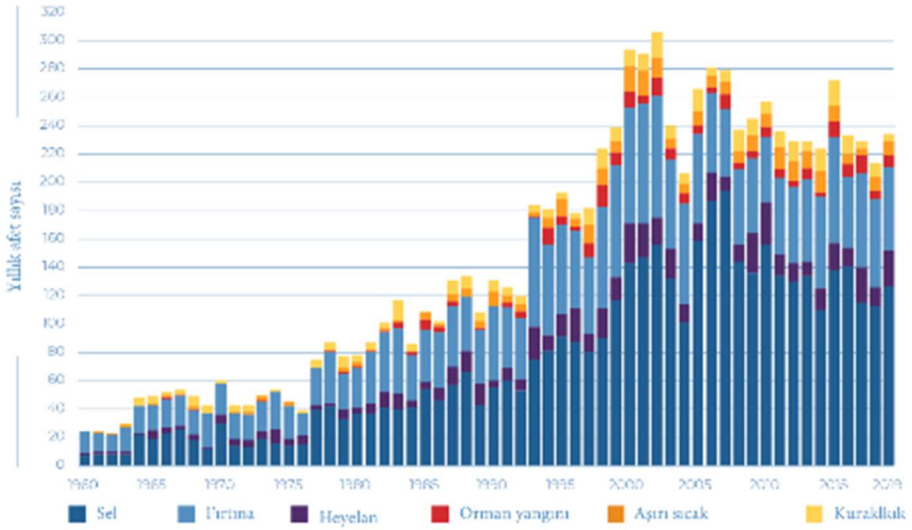

Figure 6: *Annual number of disasters caused by climate and weather events between 1960-2019*[13]

In addition, according to the studies carried out by the Cambridge University Risk Research Center, a risk map of natural and human-based threats that may be encountered between 2015 and 2025 has been created. It is seen that Istanbul and Türkiye are also included in this risk study (**Figure 7**).

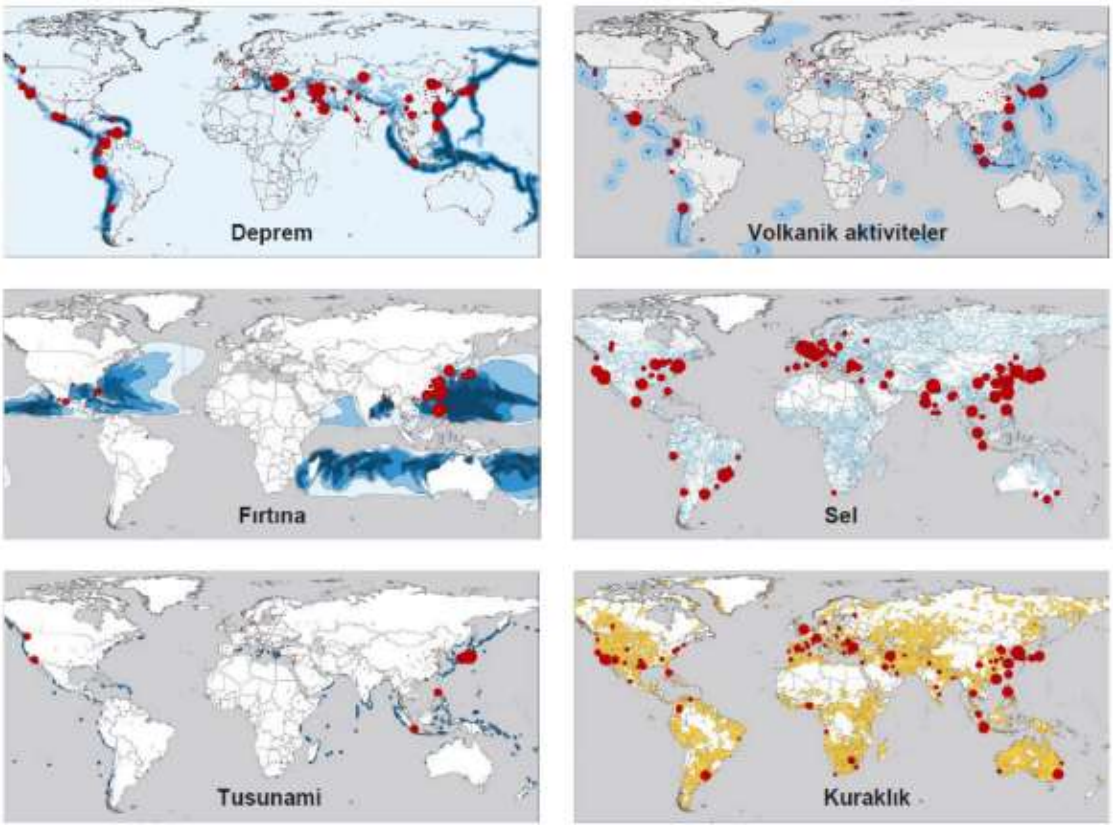

Figure 7*: Cambridge World Risk Atlas Examples: Map of disasters threatening the world*[14]

[13]Translated into Turkish from EM-DAT, FAO/FEWS NET, Dartmouth Flood Observatory, ReliefWeb and IFRC GO.
[14]*Cambridge Center for Risk Studies, Cambridge Risk Atlas, Part II: Methodology Documentation," World Cities Risk 2015-2025", 2015.*

2.1.1.2 Climate Change Scenarios

The 6th Evaluation report of the IPCC published in 2021, it is stated that the global temperature has increased by 1.1°C compared to the years 1850-1900. Although it is accepted that this increase will continue up to 1.5°C, possible model studies have been put forward for the amounts above this increase. Issues with high social reaction, such as agricultural production, urbanization, economic and technological developments, have been the basis of these models. **Figure 8** shows the events that will occur with possible temperature increases until the year 2100. Even the 1.1°C increase in temperature today causes a decrease in snowfall, drought, sudden and heavy rains, tropical cyclones, heat waves and sea level rise. When this increase is 1.5°C, 2oC and 4°C, it is clearly revealed to what extent the effects will occur.

The frequency of tropical cyclones will increase by 10% compared to the 1900s as a result of the temperature increase of the earth not staying at 1.1°C but at least 1.5°C. In this case, which is the best scenario, snowfall will decrease by 5%, the difference in rainy days will change 1.5 times compared to the previous ten years, and drought will increase 2.4 times in the same direction. However, the temperature of the days in the ten-year period will increase by 1.9°C (**Figure 9**). In order to achieve this situation, which is the most optimistic scenario, the whole world has to make an effort in cooperation. If the temperature increase exceeds 1.5°C, possible situations will lead to very bad effects: tropical cyclones increase by 13% and 30%, snowfall decreases by 9%-25%, the difference in rainy days in a ten-year time period is 1.8.

In addition, the effect of global temperature increase models by continents is shown in **Figure 10**. The dramatic differences between 1.5°C, 2°C, 3°C and 4°C increase reveal how serious a risk we face on a global scale. On the other hand, precipitation change rates are seen on a global scale according to four different temperature increase scenarios in **Figure 10**. In all temperature increase scenarios, it is seen that Türkiye, located in the Mediterranean Basin, is one of the countries that will be most affected by climate change. Since the incidence of other effects, especially the risk of drought, will increase, it is essential to take measures quickly at national and all urban scales.

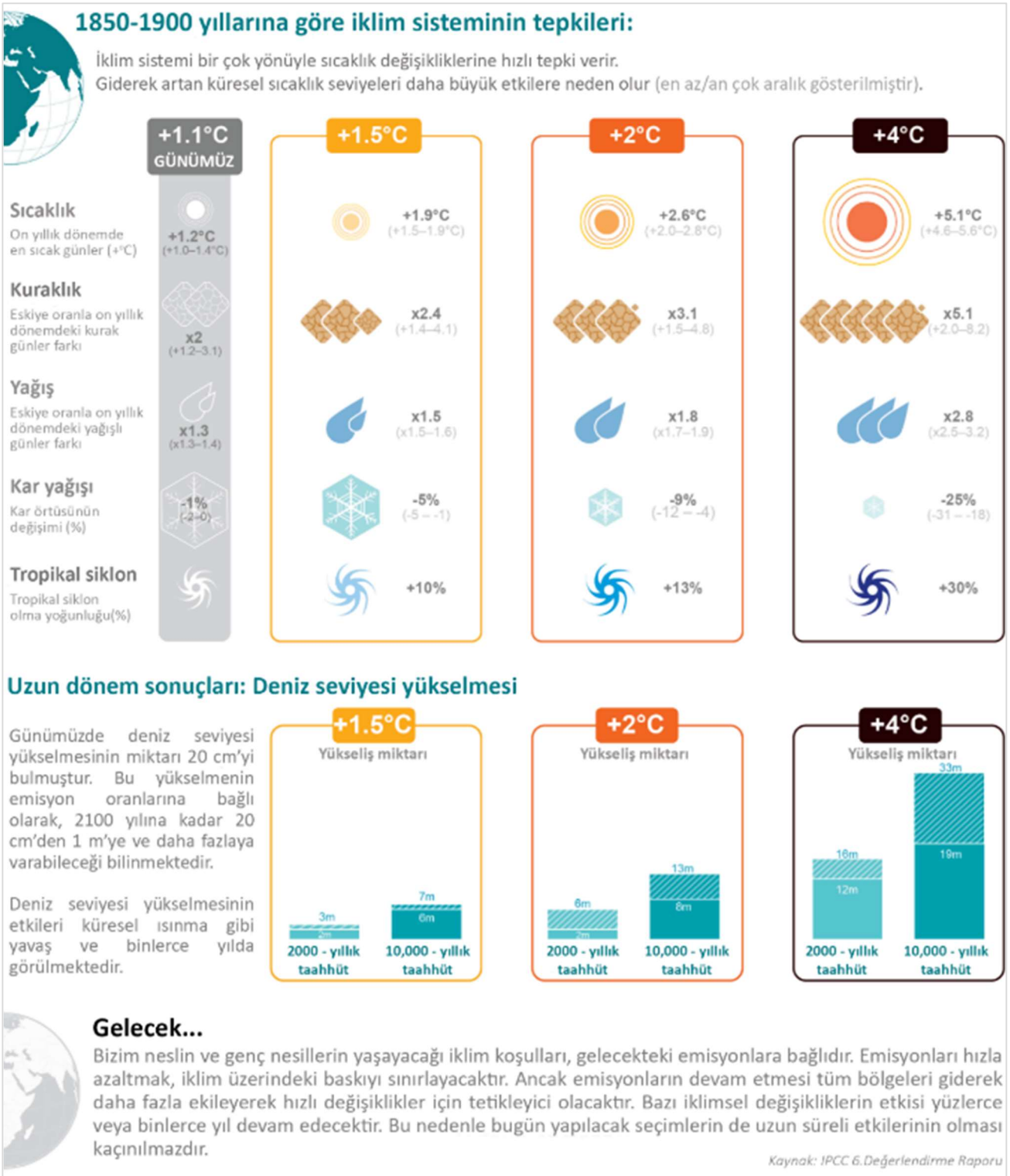

***Figure 8**: Climatic responses chart in the IPCC 6th Assessment Report*[15]

[15] *This chart, which is included in the IPCC 6th Assessment Report, has been translated directly into Turkish.*

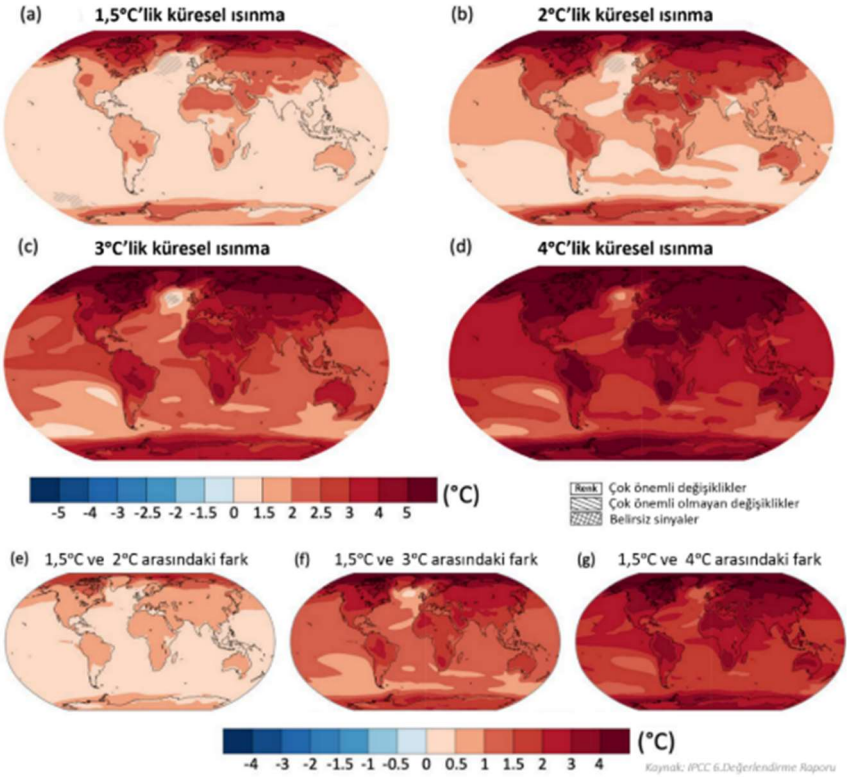

Figure 9: *Map models showing temperature rise on a global scale*[16]

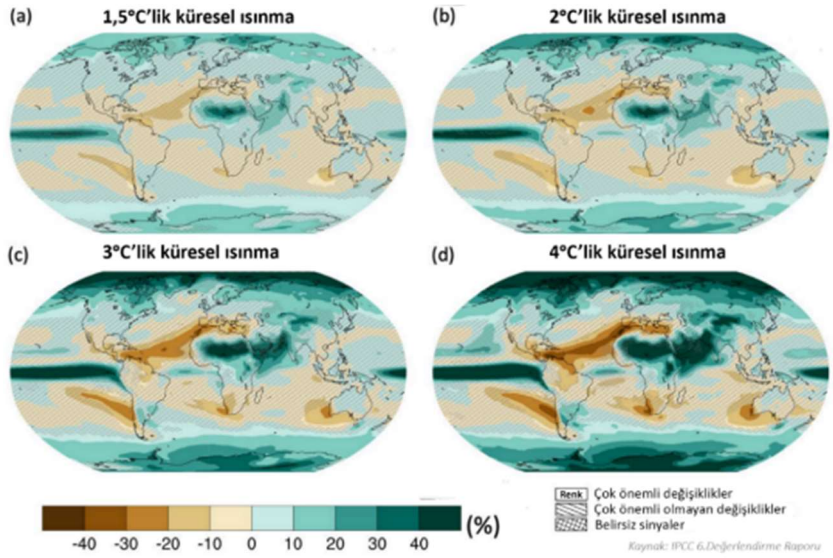

Figure 10*: Precipitation models created according to the temperature increase on a global scale*[17]

[16]This chart, which is included in the IPCC 6th Assessment Report, has been translated directly into Turkish.
[17]This chart, which is included in the IPCC 6th Assessment Report, has been translated directly into Turkish.

2.1.2 Climate Change in a National and Regional Context

Detailed studies of Türkiye in the context of climate change are included in the most recently published Seventh National Statement of Türkiye. It was prepared by the Ministry of Environment and Urbanization of the Republic of Türkiye in 2018 within the scope of the United Nations Framework Convention on Climate Change (UNFCCC). This report also includes observations and research made by the General Directorate of Meteorology (MGM). In this section, a summary of Türkiye's data on climate change will be presented.

According to the observations made by the MGM in the Seventh National Communication, it is stated that the precipitation decreases, and the temperature increases throughout Türkiye in the summer months. In studies on this subject, MGM took the years between 1971 and 2017 as a reference, and the average temperature between 1971 and 2000 was 13.2 °C. The temperature was determined to be 13.5 °C between 1981 and 2010 (**Figure 11** and **Figure 12**).[18]

Apart from this, the highest temperature recorded in Türkiye until 2017 was recorded in the summer of 2010. Both summer and winter seasons of 2010 were warmer than other years. While the warmest autumn was experienced in 2012, the warmest spring was experienced in 1989.

Figure 11: *Distribution of Türkiye's annual average temperature data between 1971-2017*[19]

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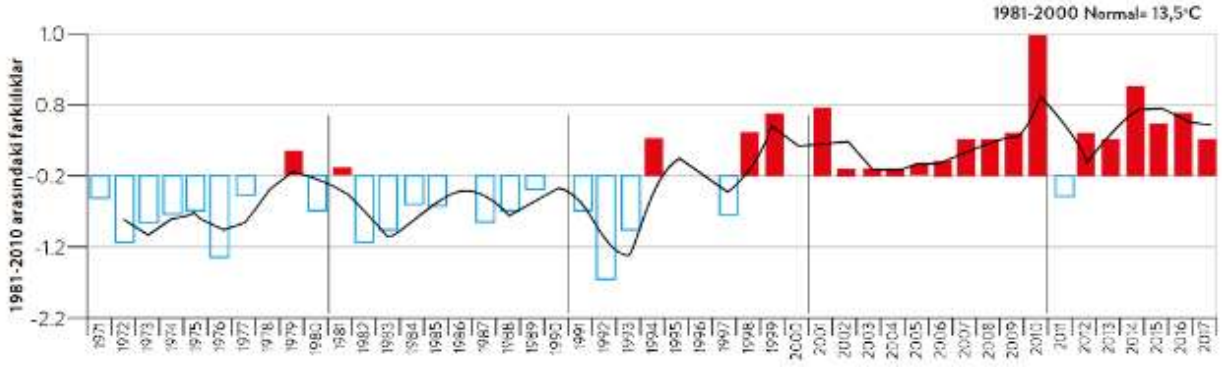


Figure 12: *Türkiye's annual average temperature anomaly between 1971-2017 (according to 130 stations)*[20]

[18]Türkiye Seventh National Statement, 2018
[19]MGM, 2018
[20]MGM, 2018

Changes in precipitation patterns, which is another anomaly arising from climate change, have also been valid for our country. According to the data included in the report and based on the MGM observations, the annual total amount of regional precipitation in Türkiye was measured as 574 mm in the period between 1981 and 2010. According to the observations, even if there is no significant change in the annual total precipitation environments throughout Türkiye until 2017, when the long-term precipitation averages are examined, it is seen that the dry and rainy periods follow each other (**Figure 13**).

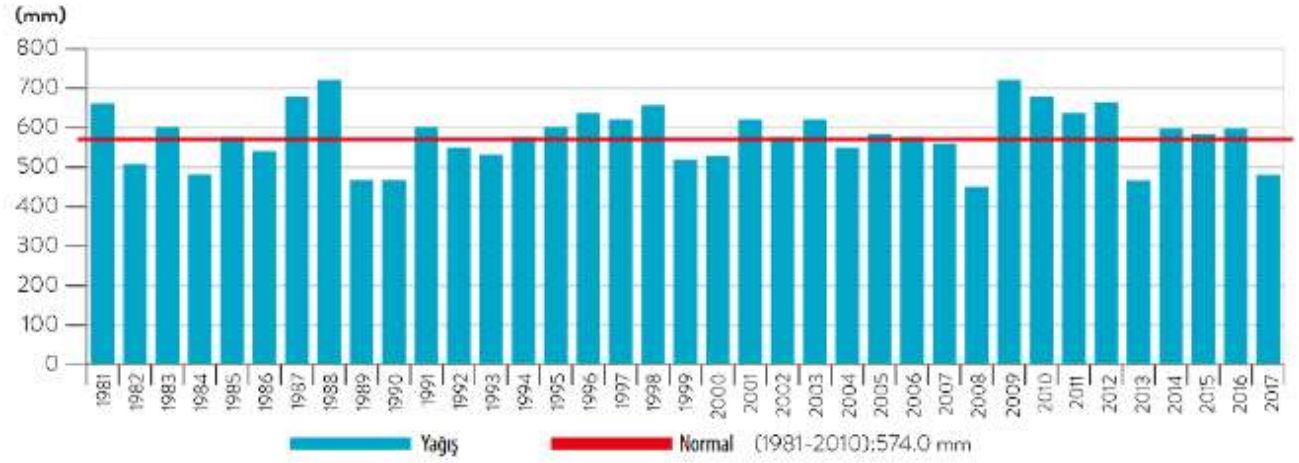


Figure 13: *Annual regional precipitation between 1981-2017 in Türkiye*[21]

In general, in the context of climate change, there is a trend affecting the maximum and minimum temperatures in the country. However, irregularities are also observed in the samples of precipitation changes. Despite the decrease in the average annual total precipitation, an increase is observed in the sudden maximum precipitation. This situation sometimes results in floods and overflow disasters.

In addition to these, Türkiye's water uses indicators prepared by the European Environment Agency show us how serious a problem the drought risk can be. Among the European countries, the risk indicator that Türkiye poses on renewable water resources with its water use is seen in **Figure 14**. Türkiye's water use change from 1990 to 2017 is shown in **Figure 15**.

[21]MGM, 2018

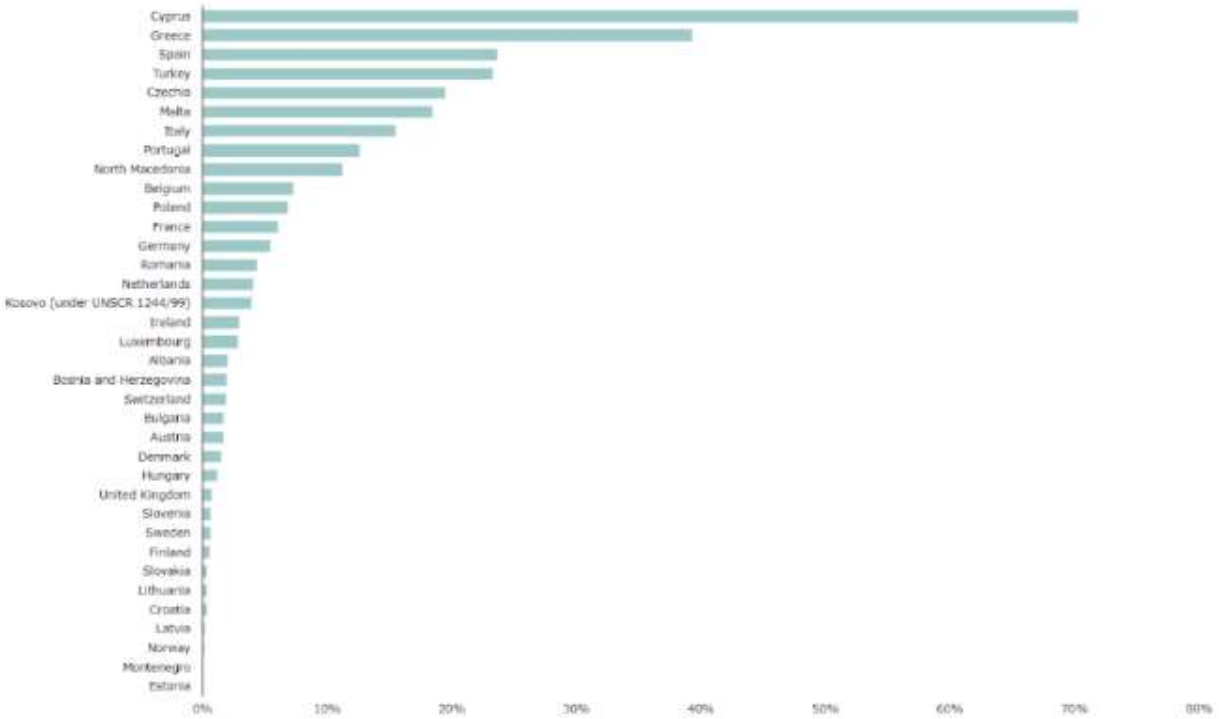


Figure 14: *Türkiye's water use indicator among EU countries (risking their resources), 2017* [22]

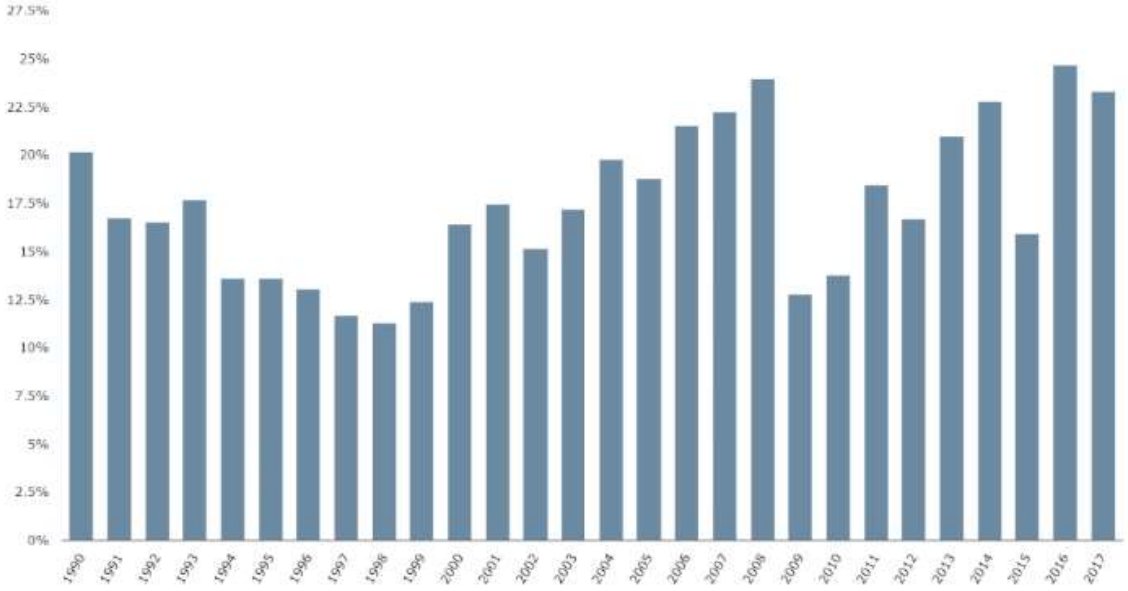


Figure 15: *Indicator of the change in Türkiye's water use over the years, 2017* [23]

As a result, it is necessary to state that the risk of drought caused by the pressure of urbanization, the decrease in forest existence, population growth and the climate crisis has become not a risk encountered after many years, but a great danger encountered and showing its effect today.

[22]https://www.eea.europa.eu/data-and-maps/indicators/use-of-freshwater-resources-3/assessment-4
[23]https://www.eea.europa.eu/data-and-maps/indicators/use-of-freshwater-resources-3/assessment-4

2.1.2.1 Climatic Disasters

In this section, disaster situations in our country are revealed by making use of the statistical information and studies in the Meteorological Disasters Assessment Report prepared by the General Directorate of Meteorology for 2020. The long years distribution of natural disasters are shown in **Figure 16**.

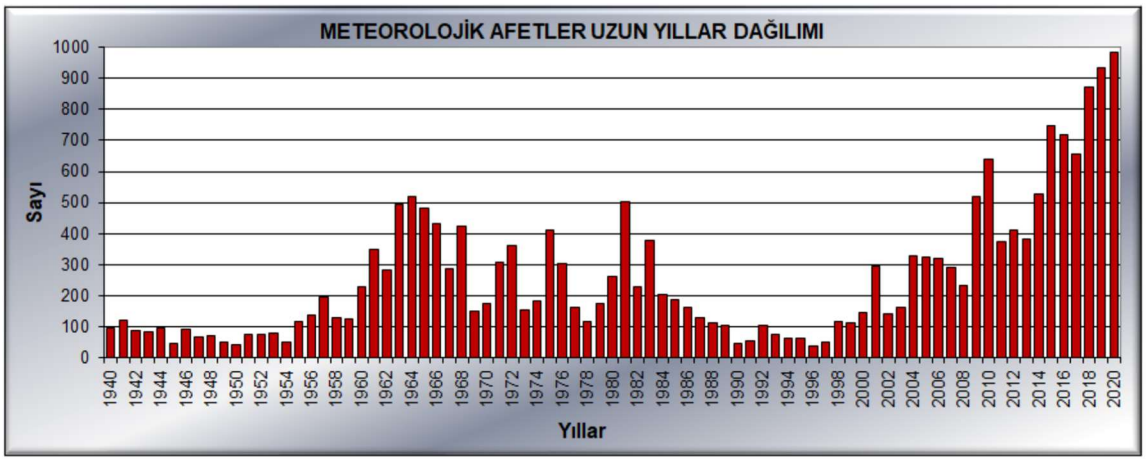


Figure 16: *Annual Distribution of Natural Disasters of Meteorological Character Observed in Türkiye in the Period 1940-2020*

Meteorological and nature-based disasters that occurred the most in Türkiye in 2020 are 297 heavy rainfall/flood events with a rate of 30%. Following the flood and heavy rain disaster, 262 storms, 223 hail and 52 snow disasters were experienced. However, most of the disasters occurred in summer with a rate of 41%.

According to MGM records, the incidence of natural disasters in our country in 2020 in cities is shown on the map in **Figure 17**. According to the map, the province with the highest number of disasters was Antalya, while the frequency of disasters in Istanbul remained at medium levels.

According to the studies of MGM, the drought map made for 2020 shows that the Marmara Region is facing a drought risk along with the country in general (**Figure 18**). Drought risk poses an extremely risky situation for Türkiye, which is one of the countries that will be most affected by climate change. According to the drought map, except for Bilecik and its surroundings, the Marmara Region has been exposed to severe drought.

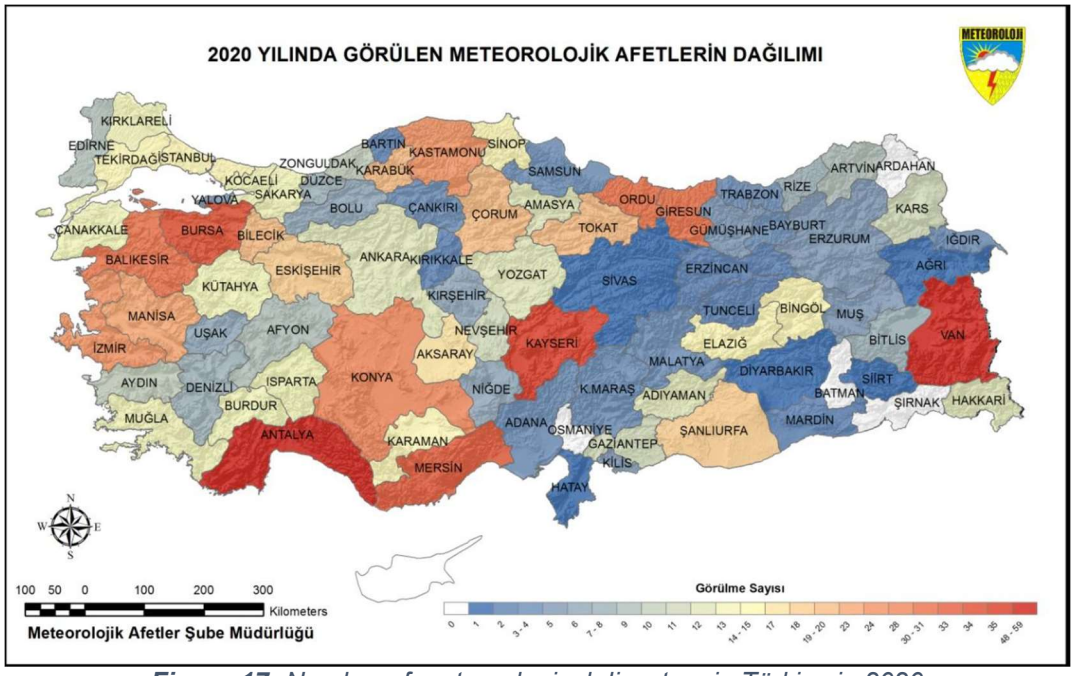


Figure 17: *Number of meteorological disasters in Türkiye in 2020*

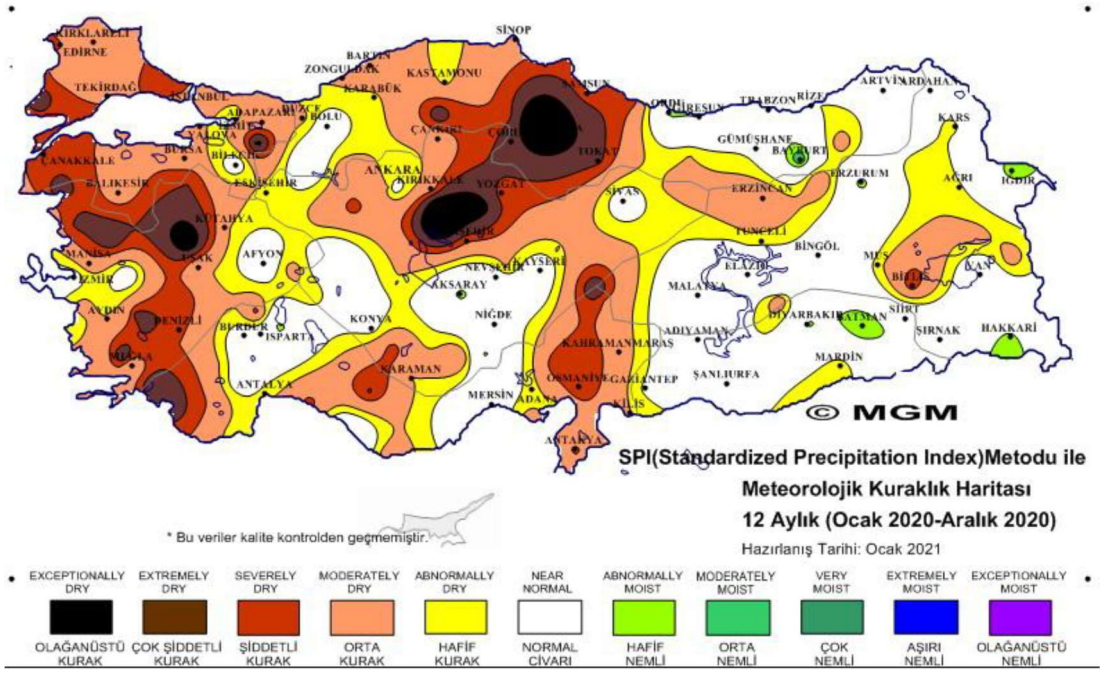


Figure 18: *Drought map in Türkiye according to the standard precipitation index for 2020*

For the annual average areal precipitation, which we directly associate with drought, 574 mm was measured. For 2020, this amount was measured as 500.1 mm, showing a decrease of 12.9% compared to the general average and 14.5% compared to the previous year's average. The precipitation amounts from 1981 to 2020 are shown in **Figure 19**. According to the figure, it is seen that the amount of precipitation in 2020 has decreased dramatically, but it is also stated that it is the sixth year with the least precipitation since 1981.

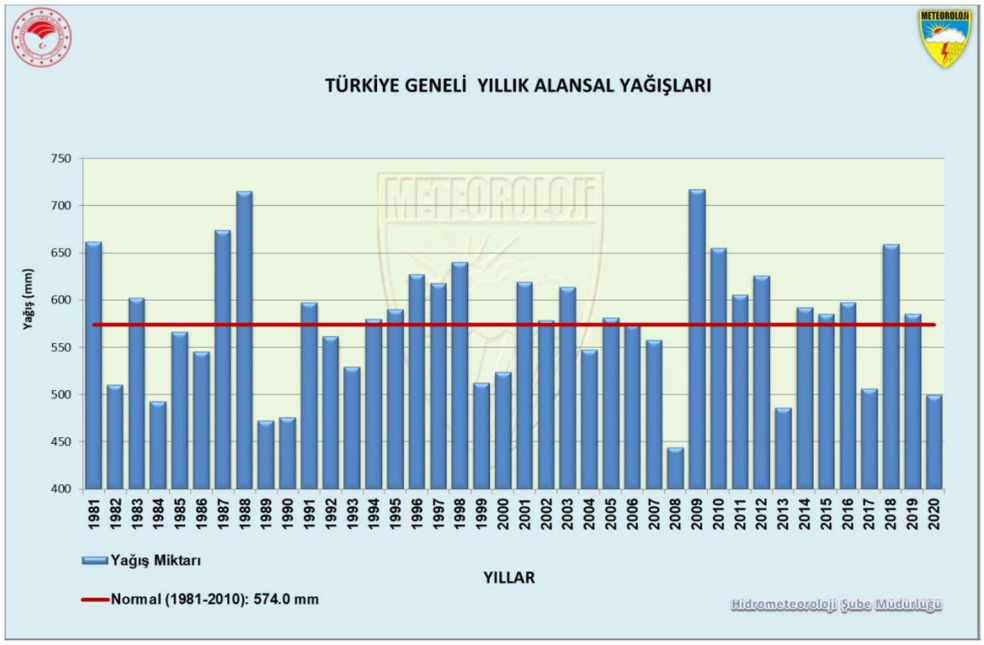


Figure 19: Precipitation distribution in Türkiye by years

There is a comparison of the areal precipitation amounts of the regions according to the years in **Table 6** created according to MGM's 2020 studies. It is seen that the amount of precipitation in the Marmara Region decreased by 17.5% compared to normal and by 3.3% compared to 2019. In this case, it turns out that Marmara is the 3rd region with the highest precipitation decrease compared to normal throughout the country. Following this, the drought risk of the region is also extremely high.

Table 6: Comparison with the normal of the regions in 2020 and last year's precipitation

AREA PREMIUM CONDITIONS OF THE REGIONS (1 January 2020- 31 December 2020)					
REGIONS	**Precipitation in 2020 (mm)**	**Normal (1981-2010) (mm)**	**Precipitation in 2019 (mm)**	**Change from Normal (%)**	**Change by 2019 (%)**
Marmara	546.7	662.3	565.5	-17.5↓	-3.3↓
Aegean	468.7	592.2	599.5	-20.9↓	-21.8↓
Mediterrenian	593.4	666.5	859.9	-11.0↓	-31.0↓
Central Anatolia	321.2	406.5	377.3	-21.0↓	-14.9↓
Black Sea	604.9	696.5	628.6	-13.2↓	-3.8↓
Eastern Anatolia	512.9	558.3	509.1	-8.1↓	Around 0.7 Normal
Southeastern Anatolia	530.6	532.2	730.0	Around -0.3 Normal	27.3↓

2.1.2.2 Climate Change Scenarios

Türkiye is one of the countries that will be most affected by climate change in terms of its location and climatic characteristics. In this regard, regional climate projections were created by the General Directorate of Meteorology based on the models preferred in the IPCC 5th Assessment Report. In the study, the years between 1971-2000 were taken as the reference period, and the years between 2016-2040, 2041-2070, 2071-2099 were taken for the projection. When the results obtained in the reference period of the regional climate model are compared with the results of the global models in

the same period, it is seen that they are in great harmony especially in summer and winter temperatures. It has been observed that the regional model results are lower than the global model results and observations at annual average temperatures (**Figure 20** and **Figure 21**)[24]:

2016-2040 period

- It is estimated that the warming will be limited to 2°C in general, and this temperature will be 2-3°C in the Marmara and Western Black Sea regions in summer.
- While precipitation increases in the Aegean coasts, Eastern Black Sea and Eastern Anatolia in winter months, precipitation will decrease by 20% in spring precipitation, except for the Aegean coasts and the east of Eastern Anatolia.

2041-2070 period

- While the temperature increases around 2-3°C in spring and autumn, it is estimated to increase up to 4°C in summer.
- It is estimated that there will be a 20% decrease in winter precipitation in Eastern and Southeastern Anatolia and Central and Eastern Mediterranean regions.
- In the summer months, there will be a 30% decrease in precipitation in Eastern Anatolia, where precipitation is important.
- It is estimated that there will be decreases in autumn precipitation, except for the Aegean coast and a small part of Central Anatolia.

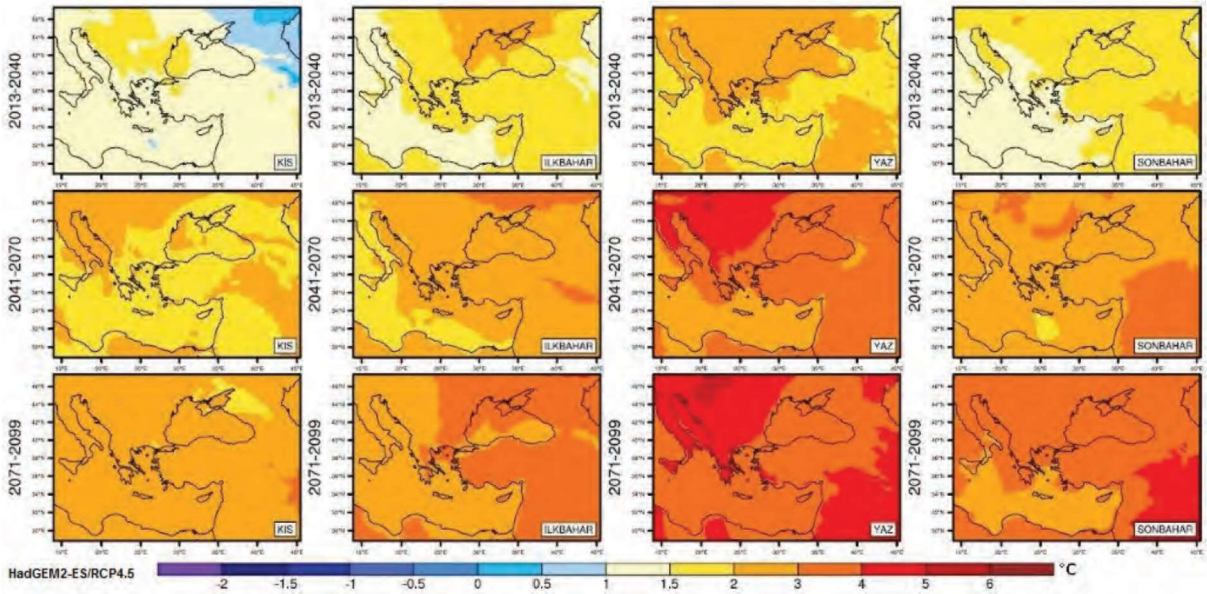


Figure 20: *MGM temperature projections according to RCP 4.5*

[24] *Türkiye's Seventh National Statement*

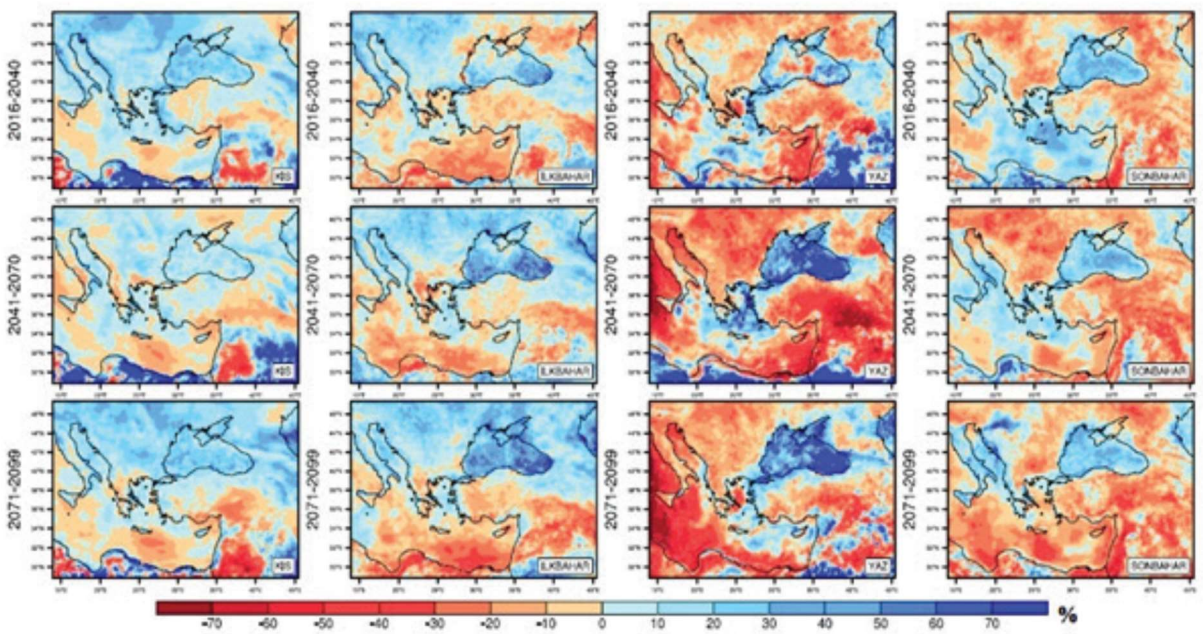


Figure 21: *MGM precipitation projections according to RCP 4.5*

2071-2099 period

- Temperatures are expected to increase by 2°C in winter and 3°C in spring and autumn. In summer temperatures, on the other hand, temperature increases exceeding 4°C are predicted in the Aegean coasts and Southeast Anatolia.
- In spring precipitation, there will be 20% reductions in precipitation, excluding the Coastal Aegean, Central Black Sea, and Northeastern Anatolia regions,
- There will be around 10% increase in winter precipitation, especially on the coastline,
- Except for the Aegean, Marmara and Black Sea coasts, there will be reductions of up to 40% in summer precipitation,
- It is expected that there will be reductions in autumn precipitation almost throughout Türkiye.

2.1.3 Climate Change in the Urban Context

In this section study, following international and national sources, the Istanbul Climate Change Action Plan Final Report prepared for Istanbul in general and other reports specific to Istanbul were used. Istanbul, where approximately 19% of Türkiye's population lives and has the status of a mega city on a world scale, is one of the cities that will experience the effects of climate change most intensely.

It is seen that the effects of climate change for Istanbul are detailed in the Istanbul Climate Change Action Plan Final Report (2018). The report shows higher resolution climatic models for Istanbul, potential challenges the city may face, and provides a guideline for the measures to be taken. In this context, studies on temperature change, urban heat island effect, precipitation change, drought and sea level rise related to climate change scenarios were revealed in the report.

2.1.3.1 Climatic Disasters

Annual disaster information about Istanbul is included in the climatic disasters report in Türkiye, which MGM prepares every year. According to this report, although the incidence of flood / excessive precipitation has increased throughout the country compared to the previous year, it decreased in

2020 with the effect of new infrastructure works carried out in Istanbul. However, flood and hail disasters are still a risk for Istanbul as of 2021.

Floods and eastern disasters have caused many losses of life and property in Marmara and Istanbul until today. On September 9, 2009 (**Figure 22**), 40 people lost their lives and serious economic losses occurred in the flood disaster that was effective in Marmara and the Anatolian side of Istanbul. One person died in the Esenyurt flood disaster that occurred on June 23, 2020 **(Figure 23**). However, 437 houses, workplaces and vehicles were damaged; 362 houses, 56 workplaces and 19 vehicles became unusable. Information on the number of floods and floods that the fire brigade intervened in between 2015-2020 is presented in **Table 7** also. According to the table, a total of 633 floods were experienced as a result of heavy rain/flood disaster in 2019.

On the other hand, the risk of drought in the Marmara Region due to decreasing rainfall directly, indirectly increasing population and infrastructure deficiencies poses a serious threat to a mega city like Istanbul.

Although some recent climatic events in Istanbul cannot be directly linked to climate change, they provide clues about the multifaceted effects of climate change. On July 27, 2017, the hail that lasted for about 20 minutes and then the heavy rain prevented land, sea and air transportation in Istanbul. Hundreds of homes and businesses, thousands of vehicles and even planes were damaged. There are injured people among those caught in the hail on foot.

Table 7: *Floods and floods intervened by the fire brigade (2015-2020)*[25]

Event	Year / Number									
	2015	2016	2017	2018	2019	2019	2020	Numerical Change		Proportional Change	
						January-November	January-November	2019 January-November	2020 January-November	2019 January-November	2020 January-November
Number of Floods	1.006	824	1,578	1,280	633	599	860	261↑	-373↓	43.6%↑	-37.1%↓

[25]Istanbul Metropolitan Municipality Fire Department, 2020 Statistics.

***Figure 22**: September 9, 2009 flood disaster [26]*

***Figure 23:** 23 June 2020 flood disaster [27]*

2.1.3.2 Climate Change Scenarios

The effects of climate change for Istanbul are at a risk that may create serious risks, as is the case across the country, according to the scenarios set forth. Melting glaciers due to climate change will cause sea level rise. Therefore, it may be possible for some areas in Istanbul to be submerged under water.

Temperature variation scenarios: In the projections made for Istanbul according to 4 different scenarios in the IPCC studies, it has been revealed that an average increase of 1.5-4.8°C is expected until the year 2100, compared to the amount of temperature in the 1986-2005 period (**Figure 24**). In addition to these models, How Will Climate Change Change the Cities of the World,

[26] *https://www.havaforum.com/2009-marmara-istanbul-sel-felaketi/*
[28] *https://www.birgun.net/haber/istanbul-valiligi-yasanan-sel-felaketinin-bilancouzun-acikladi-305749*

including Istanbul, prepared by the World Meteorological Organization and Climate Center, stated that the temperature increase of the mega city in 2100 will increase from 27.4°C to 33.7°C on average[28].

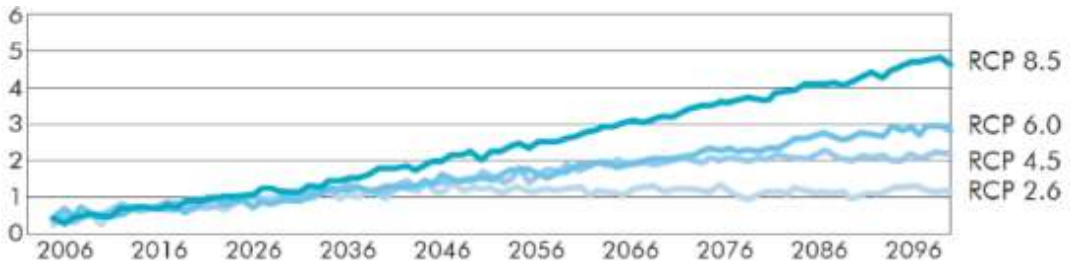


Figure 24: *Annual warming amount (°C) according to 1986-2005 period* [29]

Figure 25, the temperature distribution in Istanbul is expressed in the Strategy and Action Plan for Combating Agricultural Drought, prepared by the Istanbul Governor's Office in 2018 While the average temperature in the less densely urbanized areas remains lower, it remains higher in the more densely populated areas.

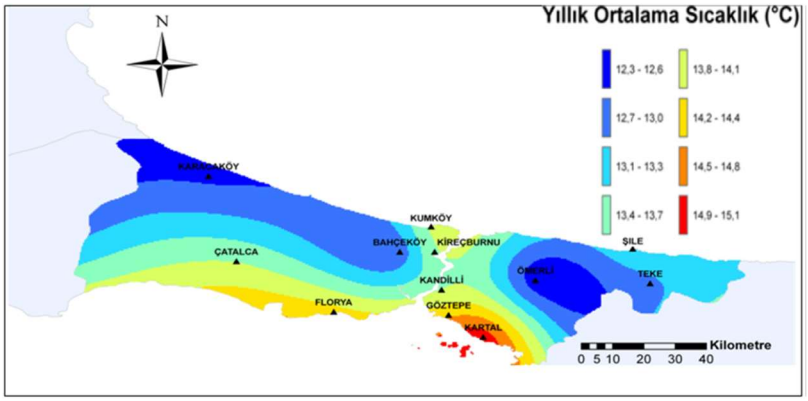


Figure 25*: İstanbul Annual Average Temperature Map, 2017* [30]

Urban Heat Island Effect: Scenarios: The urban heat island effect is the climatic changes that occur due to the decrease in the evaporation surface in urban areas and the decrease in the amount of green space. These changes occur with the pressure of urbanization, a heat and water cycle that is seen as different from the changes in rural areas[31]. Land use change in a mega city like Istanbul

[28] Istanbul Environmental Status Report, TMMOB Chamber of Environmental Engineers Istanbul Branch, 2019, p:28.

[29] Istanbul Climate Change Action Plan, Final Report, 2018, p:10.

[30] Strategy and Action Plan for Combating Agricultural Drought, Governorship of Istanbul, 2018, p:51.

[31] Tabanoğlu, O., Climate Change Adaptation Strategies Proposal for Antalya, Istanbul Technical University, Master Thesis, 2018, p:77.

poses a very risky position regarding the urban heat island effect. The fact that both the forest existence is decreasing and the pressure of urbanization is increasing daily, increases this risk even more.

In addition to these, an urban heat island projection study was carried out for Istanbul in general[32]. The scenario of the urban heat island effect in Istanbul until 2072 is seen in **Figure 26**. According to this projection, the temperature increase is 1.2°C in the current situation. According to this increase scenario, it is stated that the temperature increase may exceed 1.5°C in 2030 and 1.7°C in 2050.

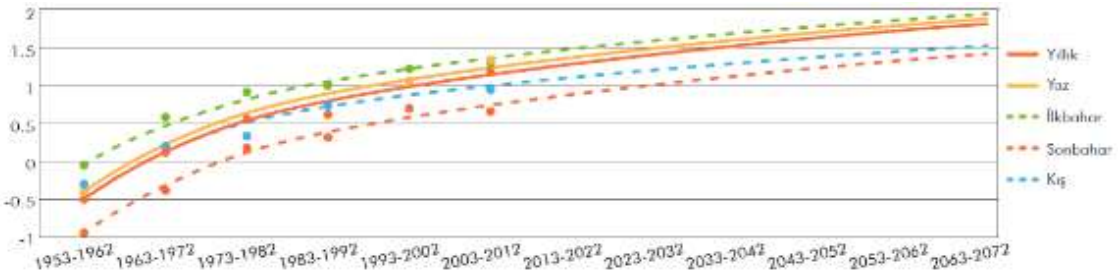


Figure 26: *Future projection of İstanbul urban heat island (°C)*[33]

Precipitation Variation and Drought Scenario: According to the precipitation projections for Istanbul until 2100, it has been shown that in the optimistic scenario (RCP2.6), there will be no significant change in precipitation, while in the worst scenario (RCP 6.0), the precipitation will decrease dramatically (**Figure 27**). It is foreseen that the drought period, which is 45 days as a result of the decrease in precipitation and the increase in temperature, will increase to 50-57 days after the 2050s and to 49-68 days towards the end of 2100. This situation increases the risk of drought.

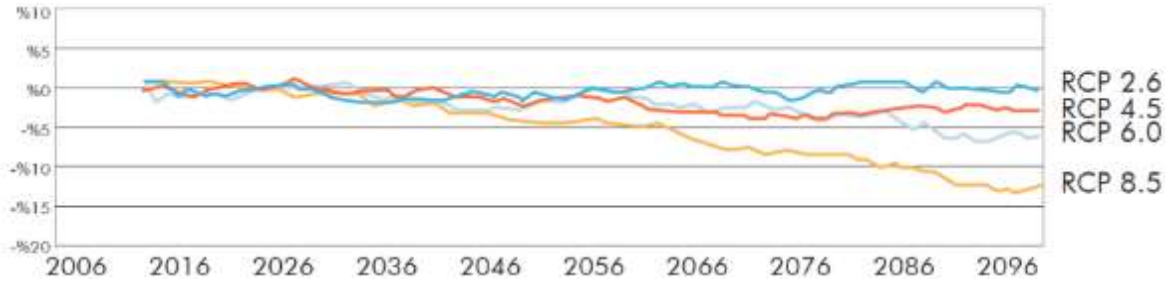


Figure 27: *Change in precipitation compared to 1986-2005 period (%)*[34]

Another important issue regarding precipitation is the forecast that the precipitation amount on rainy days will increase with the decrease in precipitation regimes. Excessive precipitation, which increases the risk of flooding, was expressed by an increase of 20% of precipitation on sunny days and 59% of precipitation during wet weather in the worst-case scenario (RCP 8.5). However, the temperature anomaly projection, which is another cause of drought, is also shown in **Figure 28**.

[32] Istanbul Climate Change Action Plan, Final Report, 2018, p:10.
[33] Istanbul Climate Change Action Plan, Final Report, 2018, p:10.
[34] Istanbul Climate Change Action Plan, Final Report, 2018, p:11.

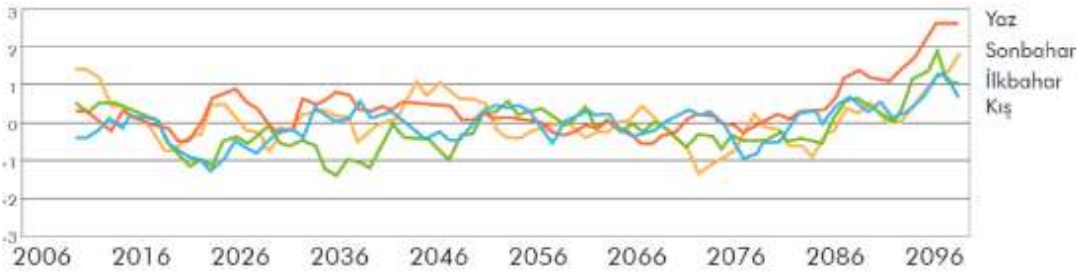


Figure 28: *Temperature anomaly (°C)*

The situation in Türkiye and especially in Istanbul shows how important the drought risk is. According to the Istanbul Rainfall and Drought in Türkiye Report prepared by the Water Policies Association in December 2020, the precipitation in Istanbul in September and November 2020 are 30% and 54%, respectively, which are below the average. For this reason, it is reported that meteorological drought turns into hydrological drought. However, it is stated that all regions in Türkiye receive 20% less precipitation than the average in 2020[35].

Sea Level Rise: According to the Istanbul Climate Change Action Plan published in 2018, melting glaciers due to global warming and the expansion of warmed water will cause a 45-75 cm rise in sea level until 2100, compared to the 1985-2005 periods. Although detailed studies have not been revealed yet for Istanbul, which is a coastal city, it is thought that it will be affected by this increase. It is revealed that these studies should be detailed and projected especially in low-altitude regions[36].

2.2 CLIMATE CHANGE POLICIES

This section provides details on global, national and local policies regarding climate change. These policies aim to reduce the negative effects of climate change.

2.2.1 Global Policies and Activities

The general framework of cooperation against climate change was laid with the 1992 United Nations Framework Convention on Climate Change. The Paris Agreement, which was adopted in 2015 and entered into force in November 2016, on climate change, in which intensive international studies have been carried out since this date, is a turning point. Today, it has become a necessity to evaluate the production and consumption activities carried out in cities on the scale of climate change and to include them effectively in the rational planning and strategy determination processes for energy saving. The timeline of the negotiations are shown in **Figure 29**. Since 2016, the agreement has been signed and ratified by nearly 200 countries. Türkiye ratified the Paris Agreement on 7 October 2021.

[35] *https://supolitikalaridernegi.org/2020/12/19/spd-istanbul-yagislari-ve-turkiyede-kuraklik-raporu-yayinladi-2021-kurak-geclenen/*

[36] Istanbul Environmental Status Report, TMMOB Chamber of Environmental Engineers Istanbul Branch, 2019, p:28.

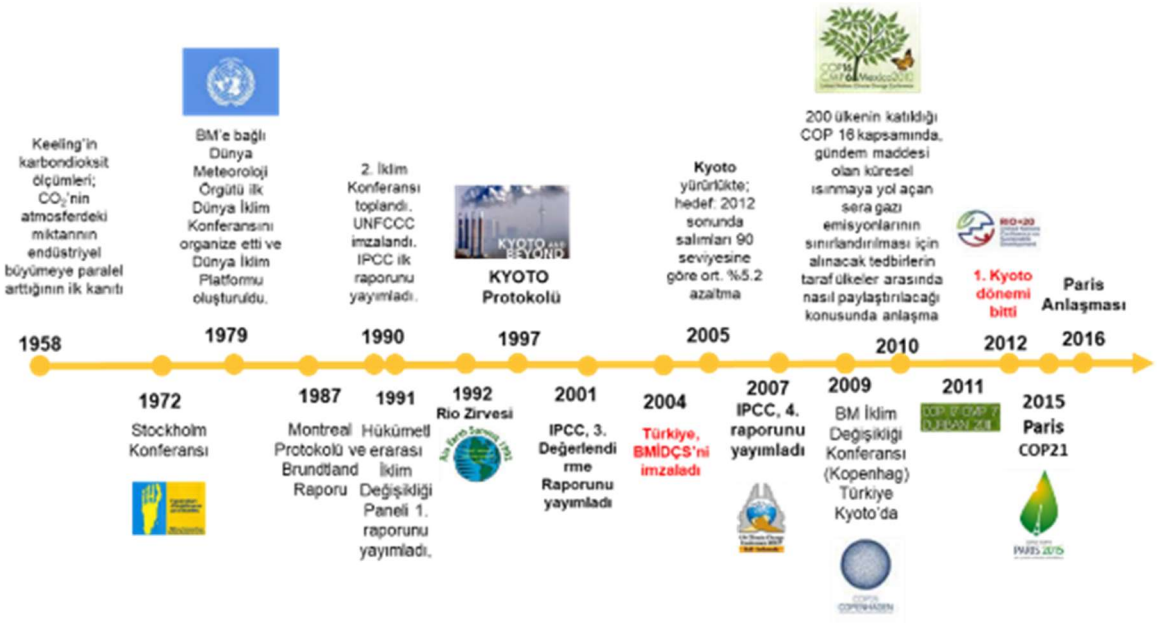


Figure 29: *International climate change negotiations summary*

It has brought different approaches to the international climate cooperation model of the Paris Agreement. Acknowledging the priority of countries' own climate policies in the global fight against climate change, the Agreement is built on the "nationally oriented logic of climate action". In this framework, the Kyoto model, in which the reduction obligations are determined at the international level and tied to strict rules and sanctions, has been moved to the cooperation model, which consists of voluntary contributions determined by the party countries according to their own national conditions. The national declaration of intent determined by Türkiye is detailed in the next section.

While the focus was on greenhouse gas reductions to reduce climate change before, the issue of adaptation to climate change has entered the agenda of more countries after the Paris Agreement. The effects of climate change are floods, droughts, heat waves, etc. shows regional and local differences according to the circumstances. Therefore, the measures that can be applied everywhere are different. Local governments have an important role in infrastructure investments as well as determining the means and methods of intervention. Organizations such as ICLEI, C40 and Covenanat of Mayors, which bring together local governments from different geographies of the world at different levels of development, offer an important opportunity for cooperation and experience sharing for local governments who want to take a step in this regard.

Since European cities' fight against climate change process started much earlier than Turkish cities, both inventory determinations and mitigation strategies are more comprehensive. The European Union plans to gradually reduce the greenhouse gas effect and carbon emissions until 2050 with its climate action plans prepared. Reducing greenhouse gas emissions by at least 40% in 2030 compared to the 1990s, providing 40% of energy consumption from renewable energy sources and reducing energy use by 40% are among the targets. In the current months, the European Union has decided to revise these targets in order to raise them even more.

When the climate action plans in Türkiye are examined; various strategies are being developed on the subjects of ensuring the use of thermal insulation and renewable energy and energy efficient lighting in existing buildings, expanding public transportation and rail systems, smart traffic management, training and awareness activities, increasing green areas, reducing the use of

chemical fertilizers, and obtaining energy from waste. Among the municipalities that have prepared Sustainable Energy and Climate Action Plans, Antalya Metropolitan, Bursa Metropolitan Municipalities as well as Kadıköy, Nilüfer, and Tepebaşı Municipalities can be mentioned.

Considering the effects and examples above, it is understood that active policies, actions and strategies are needed in various fields, from transportation to construction, from infrastructure to waste management and land use, to combat climate change in cities.

2.2.2 National Policies and Actions

Türkiye submitted Intended Nationally Determined Contributions (INDC) and signed the new climate deal in COP 21 PARIS on 12 Dec 2015. The national target is up to 21% decrease in emissions from Business as Usual (BAU) by 2030 compared to 2008.

Turkish Parliament ratified Paris agreement on 7 October 2021 and raised the emissions reduction target by announcing net zero emissions until 2053. Paris agreement requires the countries to submit their updated nationally determined contribution every 5 years.

The updated nationally determined contributions are expected to be submitted at the 27th Conference of Parties (COP27) which will take place in Egypt November 2022.

Türkiye's primary policy institution for the energy sector Türkiyeis "The Ministry of Energy and Natural Resources" (MENR). The ministry is responsible for the short and long-term energy needs and policies to ensure adequate supply to meet the demand.

Several general directorates within the MENR oversee various elements of the energy sector:

The Department of Energy Efficiency and Environment drafts action plans, regulations and legislation as it relates to energy efficiency policy; prepares harmonisation and impact assessments of current and new legislation within the scope of the environment-energy relationship; and calculates greenhouse gas emissions for public electricity and heat production in the National Inventory Report.

In addition to the MENR, other ministries and institutions have jurisdiction over energy policies.

The Presidency of Strategy and Budget aims to accelerate the country's economic and social development Türkiyeand ensure that development is balanced and sustainable.

The Ministry of Environment, Urbanisation and Climate Change (MoEUCC) oversees activities related to zoning, building construction and renovations, including as they relate to environmental standards and energy efficiency building codes.

The Ministry of Treasury and Finance is responsible for economic and fiscal policy, including energy taxation and climate financing.

The Ministry of Transport and Infrastructure is responsible for infrastructure, networks, systems and services related to transport and maritime activities.

The Ministry of Industry and Technology oversees industrial policies and strategies, including setting environmental standards and guiding energy productivity policies for the sector.

Türkiye became a party to the United Nations Framework Convention on Climate Change (UNFCCC) in 2004. Before Türkiye became a party to the UNFCCC, it established the Climate Change Coordination Board (IDKK) in 2001. After Türkiye became a party to the UNFCCC, the IDKK was restructured in 2004 and its mandate was expanded to include new members in 2010.

Türkiye has a different position from other countries in the Annex-I list of the Convention. At the 7th Conference of the Parties (COP7) meeting held in Marrakech in 2001, Türkiye's special conditions were recognized and it was decided to remain in Annex-I and be removed from Annex-II list. This situation affected the political decision of the country to become a party to the Kyoto Protocol and accelerated the process. Five years after becoming part of the Convention in 2009, Türkiye's entry into the Kyoto Protocol was documented and sent to the UN Secretariat. The protocol's ratification process was completed in August 2009. Türkiye is not included in the Annex B list of the Protocol (it does not have numerical obligations to reduce greenhouse gas emissions).

In 2009, the “Climate Change Department” was established under the General Directorate of Environmental Management, which is affiliated to the Ministry of Environment and Urbanization, in order to deal with the issues related to climate change.

TürkiyeTaking into account its own special conditions and capacity, Türkiye published a “National Climate Change Strategy” in May 2010 in order to contribute to global efforts to reduce the effects of climate change. The strategy includes a set of targets to be implemented in the short term (within one year), medium term (within 1 to 3 years) and long term (to be launched within the next 10 years) related to transport, industry, buildings, waste and agriculture. This Strategy also includes measures such as:

- Cogeneration and district heating
- Use of local renewable energy sources alongside local coal
- Increasing the efficiency of buildings

In terms of legal duties and responsibilities, the regulations introduced by the Energy Efficiency Law cover all sectors of the economy as well as all individuals and institutions at the national, regional and local level. These regulations contain new obligations, supports and actions for the industry, building and transport sectors. The Regulation on Energy Performance in Buildings has also entered into force, and as of 2011, it has become mandatory to issue an Energy Performance Certificate for new buildings. Practical measures are included in the Regulation on Increasing Efficiency in the Use of Energy Resources and Energy, which was enacted within the scope of the same law, and some examples of these measures are given below;

- Establishing corporate structure and certification programs for the Energy Service Company sector
- Providing training and capacity building for all public and private sector stakeholders
- Establishment of mechanisms to support energy efficiency projects
- Appointment of energy managers to the industrial sector and buildings

In the Regulation No. 28097 on Increasing Efficiency in the Use of Energy Resources and Energy, there are various incentives to be given to those who voluntarily undertake to reduce their energy intensity by making projects that increase energy efficiency. Legislative work on the development of local renewable energy sources has come a long way, and there has been a large increase in wind and solar power installations in Türkiye. Some of the planned actions regarding energy efficiency and the use of new energy sources are:

- Establishment of zero-emission energy generation technologies such as renewable energy sources and nuclear energy, on the condition of local content,
- Increasing the overall efficiency of existing thermal power plants,
- Reducing energy densities to 2004 levels,
- Increasing the share of local renewable energy sources in total energy production to 25%,

- Making the most of the energy efficiency potential in the industry sector,
- Leveraging the energy efficiency potential of the built environment

According to the Nationally Determined Intended Contribution (INDC) proposed by Türkiye to the UNFCCC in 2015, it is recommended to reduce greenhouse gas emissions by 21% from the usual course. In this way, Türkiye will be able to proceed on the path of low-carbon development in line with the long-term goal of reducing the increase in global temperature to below 2°C by 2030.

The reduction in emissions with these policies and plans has been compared with the normal course of business (BAU) in **Figure 30**.

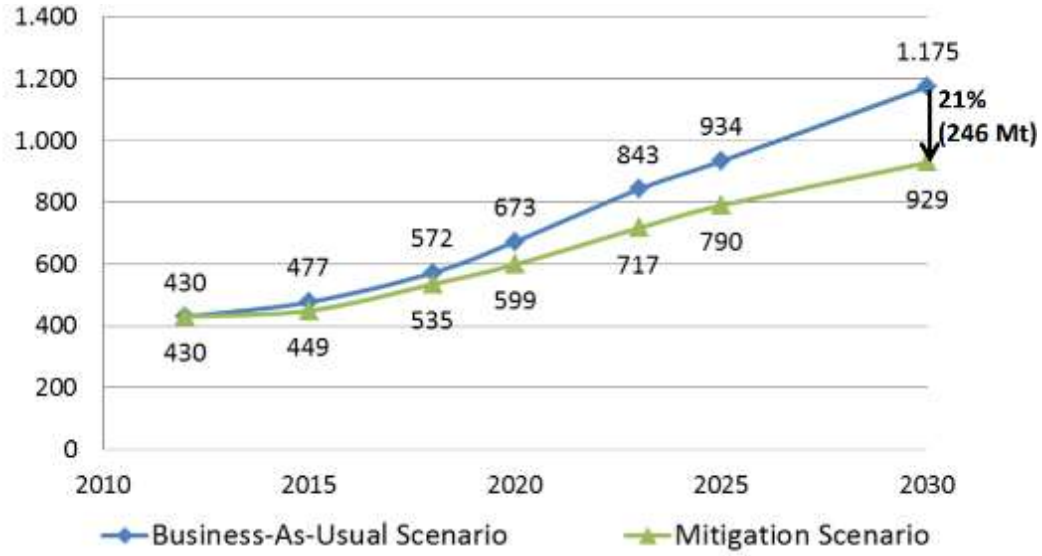


Figure 30: *Türkiye's Intended Nationally Determined Contribution (INDC) target*

Türkiye supports the INDC targets with a set of national climate change policies, including:

- 11. Development Plan
- Türkiye Climate Change Strategy (2010-2023)
- Türkiye's Climate Change Adaptation Strategy and Action Plan (2011-2023)
- Republic of Türkiye Climate Change Action Plan (2011-2023)
- 2023 Industry and Technology Strategy
- Energy Efficiency Strategy Document (2012-2023)
- National Recycling Strategy Document and Action Plan (2014-2017)
- Regulation on the Monitoring of Greenhouse Gas Emissions (2014)
- National Intelligent Transportation Systems Strategy Document (2014-2023) and Annex Action Plan (2014-2016)
- Türkiye National Renewable Energy Action Plan (2014)
- National Energy Efficiency Action Plan (2017-2023)
- Strategic Plan of the Ministry of Energy and Natural Resources (2019-2023)
- Regulation for Energy Performance of Buildings (A new version is being prepared) – 5 December 2008
- Regulation for Increasing Energy efficiency in Energy Sources and Energy Use
- Regulation for Energy Performance Contracts (EPC) for Public Buildings-15 April 2021
- Energy Performance of Buildings Regulation
- Nearly Zero Energy Buildings

- **Eleventh Development Plan (2019-2023)**
  - The Eleventh Development Plan (2019-2023), approved by the Turkish parliament, lays down a development vision for country with a long-term perspective and serves as a basic roadmap in meeting the fundamental values and expectations of the country, sets forth important targets for energy, the supply-side and demand-side targets.
- **The supply-side targets for the year 2023 include:**
  - Reducing the share of natural gas in electricity production from 29.9% to 20.7%
  - Increasing the share of renewable energy sources in electricity production from 32.5% to 38.8%
  - Increasing the amount of electricity produced from local energy sources from 150 terawatt hours(TWh) to 219.5 TWh.
- **Demand-side targets for the year 2023 include:**
  - Increasing primary energy usage per capita from 1.81 tonnes oil equivalent (toe) to 2.01 toe
  - Increasing electricity usage per capita from 3.7 MWh to 4.3 MWh to be closer to the world average
- **Türkiye Climate Change Strategy (2010-2023)**
  - The country's domestic CO_2 reduction strategy is outlined in the 2010 National Climate Change Strategy 2010-2023 and its implementing plan, the 2011 National Climate Change Action Plan (NCCAP) 2011-2023. The principles of the NCCAP include an improvement in energy efficiency as well as an expansion of renewable power.

- **Türkiye's Climate Change Adaptation Strategy and Action Plan (2011-2023)**
  - The National Climate Change Adaptation Strategy and Action Plan (NASAP), adopted in 2011, constitutes the basis of Türkiye's adaptation policies. It includes short- and medium-term objectives and actions to be implemented through 2023 related to:
    - Water resources management
    - The agricultural sector and food security
    - Ecosystem services, biodiversity and forestry
    - Natural disaster risk management
    - Human health
- **National Intelligent Transportation Systems Strategy Document (2014-2023) and Annex Action Plan (2014-2016)**
  - Country's intelligent transportation systems vision is specified as "a human and environment-oriented transportation system built with advanced information technologies" and our mission has been determined as "to create a sustainable, productive, safe, efficient, innovative, dynamic, environment-friendly intelligent transport network which creates added value and integrated with all transport modes using latest technology while making use of national resources".
  - Five main strategic goals have been identified as follows;
  - Developing the ITS Infrastructure
  - Providing Sustainable Smart Mobility
  - Ensuring Road and Driving Safety
  - Creating a Liveable Environment and Conscious Society
- Ensuring Data Sharing and Security

- ***National Energy Efficiency Action Plan (NEEAP)***
  - The National Energy Efficiency Action Plan (NEEAP), covering the period 2017-23, aims to reduce Türkiye's primary energy consumption by 14% by 2023 through 55 actions defined in 6 categories from business-as-usual levels across several sectors, including buildings and services, heat and power, transport, industry and technology, agriculture, and cross-cutting areas.
  - Implementation gaps remain across and within sectors, with policy progress slowed by delays in secondary legislation and lack of demand or incentives for energy efficiency products and services, among other factors.
  - The NEEAP Steering and Coordination Board, consists of high-level representatives of the responsible institutions of the NEEAP under the leadership of the Ministry of Energy and Natural Resources.
  - One of the important recent steps regarding promoting energy efficiency in buildings is obligatory efficiency targets for public buildings. With the Presidential Circular dated 16 August 2019, public buildings with energy managers assigned according to the Energy Efficiency Law No. 5627 are expected to procure energy savings of 15% until 2023, in order to use public resources efficiently and to reduce the energy costs on the public sector.
  - The Presidential Decision on the Procedures and Principles Regarding Energy Performance Contracts in the Public Sector from 21 August 2020 sets out the procedures and principles for energy performance contracts to be conducted by public administrations
- ***Strategic Plan of the Ministry of Energy and Natural Resources (2019-2023)***
  - The Plan aims to increase the share of renewables and domestic sources in the installed capacity from 59% to 65% by 2023. The renewable energy installed capacity targets by 2023 are: wind: 11,883 MW, hydroelectric: 32,037 MW, geothermal: 2,884 MW, solar: 10,000 MW. *(Source: IEA/IRENA Global Renewable Energy Policies and Measures Database)*
- ***Energy Efficiency Law-5627, 2 May 2007***
  - The purpose of this Law is to increase efficiency in using energy sources and energy to use energy effectively, avoid waste, ease the burden of energy costs on the economy and protect environment.
  - This is primarymain law covering principles and procedures applicable to increasing and promoting energy efficiency in energy generation, transmission, distribution and consumption phases at industrial establishments, buildings, power generation plants, transmission and distribution networks and transport, raising energy awareness in the general public, and utilizing renewable energy sources.
- ***Energy Performance of Buildings (BEP) Regulation***
  - Energy Performance of Buildings (BEP) Regulation specifies the rules and procedures to use energy and energy resources effectively and efficiently in buildings, to prevent the waste of energy, and to protect the environment.
- The BEP regulation stipulates that all new buildings must have an Energy Performance Certificate (EPC) class C or higher energy performance.
- The Energy Performance Certificate (EPC) became mandatory for all new construction, purchase, sale, and rental of buildings and structures as of 01 January 2020.
- EPC includes information on the minimum energy requirement and the energy classification, insulation properties, and efficiency of heating and/or cooling systems of a building.

- ***Nearly Zero Energy Buildings***
  - The Energy Performance of Buildings Regulation has been amended to include the concept of "Nearly Zero Energy buildings, which requires high energy performance and use of renewable energy sources in new constructed buildings. The amendment is issue on 19 February 2022 and will be applicable by 1st January 2023.

Also National Climate Change Action Plan (2011-2023) and National Climate Change Adaptation Strategy and Action Plan (2011-2023) are approved. In relation to these plans Istanbul Metropolitan Municipality has prepared an implementation-oriented Istanbul Climate Change Action Plan. The projection of this inventory for the years 2030 and 2050 has been made in the light of current national policies. In the calculation, it is assumed that the population of Istanbul will reach 21.3 million in 2050. Since Istanbul continues to grow especially in terms of population, it is seen that its emissions will not peak until 2050.

According to the results, it is estimated that the carbon footprint of the city will be 84.7 million tCO2e in 2030 and 117.9 million tCO2e in 2050 in the basic scenario. It is understood that these figures can be reduced to 57.1 million tCO2e in 2030 and 76.1 million tCO2e in 2050. This calculation corresponds to a reduction of 27.6 million tCO2e (33%) for 2030. This "reduce from increase" approach coincides with the target defined by Türkiye as 21% for 2030 in its national declaration of intent, and is considered an ambitious reduction target for Istanbul considering the rapid growth dynamics of the population and economy. This goal will be achieved through projects such as energy efficiency in buildings and industry, renewable energy, waste management and 1,100 km of metro lines.

To adapt to the changing climate, Istanbul will reduce disaster risks and recovery times. Climate change adaptation is a matter of risk management and good governance, and is local and tailored. Istanbul compliance strategy is based on risk and vulnerability analyses made on a sectoral basis. In order to strengthen the most fragile elements of the city's ecosystem, infrastructure and socio-economic systems, an analysis was made on critical infrastructures. Cities that are resistant to climate change depend not only on the correct construction of the urban infrastructure, but also on increasing the knowledge and competence of the relevant institutions, the resilience of their industrial and commercial assets, and raising public awareness.

Reducing vulnerability is possible with properly planned and managed processes. Istanbul, which has the highest population in Türkiye, is located in an ecologically sensitive region, has a dense urbanization rate andis the lifeblood of the country in terms of economy, will be less affected by possible extreme climate eventsand will gain a structure that will heal its wounds more quickly and effectively.

Greenhouse gas emissions from Bağcılar Municipality's local government activities have been compiled with energy and other data collected from various sources. These data, summarized in the tables in this section, reveal the sources of energy consumption and greenhouse gas emissions, and form the basis for future energy saving and emission reduction studies.

Any carbon footprint study, institutional or regional, should be compiled and reported in accordance with the International GHG Protocol, which aims to bring greenhouse gas emissions breakdowns to a comparable standard. **Table 8** shows the distribution of final energy consumption by main sectors and total greenhouse gas emissions of Bağcılar Municipality over the emission amounts of different greenhouse gases.

Table 8: Final energy consumption (GWh) of main sectors of Bağcılar Municipality 2018

Sector	Electricity	Natural gas	Liquid gas	Lignite	Diesel	Gasoline	Other
Buildings							
Municipal buildings, equipment/facilities	6,39	9,02					
Tertiary (non municipal) buildings, equipment/facilities	784,76	360,46	10,19				
Residential buildings	430,72	1631,38	32,86	61,51			
Public lighting	12,95						
Transport							
Municipal fleet					3,34		
Public transport	13,45				11,83		
Private and commercial transport			163,57		1702,02	173,28	3,16
Total	1248,28	2000	200,61	61,51	1717,2	173,28	3,16

Three main energy sources dominant in Bağcılar Municipality are natural gas, diesel and electricity. Most of the energy is consumed by natural gas, which accounts for as much as 37 percent of final energy consumed and main it used in buildings sector. The second in terms of energy consumption is diesel, which is mainly consumed by the transport sector and 32 percent in total. electricity is mainly consumed in the buildings sector and accounts for 23% of total final energy consumption (**Figure 31**).

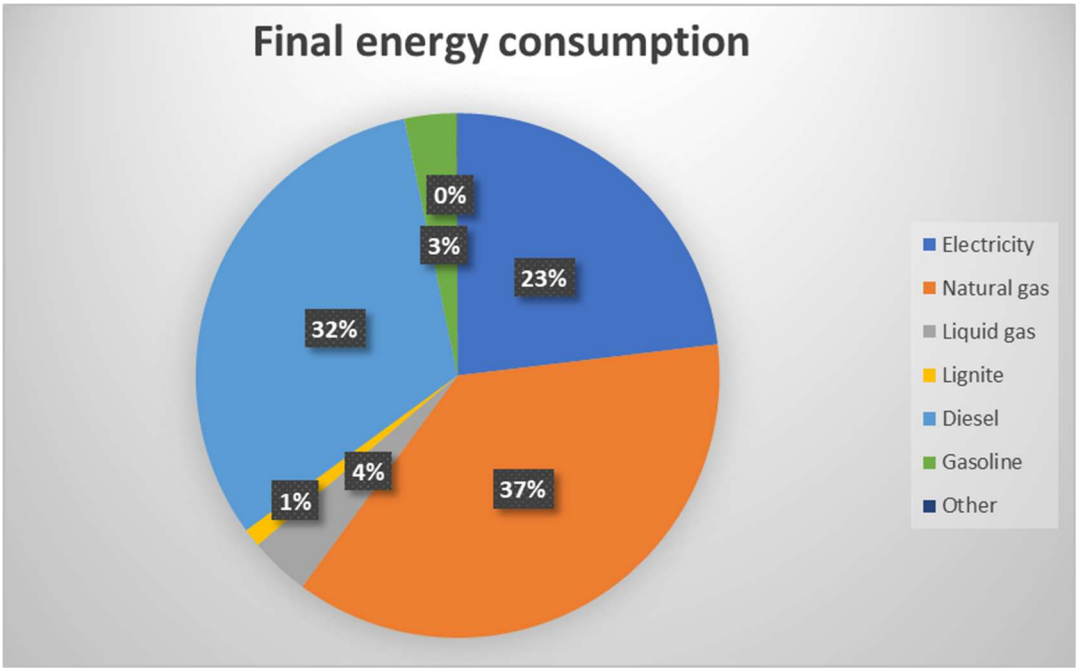


Figure 31: Percentage of final energy consumption

The total energy consumption of Bağcılar district, excluding industry, is 5,404 GWh and its greenhouse gas emissions are calculated as 1,851,712 tCO2e (**Table 9**). CO2 emissions from the electricity sector account for nearly 40% of total emissions in Bağcılar Municipality (**Figure 32**).

With Bağcılar's BAU (Business as Usual) scenario, predictions made by different institutions regarding population and sectoral growth were evaluated that in 2030 final energy consumption would rise to 6,464 GWh and 2030 emissions were calculated as 2,389,356 tCO2e according to this scenario. It is predicted that the population will reach 752,084 in 2030.

Table 9: *Emission inventory in CO2 emissions (t) of main sectors of Bağcılar Municipality in 2018*

Sector	Electricity	Natural gas	Liquid gas	Lignite	Diesel	Gasoline	Other
Buildings							
Municipal buildings, equipment/facilities	3239	1833					
Tertiary (non municipal) buildings, equipment/facilities	397875	73174	2322				
Residential buildings	218376	331164	7492	22574			
Public lighting	6568						
Transport							
Municipal fleet					906		
Public transport	6823				3208		
Private and commercial transport			37294		461249	45227	734
Total	632880	406170	47109	22574	465362	45227	734

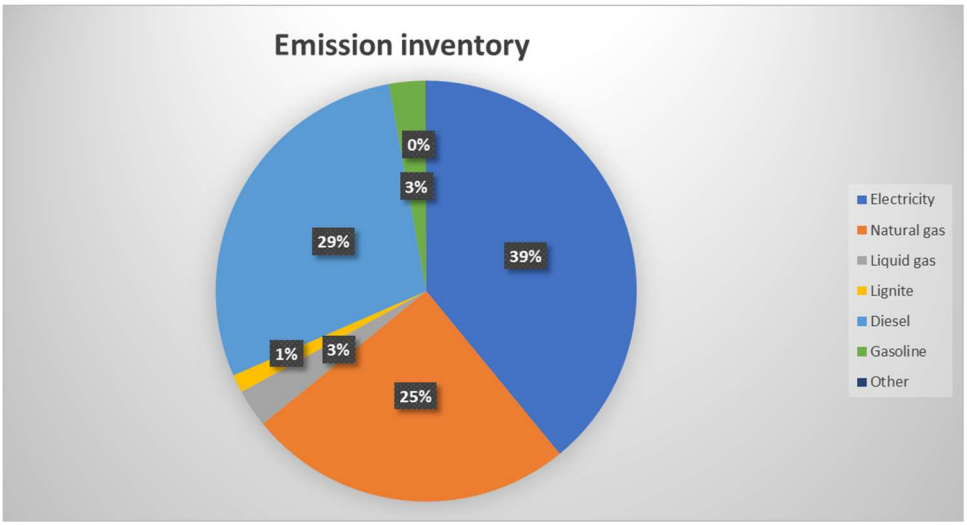


Figure 32: *Percentage of sources in emissions inventory*

The plans and policies to be implemented for different sectors with INDC summarized below;

Buildings

The basic INDC policy adopted in the buildings sector is the reduction of primary energy demand in new and existing buildings. This goal will be achieved through design, technological equipment, building materials and methods that encourage renewable energy sources (such as loans and tax relief). The following measures will be supported to reduce energy use and its negative effects on the climate:

- Passive energy and zero energy home design to minimize energy demand and enable local energy generation
- Energy-efficient construction of new residences and service buildings in accordance with the Regulation on Energy Performance in Buildings
- Creation of Energy Performance Certificates for new and existing buildings to control energy consumption and greenhouse gas emissions and to reduce the energy consumed per square meter

Buildings sector in 2018 consumed 3 340 GWh of all types of energy of which 96 percent came from electricity and gas. Energy efficiency and renewable energy measures are needed to meet the targets set for 2030 and reduce energy consumption in the buildings sector by 42% or 1 425 GWh. Achieving a breakthrough in renovation will require significantly higher investment. According to preliminary calculations, to achieve the SECAP targets, by 2030 an average of 1 100 000 m2/year of buildings will be needed to renovate the building stock 300 000 000 EUR/year.

Also, significant investment into renewables especially solar PV will be needed till 2030. Around 210 MW of new installations of PV on the ground and on buildings roofs should be installed to generate 284 GWh of electricity annually and to save 143 735 tCO_2. To achieve this is target total investment of 210 000 000 EUR or 21 000 000 EUR/year will be needed.

Industry

The main intervention areas in industry are energy efficiency and waste. Implementation of the Energy Efficiency Strategy Document and the National Energy Efficiency Action Plan, aims to reduce the emission intensity, increase energy efficiency in industrial facilities and provide financial support to energy efficiency projects. Carrying out studies to increase the use of waste as alternative fuels in suitable sectors is another solution that will provide sustainability and cyclicity to the industrial sector.

Energy

Renewable energy investments will be supported to increase the electricity generation capacity from solar and wind energy. The target is to increase solar capacity to 10 GW and wind power to 16 GW by 2030. In 2030, it is aimed to reduce electricity transmission and distribution losses to 15 percent and to improve public power generation plants. Initiatives such as utilizing the full hydroelectric potential in electricity generation, establishing micro-production, cogeneration systems and producing on-site can be counted as other initiatives that can be mentioned for the energy sector.

Transportation

The strategic aim of the transport sector is to promote sustainable modes of transport such as walking, cycling and using public transport. Goals suitable for this purpose include:

- High-speed rail system projects
- Increasing urban rail systems
- Encouraging the increase in the use of sea and rail transport instead of road transport in both freight and passenger transport

Energy use of the transportation sector is another strategy area for INDC. Among the targets are the promotion of alternative fuels and environmentally friendly vehicles, the reduction of fuel consumption and road transport emissions with the National Intelligent Transportation Systems Strategy Document (2014-2023) and its annexed Action Plan (2014-2016), and fuel savings with tunnel projects and the use of old vehicles, removal is included. To ensure energy efficiency, there are policies that include excise duty exemptions for maritime transport, buildings and urban transformation, as well as green port and green airport projects.

Transport sector in Bağcılar Municipality consumed 2 070 GWh of all types of energy of which 83 % in form of diesel. All measures will lead to reduction of energy consumption of 1 172 GWh till 2030. The electrification of the sector will require significant investment in order to establish charging infrastructure and purchase electric vehicles. By 2030 around 32 000 electric vehicles should be bought by citizens of municipality. This will require investments of around 960 000 000 EUR in total or about 140 000 000/year.

Waste

National policies to ensure the circularity of the waste sector include sending solid waste to managed landfills, reducing waste on the one hand, and recycling secondary raw materials and using them as an energy source. Energy can be recovered from waste with the industrial symbiosis approach. For this, processes such as the following can be used:

- Material recycling
- biological drying
- Biological methanization
- producing compost
- Advanced thermal processes or gas recovery in incineration and landfills
- Use of industrial waste as an alternative raw material or fuel in other industrial sectors

Other policies for the waste sector include using waste from livestock and poultry farms, rehabilitating unmanaged landfills and ensuring that waste is taken to managed landfills.

Biodiversity

Major national policies regarding sustainability have been developed in areas such as fuel reduction through land consolidation in agricultural areas, improvement of grazing lands, controlling the use of fertilizers, adopting modern agricultural practices and supporting the reduction of tillage methods in land management. When these policies are implemented together, they will help reduce direct and indirect emissions from agriculture and livestock, reduce negative impacts on soil, water and air quality, and support healthier ecosystems. National policies regarding forest areas, increasing sink areas and preventing land degradation are the implementation of the Forest Rehabilitation Action Plan and the National Afforestation Campaign.

Actions suggested in Bağcılar Sustainable Energy and Climate Action Plan, 11th Development Plan (2019-2023), National Energy Efficiency Action Plan, Türkiye Climate Change Strategy 2010-2023, TR Ministry of Energy and Natural Resources 2019-2023 Strategic Plan, Türkiye Transportation and

Communication Strategy 2023, National Intelligent Transportation Systems Strategy Document (2014-2023) has been prepared under existing plans and strategies.

2.2.3 Local Policy and Actions

Under the aim of "A livable and healthy city with a sustainable environment, livable and healthy for all living things will be designed" in the Strategic Plan of Bağcılar Municipality for the Year 2020-2024, "The carbon emissions of the city will be made manageable on a district basis with new technologies." target has been determined. The objectives and targets included in the strategic plan related to the Sustainable Energy and Climate Action Plan prepared are presented in **Table 10**

Table 10: *Strategic goals and objectives of Bağcılar Municipality strategic 2020 – 2024 plan associated with the Sustainable Energy and Climate Action Plan*

Sector	Strategic Purpose	Strategic Target
Buildings	A3. Creating a More Livable, Safe and Planned City	H3.2 To create a more disaster-ready district by accelerating urban transformation works
Energy	A8. Increasing the Institutional Service Quality of the Municipality with an Understanding of Continuous Development and Governance	H8.4 Managing municipal resources more transparently, effectively and efficiently
Transportation	A1. Strengthening and Developing Bağcılar's Urban Infrastructure	H1.1 Constructing new pedestrian and disabled priority roads, improving existing roads and facilitating transportation in Bağcılar
Waste	A2. Creating a More Livable, Environmentally Friendly District by Extending Sustainable Environmental Services	H2.3 Supporting recycling activities and carrying out Zero Waste Project studies
Urban Heat Island and Green Spaces	A2. Creating a More Livable, Environmentally Friendly District by Extending Sustainable Environmental Services	H2.2 Increasing the amount of parks and green spaces in Bağcılar
Disaster Management	A1. Strengthening and Developing Bağcılar's Urban Infrastructure	H1.2 To ensure that Bağcılar is prepared for natural disasters
Public health	A6. Improving Health Conditions in Bağcılar	H6.1 Increasing the effectiveness of inspection for the protection of public health

3. CLIMATE CHANGE MITIGATION

In this section, the greenhouse gas emissions due to fuel and energy consumption that cause climate change are calculated throughout the district, and the details of the actions planned in buildings, energy supply, transportation and waste management sectors in order to reduce the current emissions are presented. Calculations were carried out following the internationally accepted IPCC methodology. Assumptions made to ensure greenhouse gas reduction are detailed in the relevant section on a sectoral basis.

In addition to using data directly obtained from Bağcılar Municipality, TÜİK, natural gas and electricity distribution companies during baseline emission inventory preparation and projection for 2030, Bağcılar Municipality 2020-2024 Strategic Plan, Energy Efficiency Strategy Document (2012-2023), National Energy Efficiency Action Plan (2017-2023), Türkiye Mitigation action tags have been created in line with the contents of plans and documents such as the Transportation and Communication Strategy 2023, the National Intelligent Transportation Systems Strategy Document (2014-2023) and the National Waste Management and Action Plan (2016-2023).

3.1 GREENHOUSE GAS CALCULATION METHODOLOGY

This chapter presents the basic framework of the greenhouse gas calculation methodology of Bağcılar district. In addition to sharing information about how the base year, scope and method are determined while making the calculation, details are shared about the assumptions made on a sectoral basis while creating the 2030 projection.

3.1.1 Process Followed

The Covenant of Mayors initiative allows municipalities new to this process to develop a GHG mitigation action plan that fits their local conditions. It allows municipalities that have already taken energy and climate actions to develop a mitigation action plan without making major changes in their approaches. With this principle in mind, the Convention has developed a multi-option methodology based on or adapted from existing standards and methods. The different options, some of which are interdependent, are the choice of base year, the emissions inventory approach, the greenhouse gases included, the emission factors and the definition of abatement targets.

Base Year

An emissions inventory should include all emissions during the selected calendar year. The base year is the year against which the emission reduction target will be compared to monitor the results of the proposed actions. To establish a complete and consistent inventory, local governments must examine the available data sources and select the year in which accurate records of all emission sources can be found in sufficient detail before collecting data. It is important to prepare an inventory of the oldest year in which all error-free data can be found and no extraordinary eveare nts present. Bağcılar Municipality has determined 2018 as the base year to form the basis for emission reduction targets.

Scope

Local government GHG emissions inventory consists of two parts:

- Emissions related to the local governmenown activities,
- Emissions from the managed community`s activities.

Emissions from local government activities are similar to a somewhat complex private sector. For this reason, the calculations are not very different from the emission inventory requirements in the Institutional Calculation and Reporting Standard within the scope of the Greenhouse Gas Protocol (GHG Protocol) developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD).

The analysis of corporate-scale GHG emissions representing local government activities include GHG emissions from all major organizations and services. All emissions as a result of local government activities and activities where institutions have operational control are included, regardless of where the emissions occur.

The selected sectors within the borders of Bağcılar Municipality are buildings, energy supply, transportation, waste management and wastewater treatment sectors. Greenhouse gas calculations for the industrial sector have also been made. Bağcılar Municipality has no operational control over the industrial sector, which can be defined as the private sector to a large extent. For this reason, industrial greenhouse gases are excluded from the scope while determining the reduction targets.

Methodology

GHG emission calculation approach for the baseline emissions inventory is performed according to Greenhouse Gas Protocol (GHG Protocol) developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). In the GHG Protocol, release categories (**Table 11**) are classified as follows:

- **Scope 1 – direct greenhouse gas emissions:** Emissions from all fixed and mobile emission sources owned or directly controlled by the organization. These resources include assets owned, leased or financed. The scope limit is all controllable emission sources. Refrigerant gases of air conditioning systems used for activities should be included in this scope.
- **Scope 2 – indirect energy greenhouse gas emissions:** Emissions from energy purchased for the organization's activities. This chapter should include the main electricity used or other types of energy used for heating/cooling purposes.
- **Scope 3 – other indirect greenhouse gas emissions:** GHG emissions are under the control of the organization, excluding indirect emissions caused by its activities. These may arise from activities upstream or downstream of the organization's core activities, employee travel, or sub-contractor activities. In this context, the decision parameter should be the level and quality of the available data.

Table 11. *GHG Release Categories (GHG Protocol)*

	Municipal Scale	Urban Scale
Scope 1	Direct emissions (e.g. municipal vehicle fleet, municipality fossil fuel consumption for heating in buildings)	Direct emissions (e.g. from vehicles in the city)
Scope 2	Indirect emissions (e.g. consumed electricity in the municipality buildings)	Indirect emissions (e.g. electricity consumed in the city)
Scope 3	Consumption-based emissions (e.g. emissions due to purchasing and receiving products of the municipality/services production and shipping)	Consumption based emissions (e.g. products and services consumed in the city due to production and shiping in a different country or region)

The GHG calculations within the determined borders of Bağcılar Municipality are based on the 2006 IPCC Guidelines for National Greenhouse Gas developed by the Intergovernmental Panel on Climate Change (IPCC) "Tier-1" and "Tier-2" methodology.

The direct and indirect CO2 emissions of each energy carrier were calculated by multiplying the final energy consumption by the corresponding emission factor according to the IPCC guideline (**Table 12**). In addition, CH4 and N2O emissions from waste management and wastewater treatment were calculated and converted to CO2eqv.

__Table 12__: CO2 emission factors (t/MWh) used in calculations

Electricity		Fossil fuels							
National	Local	Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels
0.507	0.507	0.203	0.228	0.281	0.271	0.261	0.367	0.357	0.232

The activity-based approach, which is the most widely used by cities, was used in the preparation of the Baseline Emissions Inventory. This approach includes all CO2eq emissions from direct energy consumption (through fuel combustion) or indirect (through electricity consumption) in Bağcılar. While most greenhouse gas emissions are CO2 emissions, CH4 and N2O emissions are secondary to combustion processes in the residential and transportation sectors. All CO2, CH4 and N2O emissions are calculated for all fuel types together with their global warming potential (GWP) taken from the Fifth Assessment Report by the IPCC in 2013(AR5).

Accordingly, the following formulas and variables were used in the calculations according to GHG Protocol Scope-1, Scope-2 and Scope-3 GHG sources:

$$\text{Emissions GHG, fuel} = \text{CO2 emissions, fuel} + \text{CH4 emissions, fuel} + \text{N2O emissions, fuel} + \ldots$$

$$\text{CO2 emissions, fuel} = \text{Fuel consumption} \times \text{Emission Factor CO2, fuel}$$

3.1.2 Assumptions for GHG emission scenarios

Assumptions of greenhouse gas emissions for the targeted year 2030 are population growth rate, building and service sector growth rate, energy consumption trends in the last ten years and legislative changes in the jurisdiction of Bağcılar Municipality. The assumptions by which we calculate the greenhouse gas development of the city in case the current sector-based situation continues (Buisiness as Usual (BAU) scenario) are listed below. Assumptions about reductions are also specified in the content of each action.

a) Population projection

A population projection for 2030 was made according to the average population growth rate of Bağcılar district between the years 2010-2020. When the population change in the last 10 years is examined, it is seen that there is an increase of around 0.2% annually. In the 2030 projection, it is predicted that the population will be 752,084 people in 2030, with an increase of 0.2% per year.

b) Buildings

Greenhouse gas emissions related to buildings have been increased with the assumptions made according to the building typologies below.

i. **Residential buildings**: Energy consumption is directly proportional to population growth and the rate of increase has been taken as constant per year. To determine an increase rate in energy consumption, the change in previous years was taken into account. As issues such as infrastructure changes or an increase in natural gas penetration rate will affect this increased rate radically, a sound evaluation cannot be made. For this reason, a change in direct proportion to the population growth is foreseen. To be able to detail the reduction calculations, the electricity consumption in residences has been broken down with some assumptions based on the general consumption habits in Türkiye. It is assumed that the electricity consumption in the houses is 5% cooling, 5% heating, 55% other electrical devices and 35% lighting.

ii. **Non-residential buildings**: Energy consumption increases have been determined by taking into account the trends in the last 5 years and the development status of the service sector. The assumptions are as follows:
   - Natural gas: The increase in natural gas consumption is projected to be 3% annually.
   - LPG: An annual increase of 1% is foreseen.
   - Fuel: No increase is foreseen.
   - Electricity: An annual increase of 3% is anticipated.

iii. **Municipal buildings**: Considering the increase in service points and their sizes and the stable course to be achieved after the transition to new service points, the following assumptions have been made regarding the energy consumption of municipal buildings:
   - Natural gas: An annual increase rate of 3% is foreseen.
   - Electricity: An annual increase rate of 3% is foreseen.

c) Transportation

In the transportation sector, the municipality's current situation, the number of vehicles and the private vehicle situation in the city are considered separately. While it is predicted that the number of vehicles in the city will increase similar to the population growth, the decrease in fuel consumption of renewed vehicles with the developing technology has also been evaluated. The increased rates of fuel consumption and greenhouse gas emissions in the transportation sector are as follows:

i. Municipal vehicle fleet:
   - Diesel: An annual increase rate of 1% is foreseen.

ii. Special Vehicles
   - Diesel: An annual increase rate of 2% is foreseen.
   - Gasoline: An annual increase of 1% is anticipated.
   - LPG: An annual increase rate of 1% is foreseen.

d) **Waste and wastewater:** Since the emissions related to waste and wastewater are directly related to the activities of the people, the 2030 projection was created according to the projected 2% population increase in a decade.

3.2 STAKEHOLDER PARTICIPATION

Ensuring stakeholder engagement is an important element in the creation of the Sustainable Energy and Climate Action Plan. In the preparation of the action plan, a reduction workshop was held for the district of Bağcılar on February 24, 2021, on greenhouse gas reduction to determine the priority areas in the fight against climate change and to access important location-specific information. In these workshops, the Sustainable Energy and Climate Action Plan was prepared with participants from the development agency, provincial directorates and professional chambers, and representatives from the metropolitan municipality.

The Sustainable Energy and Climate Action Plan preparation process include a series of multi-actor and multi-disciplinary activities. The content of the training and workshop organized in this context; It was carried out with the participation of experts and officials in the fields of buildings, renewable energy, transportation and waste and wastewater. Mitigation activities and priority levels to be implemented within the scope of SECAP have been determined within the scope of the following working groups:

- Buildings
- Renewable energy
- Transportation
- Waste and Wastewater

Multi-Criteria Assessment (MCA-Multi-Criteria Assessment) analysis was used to prioritize mitigation activities. Within the scope of the evaluation, SECAP reduction activities prewire pared with the main objectives of supporting the transition to sustainable energy and reducing greenhouse gas emissions. Several of criteria, including environmental, economic, social and institutional, were taken into account (**Figure 33**). The criteria in four main categories have been determined, taking into account the strategic objectives. The criteria to be used in the Multi-Criteria Evaluation analysis were determined by making a joint evaluation with the relevant units under the leadership of the Department of Environmental Protection and Inspection, which is the project executive unit.

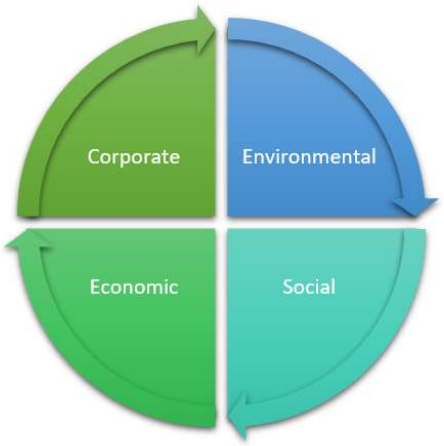


Figure 33: *Categories of criteria used in Multi-Criteria Evaluation Analysis*

The participants carried out discussions on mitigation measures within the scope of the workshop. The priority levels of the activities were requested to be determined as high, medium and low according to the aforementioned criteria. Then, the applicability of the mitigation activities, whose priority levels were determined, was evaluated by discussion by the participants. In the applicability evaluation of the activities, issues such as institutional capacity, authority and financial resources were taken into account to realize the implementation. In the workshop held interactively with online tools, the screenshot of the workshop working group created for transportation is shared (**Figure 34**).

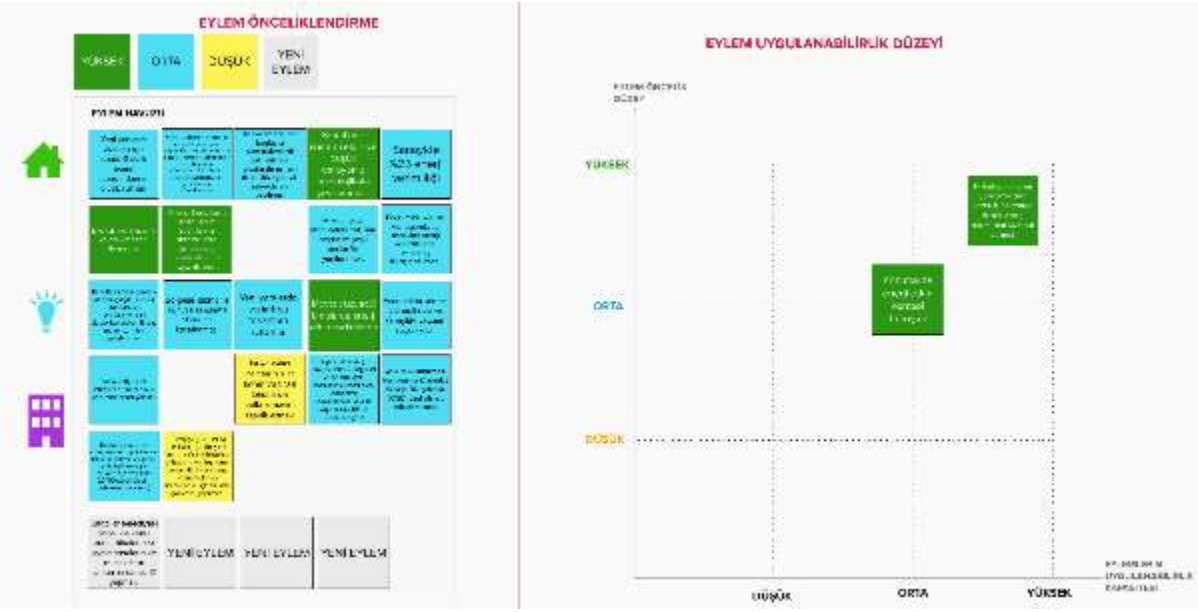


Figure 34: *Screenshot of interactive greenhouse gas reduction workshop buildings topic with online tools*

After the workshop, considering the growth dynamics of the city, energy consumption and greenhouse gas emission projections were created. Based on these foresights and taking into account the solution proposals expressed at the workshop, the reduction potential of each measure was determined, and the sectoral and total final and per capita reduction targets for 2030 were determined. During the workshop held, it was emphasized that the evaluation of all stakeholders is important, and the priorities included in the action plan were created by evaluating the stakeholders with different expertise.

3.3 GREENHOUSE GAS REDUCTION

Bağcılar Municipality's local government activities greenhouse gas emission inventory for 2018 has been compiled with energy consumption and other relevant data collected from various sources. These data, summarized in this section, reveal the sources of energy consumption and greenhouse gas emissions and form the basis for future energy savings and emission reduction measures by 2030. The action plans for GHG emission reductions are defined to be in line with the Bağcılar Municipality 2020-2023 Strategic plan and the data directly obtained from Bağcılar Municipality, TÜİK, electricity and natural gas distribution companies.

3.3.1 Greenhouse Gas Emissions Inventory

Baseline GHG emission inventory report for Bağcılar Municipality has been prepared as a separate study and summary of that report is presented in this chapter. It has been decided to handle the boundaries of the municipality with a control approach, and to keep the service buildings of Bağcılar Municipality, cultural centers, sports facilities, health facilities, mayor's office, education buildings, parks and gardens and street lighting within the scope of operations. GHG inventory of the whole city has been made with industry sector included, but as municipality has no control over industrial sector then these emissions have been excluded from the SECAP scope. The industrial emissions are under the control of central-government and industry is reporting its emissions to nation-wide system. The inventory covers the building, transportation, waste management and wastewater treatment sectors. Greenhouse gas emission and energy consumption amounts are calculated in line with the data obtained from Bağcılar Municipality, TurkStat, electricity and natural gas distribution

companies. The 2018 baseline greenhouse gas emissions inventory calculated for SECAP is presented in **Table 13**.

Table 13: *Bağcılar greenhouse gas emissions, 2018*

Sector	MWh	tCO2eq	%
Buildings, equipment/facilities	**3,340,222**	**1,064,616**	**57.5**
Municipal buildings, equipment/facilities	15,415	5,071	0.3
Tertiary buildings (non-municipal) equipment/facilities	1.155.412	473,371	25.6
Residential buildings	2,156,439	579,605	31.3
Public lighting	12,955	6,568	0.4
Transportation	**2,070,679**	**555,440**	**30.0**
Municipal vehicle fleet	3,342	906	0.0
Public transportation (municipal buses)	11,836	3,208	0.2
Public transport (electrical vehicles, e. g. railway)	13,457	6,823	0.4
Urban vehicles (private and commercial transport)	2,042,044	544,504	29.4
Other releases		**231,656**	**12.5**
Waste management (solid waste disposal)		99,749	5.4
Wastewater treatment plant:		131,907	7.1
• *Wastewater treatment process CH4*		*102,376*	*5.5*
• *Wastewater treatment process CO2*		*24,046*	*1.3*
• *Wastewater treatment process nit./denit. N2O*		*1,508*	*0.1*
• *Wastewater treatment process nit./denit. Non*		*71*	*0.0*
• *Wastewater treatment process N2O*		*3,905*	*0.2*
Industry	412,849	150,698	
Total (Bağcılar GHG Inventory, incl. Industry sector)	5,823,750	2,002,410	
Total (Bağcılar GHG Inventory, excl. Industry sector)	**5,410,901**	**1,851,712**	**100**

The total amount of energy consumption of Bağcılar district, excluding industry, is 5,410,901 MWh and total greenhouse gas emissions amount to 1,851,712 tCO2eq. The GHG emission value per capita (excluding industry sector) is 2.52 tCO2eq. According to the calculations, 57.5% of the emissions come from buildings, 30% from transportation and 12.5% from solid waste and wastewater treatment sector.

During the Sustainable Energy and Climate Action Plan preparation, the short and long-term strategic plans of Bağcılar Municipality, the views of academics, the Istanbul planning agency, chambers of industry and commerce, public institutions, provincial directorates and professional organizations were taken into consideration.

3.3.2 Greenhouse Gas Emission Reduction Scenarios

As a result of the assumptions made, greenhouse gas emissions (excluding industry) in Bağcılar district were calculated as 2,211,992 tCO2e in 2030 (BAU scenario). The per capita emission amount, which was 2.52 tCO2e in 2018, is expected to be 1.48 tCO2e per capita with the implementation of action plans in 2030. The effects of the above-mentioned targets can be observed with the graphic below, which includes the current situation, BAU scenario and reduction scenarios (**Figure 35**).

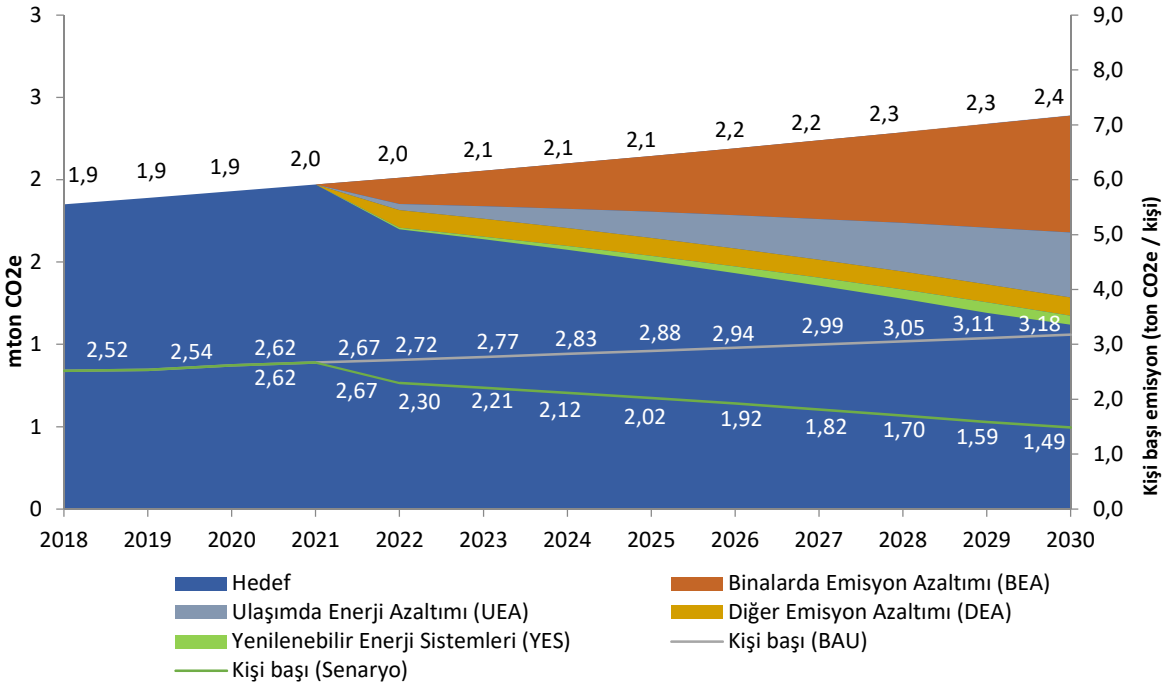


Figure 35: *Bağcılar greenhouse gas emission BAU and reduction scenarios for 2030*

When the greenhouse gas inventory (industry excluded) is analyzed, buildings in Bağcılar have the highest share of the emissions (57.5%), as detailed under the heading 3.1 Greenhouse Gas Emission Inventory of this report. With the actions detailed under the title of 3.3.2 Contents of Actions, a total reduction by 49.4 % or about 525,717 tCO2e is targeted in the buildings sector by 2030.

The transportation sector has the second largest share of emissions (30%). With the actions detailed under the title of 3.3.2 Contents of Actions, a reduction of 48.1 % or 267,151 tCO2e is targeted in the transportation sector by 2030. Reduction actions are envisaged for waste and wastewater sector and other emission sources, which make up the remaining 12.5% of the Bagcilar emissions. With the actions detailed under the heading 3.3.2 Contents of Actions to be implemented in these sectors, a reduction of 59.9 % or 38,649 tCO2e is targeted by 2030.

In **Table 14**, the reduction targets of all main sectors are summarized.

Table 14*: Sectoral reduction targets for 2030*

Sector	MWh Reduction 2030	Tons of CO2e reduction 2030
Buildings	1,425,841	525,717
Renewable energy	283,500	143,735
Transportation	1,172,009	267,151
Other (Waste and wastewater)	-	138,649
Total Reduction	**2,881,350**	**1,075,252**

3.4 MITIGATION ACTIONS

In this section, mitigation actions are detailed by sector. Each action has also been aligned with the Bağcılar Municipality Strategic Plan, including the municipality's defined targets for the years 2020-2024.

Emissions can be significantly reduced with energy consumption reduction measures to be carried out in the building sector. For example, different energy efficiency measures, fuel conversion and use of renewable energy. Most of the transport sector emissions are related to private and commercial transport (cars, trucks). There is no direct influence and control of the municipality on the consumption in this sector, thus; the reduction can only be targeted with indirect and long-term measures. For example, developing public transportation, increasing the use of bicycles and pedestrianization and urban planning measures to reduce daily travel are the important actions of emission reductions.

Action Types

Actions under SECAP fall into the following categories:

- **Investment projects:** Infrastructure investments that Bağcılar Municipality will undertake either by using its own resources or with the support of donor organizations.
- **Policy measures:** New legislation or policies enacted to drive more environmentally friendly actions.
- **Plans and strategies:** It provides a more detailed roadmap for improving performance in a particular sector or region (e.g. Climate Action Plan).
- **Behavioral:** Measures that seek to shift a community's behavior in a particularly targeted direction (for example, towards greater use of public transport). While there is a behavioral component to policy measures, actions in this category focus specifically on behavior change, such as the organization of awareness campaigns.
- **Education:** Actions aimed at increasing capacity through information exchange.
- **Enforcement and sanction:** Measures that seek to improve compliance with policies and regulations through monitoring and potential penalties.

Contents of Actions

3.4.1 Buildings and Energy

Current Status of Buildings

In the buildings sector, many national strategic plans and regulations, including the Energy Efficiency Strategy Document (2012-2023) and the National Energy Efficiency Action Plan (2017-2023), Turkish Energy Efficiency Law and the EU Regulation on Energy Performance in Buildings, prepared by the Ministry of Environment and Urbanization for the building sector are available. In order to help reduce the effects of this sector on global climate change, especially through measures aimed at reducing greenhouse gas emissions and resource consumption, various actions are being taken in Bağcılar district. These actions include municipal buildings, non-residential buildings and residential buildings.

Bağcılar Municipality's 2020-2024 Strategic Plan includes “A3. Under the strategic objective of “Creating a More Livable, Safe and Planned City” and the objective of “Creating a district more prepared for disasters by accelerating the urban transformation works” has been stated. The objective of “Increasing the Institutional Service Quality of the Municipality with an Understanding of Continuous Development and Governance” was included.

The buildings sector is the most important factor for greenhouse gas emission reductions and it is important to take effective actions in this regard. However, limited data on buildingsmakes it difficult to predict the scale of improvement that can be achieved. The last detailed survey of all existing buildings was made in 2000. Considering the changes that occurred as a result of the urban transformation initiatives implemented by the Ministry in response to the earthquake disaster that occurred in Gölcük in 1999, it is now significantly out of date.[37] In the last 20 years, there has been a significant amount of construction and demolition work in cities in Türkiye, and the process is still ongoing. While this may create some opportunities for large-scale energy efficiency gains, particularly where properties are demolished and rebuilt, it will also be important to reduce the impacts of the construction process itself, taking into account issues such as the circular economy and embedded carbon.

In Bağcılar district, the share of the buildings sector, including industry, in the total share of GHG emissions is 60.7%. Excluding industry, this share is 57.5%. This ratio can be described as the emission source that has the highest share in the total GHG emissions. Since buildings represent a large part of the total emissions, it can be concluded that achieving the reduction target largely depends on the interventions to be made in this sector. The greenhouse gas emission amounts of the buildings sector are shown as broken down **(Figure 36).**

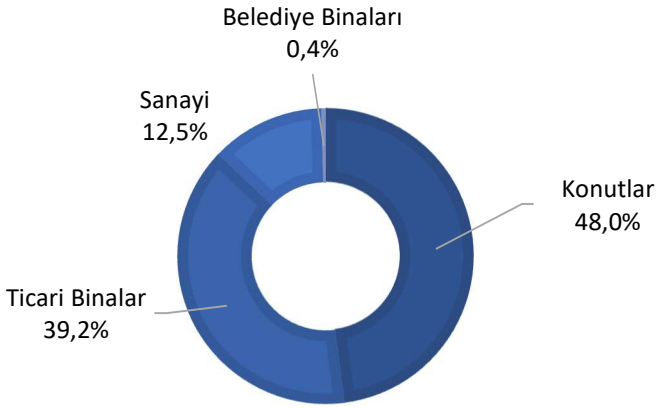


Figure 36: *Greenhouse gas distribution of buildings, 2018*

When the breakdown within the buildings sector is detailed, greenhouse gas emissions originate from residences with 48%, commercial buildings with 39.2%, industry with 12.5% and municipal buildings with 0.4%. **Figure 37** shows the breakdown of the emissions by the type of energy consumption source of the residences.

[37] See. "Law No. 6306 on Transformation of Areas Under Disaster Risk.

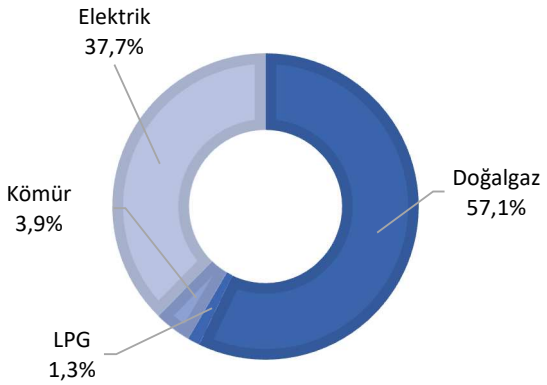


Figure 37: *Household greenhouse gas emissions breakdown, 2018*

When the greenhouse gas emissions are analyzed according to the energy consumption source in residences, natural gas is in the first place with 57.1%, electricity is in the second place with 37.7%, coal is in the third place with 3.9%, and LPG is in the fourth place with 1.3%.

Main benefits of renovation

In order to achieve sufficient renovation levels municipality and other institutions should focus on the building owner, his expectations, and the removal of significant barriers to his decision to participate in the renovation. Different studies and research present different expectations of building owners and typical barriers that hinder owners 'decision to participate in renovation. In summary, however, it can be said that the owner of the building will be involved in the renovation when he expects the benefits of the renovation to outweigh his investment.

In order for the building owner to trust the benefits of the renovation, several essential conditions must be met:

- The benefit to the owner must objectively exist.
- The owner must be informed of the existing benefits - it is important to consider that the owner's investment is financial and that the benefits of renovation are manifold (not only energy savings and reduced costs, but also increased housing value, better social environment, etc.). informed about the full range of renovation opportunities and benefits.
- Financing solutions need to be developed - even if the building owner is expected to benefit from the renovation, he will not be involved in the renovation if he does not have the financial means to do so.
- There must be sufficient assurance that the benefits of the renovation will be realized - even if they expect the benefits of the renovation and have attractive financing options, the building owner is unlikely to participate in the renovation if they do not expect the planned result to be achieved.

Principles for successful renovation:

1. Planning targets. The renovation process is fragmented, involves different stakeholders, has a direct impact on the sectors concerned (eg energy infrastructure planning, urban planning, regional development planning, social welfare, etc.) and the targets set by the municipality depend directly

on the energy sector development scenario. Accordingly, in order to implement transformation of the building stock, it is necessary to make basic, managerial decisions in the planning phase:

- Integration of targets into the SECAP.
- To form an inter-institutional committee, working group, etc. an organizational unit that would perform the functions of SECAP manager, i. bring together the competencies of key stakeholders and be responsible for planning, coordinating and monitoring the implementation of the SECAP.
- Develop a comprehensive, user-oriented package of support measures.
- Detailed targets at the administration level of municipality, delegating responsibility for their implementation from administration, while providing the necessary funding and tools for implementation.
- Implement a monitoring system and ensure periodic updating of targets in line with implementation progress.

2. A comprehensive package of support measures. The support package must be user-centered and address the implementation of specific IRS indicators, and address three key challenges:

- Ensure sufficient depth and complexity of transformation i.e. to seek a deep, substantial transformation of the building stock integrated with the related infrastructure (DH and electricity networks, streets, urban areas, etc.), thus maximizing energy savings and other essential renovation benefits.
- Ensure the required pace (volume) of transformation without sacrificing the depth, quality or sustainability of the renovation.
- Ensure the replacement of fossil fuel production sources.

The main elements of the renovation package are:

- Increased energy efficiency requirements to B / A energy efficiency class (transformation depth).
- Aiming for zero CO2 emissions (abandonment of fossil fuel production sources).
- Priority quarterly renovation (integration with related infrastructure, pace of transformation, economies of scale).
- Possibility of partial renovation (flexibility, user orientation).
- Project aggregation (transformation rates, economies of scale, financing decisions).
- Industrialization of construction, “factory construction” (pace of transformation, economies of scale, quality assurance, smart technologies).
- Solutions implementing the principles of the circular economy that ensure the sustainability of the transformation.

3. Adequate funding. The support measures must be accompanied by financing solutions for all the necessary financial flows of the owner during the renovation period so that the building owners can and want to invest in the renovation.

Achieving a breakthrough in renovation will require significantly higher investment. According to preliminary calculations, in order to achieve the SECAP targets, by 2030 an average of 1 100 000 m2/year of buildings will be needed to renovate the building stock 300 000 000 EUR/year.

Accordingly, securing funding must address two key issues:

- Securing funds for the state-funded part (subsidies). Current sources should be known until 2030

- Preparation of building owners' investment financing decisions. Significant growth in the owner's need for investment financing is expected and will not be possible with existing financing solutions. The ability to create and offer to the market financial instruments that have a high leverage effect and involve private funds from pension funds and international financial institutions is gaining in importance.

It is important to note that other existing renovation measures can significant impact on reducing the need for renovation (eg rising energy prices, pollution taxes) and increasing access to finance (eg merging projects).

4. Effective communication. Effective communication should not only inform the target audience about renovation packages, success stories, etc., but should also highlight 2 additional important messages:

- The benefits of renovation are manifold and not limited to energy savings.
- In the long run, there is no option for energy-inefficient buildings in poor technical condition to participate or not to participate in the renovation.

The owner's investment is financial, while the benefits of renovation are manifold (not only energy savings and reduced costs, but also increased housing value, better social environment, improved health, building security, etc.). Accordingly, for a building owner to believe in the benefits of renovation, he must be informed of the full range of opportunities and benefits of renovation. This is especially true when the cost of energy is low due to the inclusion of incomplete costs and as a result the benefits of financial renovation are not a sufficient incentive to participate in the renovation.

Communication on the inevitability of renovation should focus on two segments:

- Building owners (motivating them to participate in renovation).
- Representatives of construction, design, financing and other stakeholders involved in renovation (ensuring that public policy on this issue is clear, binding and long-term).

5. Reliable implementation system. To attract building owners and to ensure the achievement of renovation indicators, a reliable and smooth process of renovation implementation is necessary.

Even believing in the benefits of renovation and having attractive financing options, a building owner may not be involved in renovation if they see administrative barriers (both at the planning and implementation stages), the process will require significant time investment or competencies they do not have.

In order to ensure a smooth process and to take into account the needs of building owners, it is necessary to approach building owners both physically and in response to their needs:

- Ensure implementation of the "one-stop shop" principle. The municipality should have the best preconditions for implementing the one-stop-shop function
- Create a competence center. Such a center should centralize the collection of good practice, standardize processes and provide methodological and advisory assistance to building owners.
- Establish a maintenance mechanism. An external control mechanism should be put in place at each stage of the renovation process. This would increase the confidence of building owners and reduce the risk of renovation delays.

The priorities and principles described above are in line with the provisions of SECAP, which provide that:

- Renovation of buildings gives priority to "energy efficiency, applying the principle of" energy efficiency first "and considering the use of RES".
- Great attention must be paid to the least energy efficient buildings.
- Financial measures to increase energy efficiency in the renovation of buildings should be linked to targeted or achieved energy savings.

Buildings Desk Workshop Results

Energy Current Status

According to the 11th Development Plan (2019-2023) target, increasing the share of renewable resources in electricity generation to 38.8% by 2023 and avoiding CO2 emissions from newly established renewable energy plants from 2018 to 2023 by 18 million tons (cumulatively) is aimed to reach the value.[38] [39] [40]According to Türkiye's Climate Change Strategy 2010-2023, the share of renewable energy in total electricity generation is expected to increase to 30% by 2023. In this framework, all of our technical and economic hydropower potential will be evaluated, and an electricity generation capacity of 20,000 MW in wind and 600 MW in geothermal will be reached. Obtaining electrical energy from solar energy will be encouraged.[41]

There are many strategic national plans and regulations regarding energy efficiency and this information is given in general terms in Chapter 1.3. Regulations on building energy efficiency standards are set at the national level. In the energy sector, increasing investments, implementations and capacities in Bağcılar district in the short and medium term coincide with the current plans and reports. In particular, the generation of electricity from solar energy as a renewable energy source can contribute to the achievement of the targets determined in this field. Solar energy comes to the force when evaluated as a renewable energy potential in Bağcılar (

Figure 38).[42].

Considering the total solar radiation data, although it is lower than Türkiye's average of 1527 kWh/m2-year with 1400-1450 kWh/m2-year, it actually has a significant potential.[43] [44] [45] [46]

[38] https://www.sbb.gov.tr/wp-content/uploads/2019/11/ON_BIRINCI_KALKINMA-PLANI_2019-2023.pdf,*Access Date: November 2021.*
[39] *https://sp.enerji.gov.tr/ETKB_2019_2023_Stratejik_Plani.pdf, Access Date: November 2021.*

[41] *https://www.gmka.gov.tr/dokumanlar/yayinlar/Turkiye-Iklim-Degisikligi-Stratejisi.pdf, Access Date: November 2021.*
[42] *http://www.yegm.gov.tr/MyCalculator/pages/54.aspx, Access Date: November 2021.*
[43]solargis.com, Accessed November 2021.
[44] *https://www.statista.com/statistics/497549/solar-photovoltaic-power-electricity-production-volume-in-germany/, Access Date: December 2021.*

[46] *https://gepa.enerji.gov.tr/MyCalculator/pages/34.aspx,*Access Date: December 7, 2021.

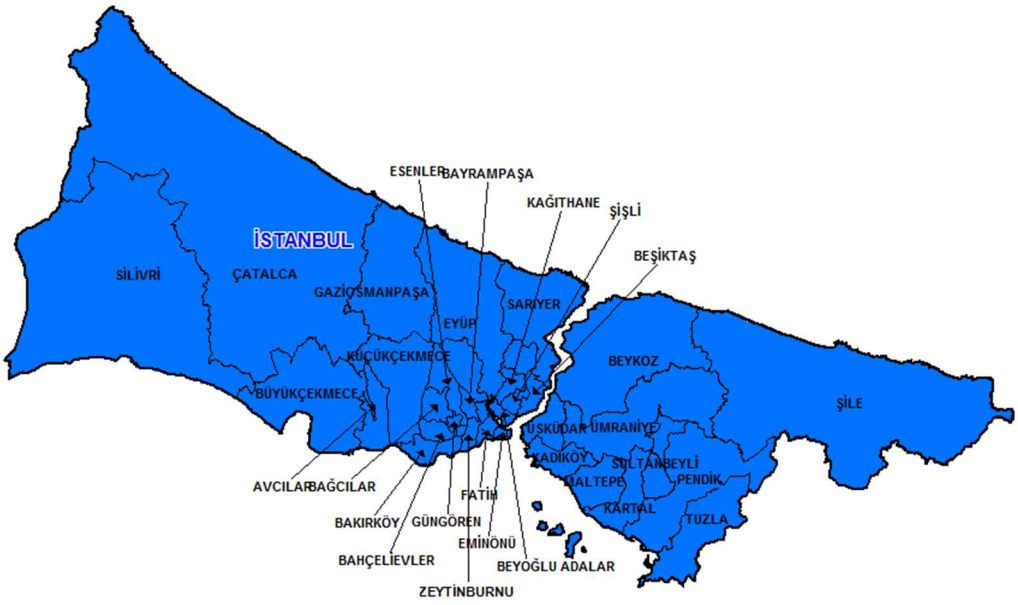


Figure 38: *İstanbul solar radiation map*

In the 2020-2024 Strategic Plan of Bağcılar Municipality, one of the strategic objectives is stated as “Aim 3. A livable and healthy city with a sustainable environment will be designed for all living things” and “Goal 3.1. Environmental activities will be developed and implemented for a sustainable urban policy. and “Goal 3.7. With new technologies, the city's carbon emissions will be made manageable on a district basis.” targets are included. In terms of energy, the use of alternative energy sources with long sunshine duration is brought to the agenda in the plan. Although the solar radiation in Europe is lower than in Türkiye, there are some other countries that meet their energy needs from solar energy (**Figure 39**).

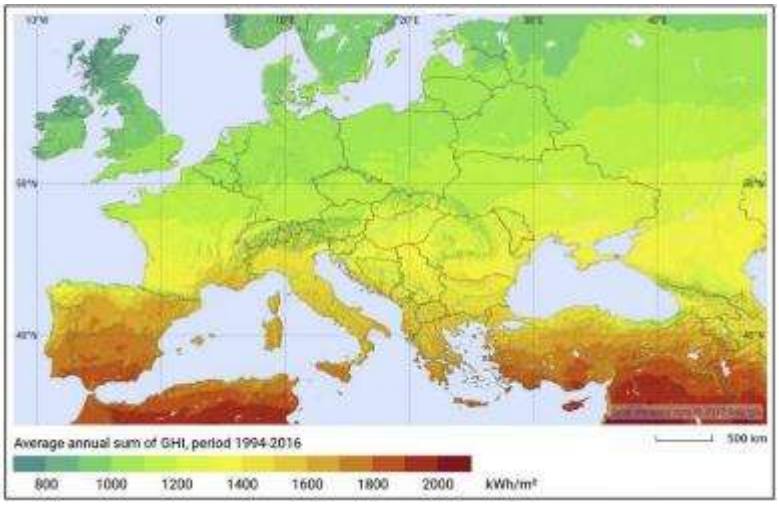


Figure 39: *Europe solar radiation map*

Energy Efficiency in Buildings:

Türkiye has a high rate of urbanisation approaching a growth rate of 2% per year. On an average year, 100,000 new buildings are added to the building stock in Türkiye. Their combined energy use, including those of residential, commercial and public buildings, was responsible for around one-third of the country's total final energy consumption in 2015. In this context, given the rapid increase in the sector's energy demand averaging 4.4% per year in recent years effectively rendered the building sector the largest energy user in Türkiye. The residential sector's energy demand represents just over half of the entire building sector's total final energy consumption. Public and commercial buildings account for the rest.

Estimated total electricity savings in buildings could be as high as 16.6 TWh by 2030 according to a study carried out in 2020 (Executive Summary: the most economic solution for Türkiye's power system: Energy Efficiency and Business Models by SHURA). Most of these savings will be achieved through technology and the measures taken to increase energy efficiency. Additionally, significant gains can be achieved through methods such as energy management systems and the optimization of energy consumption on the demand side.

Industry Target

Improving the energy efficiency of existing and future buildings, supporting the widespread adoption of sustainable construction techniques and the use of environmentally friendly materials can be said to be the sector's target. In addition, some of the electricity consumption can be provided from renewable sources with solar energy systems to be installed in residential and tertiary buildings, especially integrated into roofs. For buildings and energy, the target year 2030 is to save 1,709,341 MWh of energy and to reduce 669,452 tons of CO2e greenhouse gas.

Action Details

The energy efficiency and GHG reduction mitigation measures for buildings sector of Bağcılar are presented in **Table 15, Table 16, Table 17, Table 18,**

Table 19, Table 20, Table 21 and **Table 22.**

Table 15: *Increasing the use of renewable energy in municipal buildings*

Action 1.1	**Increasing the use of renewable energy in municipal buildings**
Current Situation/Purpose	According to the Bagcilar 2018 greenhouse gas inventory, the share of buildings excluding industry is 57.5%, and it is the sector with the highest emissions among the sectors. When the breakdown within buildings is analyzed, the share of greenhouse gas emissions originating from municipal buildings is 0.5%. With this action, it is aimed to increase the use of renewable energy in municipal buildings.
Relationship to Existing Plans	Circular on energy saving in Presidential public buildings (dated 16 August 2019, no 30860)
Priority Level	High
Action Steps	✓ Carrying out energy audit studies in order to evaluate their efficiency for the energy currently used in municipal buildings within 2 years, which is obligatory by Turkish legislation. ✓

	✓ Ensuring the use of energy-saving systems in municipal buildings that consume more energy ✓ Examining ESCO-EPC Models (investment, saving contract model) and BOT (built-operate-transfer) as a finance model and planning within this scope
Action Type	Investment (public and private)
Savings Amount	In 2030, a total of 2,787 MWh energy savings and 1.120 tCO2e greenhouse gas reductions can be achieved. With renewable energy,13.580 MWh of energy is saved and 16,224 tCO2e of greenhouse gas is reduced.
Responsible	Bagcilar Municipality
Stakeholders	Istanbul Metropolitan Municipality and financial institutions, İlbank, Ministry of Energy, Ministry of Envirınment and Climate Change
Contribution of the Municipality	Practitioner
Cost	There is no prediction for the cost of the action Appr. 3.000.000 Euro for 3 MW rooftop and car parking Solar PV systems on Municipality Buildings.
Timing	2022-2030
Risks	High investment cost, lack of human resources

Table 16: *Making every efficient renewals within the scope of urban transformation activities*

Action 1.2	**Making energy efficient renewals within the scope of urban transformation activities**
Current Situation/Purpose	When the emissions excluding industry are analyzed in Bağcılar's 2018 greenhouse gas inventory, the share of residences in the total inventory corresponds to 31.3%. When the breakdown for the buildings sector is analyzed, this rate rises to 54.4%. With this action, it is aimed to provide energy saving and greenhouse gas reduction by making energy efficient renewals with urban transformation activities in the district.
Relationship to Existing Plans	Bağcılar Municipality 2020-2024 Strategic Plan Target 3.2 Istanbul Metropolitan Municipality 2020-2024 Strategic Plan Target 1.3
Priority Level	High
Action Steps	✓ Determination of performance criteria in urban transformation activities in Bağcılar district ✓ Making energy efficient applications in buildings within the scope of urban transformation ✓ Ensuring the use of renewable energy in existing and new buildings
Action Type	Investment (public and private)
Savings Amount	In 2030, a total of 742 MWh energy savings and 204 tCO2e greenhouse gas reduction can be achieved.
Responsible	Bagcilar Municipality
Stakeholders	Istanbul Metropolitan Municipality, Ministry of Environment, Urbanization and Climate Change and financial institutions
Contribution of the Municipality	Practitioner and mentor
Cost	Considering the construction costs announced for 2021, the average cost of a 1st class flat is 350 Euro/m2. The additional cost to be created by the selection of sustainable materials in buildings and the integration of renewable energy is generally estimated at around 10%. Based on the cost of a 100 m2 flat, an additional cost of 350.000 Euro* per flat will arise. The employment need to be created by the spread of such investments will be beneficial in socio-economic terms.
Timing	2022-2030
Risks	High investment cost and lack of human resources

Table 17: *Increasing energy efficient practices in residences*

Action 1.3	Increasing energy efficient practices in residences
Current Situation/Purpose	The largest share in Bağcılar 2018 inventory belongs to the buildings sector with 57.5% (excluding industry). Residences have the largest share among buildings (31.3%). With this action, it is aimed to make applications that can save energy in houses.
Relationship to Existing Plans	11. Development Plan Article 687.2. IDEP 2011-2023 Target B1.1
Priority Level	Middle
Action Steps	✓ Identifying neighborhoods with intense fuel and electricity consumption ✓ Conducting feasibility study to reduce energy consumption in identified neighborhoods ✓ Implementing renewable energy applications in existing residences
Action Type	Investment (public and private)
Savings Amount	In 2030, a total of 748,694 MWh energy savings and 222,258 tCO2e greenhouse gas reduction can be achieved.
Responsible	property owners
Stakeholders	Bağcılar Municipality, Istanbul Metropolitan Municipality, Ministry of Environment, Urbanization and Climate Change and financial institutions
Contribution of the Municipality	Guiding and technical support with energy consulting service (Energy Table – call center)
Cost	3000 Euro for Rooftop PV system per house generating around 3 kW.
Timing	2022-2030
Risks	High investment cost and lack of human resources

Table 18: *Conducting awareness studies to ensure energy efficiency in residences*

Action 1.4	Conducting awareness studies to ensure energy efficiency in residences
Current Situation/Purpose	Houses have the largest share in the total emissions inventory. The importance of measures to save energy and reduce greenhouse gas emissions in residences draws attention. With this action, it is aimed to carry out awareness studies on energy efficiency in residences.
Relationship to Existing Plans	IDEP 2011-2023 Target B1.1 EVEP 2017-2023 Action B1 and B5
Priority Level	High
Action Steps	✓ Survey, focus group meetings, etc. of the people living in Bağcılar district. Ensuring that current awareness levels are determined with ✓ Conducting meetings with relevant central management units ✓ Ensuring participation in awareness programs on energy efficiency in residences ✓ Collaboration with experts in order to raise awareness about energy efficiency and greenhouse gas reduction in residences ✓ Organizing information meetings to increase public awareness at certain time intervals ✓ Energ Support Table-call center for technical info to the people
Action Type	Behavioral
Savings Amount	In 2030, a total of 19,412 MWh and 9,842 tCO2e greenhouse gas reductions can be achieved.
Responsible	Bagcilar Municipality
Stakeholders	Ministry of National Education, Ministry of Environment, Urbanization and Climate Change, Ministry of Energy and Natural Resources, Istanbul Metropolitan Municipality, universities, building material manufacturers, contractors, financial institutions and the people of Bağcılar
Contribution of the Municipality	Practitioner and guide
Cost	No predictions have been made regarding the cost.
Timing	2022-2030

Risks	Unwillingness to change negative behaviors about energy efficiency

Table 19: Making energy efficient applications in commercial buildings

Action 1.5	**Making energy efficient applications in commercial buildings**
Current Situation/Purpose	In Bağcılar 2018 greenhouse gas inventory, the share of commercial buildings in the total share of emissions is 25.6%, excluding industry. When the breakdown for buildings is analyzed, this share rises to 44.5%. With this action, it is aimed to provide energy saving and greenhouse gas reduction by making energy efficient renovations in commercial buildings.
Relationship to Existing Plans	Bağcılar Municipality 2020-2024 Strategic Plan Target 8.4 Istanbul Metropolitan Municipality 2020-2024 Strategic Plan Target 3.2
Priority Level	High
Action Steps	✓ Efficiency analysis of fuels used in commercial buildings ✓ Preliminary studies for energy efficient renovations for commercial buildings ✓ Ensuring the exchange of fuels used in commercial buildings with energy efficient systems ✓ Promoting nature-based solutions (NBS) in commercial buildings ✓ Developing R&D projects for energy saving and greenhouse gas reduction in universities and commercial buildings
Action Type	Investment (public and private) ESCO-EPC Models
Savings Amount	In 2030, a total of 526,175 MWh energy savings and 215,750 tCO2e greenhouse gas reductions can be achieved.
Responsible	Bağcılar Municipality and property owners
Stakeholders	Ministry of Environment, Urbanization and Climate Change, universities and financial institutions
Contribution of the Municipality	Practitioner and mentor
Cost	900 € / kWp
Timing	2022-2030
Risks	Lack of cooperation between organizations, lack of national support, lack of awareness and high investment cost

Table 20: Energy efficient renewals in public lightning (streets and public spaces)

Action 1.6	**Energy efficient renewals in public lighting (streets and public spaces)**
Current Situation/Purpose	When Bağcılar 2018 greenhouse gas emission inventory is analyzed, the share of public lighting in the total emission corresponds to 0.4%, excluding industry. With this action, it is aimed to provide energy saving and greenhouse gas reduction with energy efficient applications in public lighting.
Relationship to Existing Plans	Bağcılar Municipality 2020-2024 Strategic Plan Target 8.4 IDEP 2011-2023 Target 1.5 and B2.1 EVEP 2017-2023 Action B3 and B10
Priority Level	High
Action Steps	✓ Identification of street lighting, which is expected to benefit primarily from renewable energy sources. ✓ Implementation of energy efficient renewals of public lighting operated by Bagcilar municipality and İBB by 2030
Action Type	Investment (public and private) ESCO-EPC Model
Savings Amount	In 2030, a total of 16,143 MWh energy savings and 8,185 tCO2e greenhouse gas reductions can be achieved.

Responsible	Bagcilar Municipality, Electricity Utilities, Highway Agency (Park and Garden, Tunnel Lightings belongs to Municipality, State Highway Institute and Utilities responsible for street lightings)
Stakeholders	Financial Institutions, Iller Bank, Utilities
Contribution of the Municipality	Practitioner
Cost	No predictions have been made regarding the cost.
Timing	2022-2030
Risks	High investment cost and lack of human resources to make the necessary replacement

Table 21: *Conducting awareness studies on energy efficiency and greemhouse gas reduction in commercial buildings*

Action 1.7	**Conducting awareness studies on energy efficiency and greenhouse gas reduction in commercial buildings**
Current Situation/Purpose	Commercial buildings have a 25.6% share in 2018 Bağcılar greenhouse gas inventory, excluding industry. With this action, it is aimed to carry out studies to provide energy efficiency and greenhouse gas reduction for commercial buildings.
Relationship to Existing Plans	IDEP 2011-2023 Target B1.1 EVEP 2017-2023 Action B1 and B5
Priority Level	Middle
Action Steps	✓ Sharing good practice examples by organizing focus group meetings with energy managers of commercial buildings in Bağcılar district ✓ Carrying out awareness studies by getting support from experts with applications (heat pump, etc.) for energy efficiency and greenhouse gas reduction in commercial buildings.
Action Type	Behavioral
Savings Amount	In 2030, a total of 111,888 MWh of energy savings and 68,358 tCO2e greenhouse gas reuction can be achieved.
Responsible	Private and Commercial Buildings Owners
Stakeholders	Ministry of Environment, Urbanization and Climate Change, Ministry of Energy and Natural Resources, Istanbul Metropolitan Municipality, building material manufacturers, contractors, financial institutions and business owners
Contribution of the Municipality	Establishing the necessary incentive mechanism with awareness-raising activities
Cost	No predictions have been made regarding the cost.
Timing	2022-2030
Risks	Unwillingness to change negative behaviors about energy efficiency and finance

3.4.2 Transportation

The measures to be taken regarding the transportation sector are listed in the National Energy Efficiency Action Plan (2017-2023). It can be a guide in certain measures that are planned to be implemented in the National Energy Efficiency Action Plan and that Bağcılar Municipality can implement in the field of transportation. Below are the general actions of the plan regarding the transport sector:

- Promoting energy-efficient vehicles
- Development of comparative study on alternative fuels and new technologies
- Developing and Improving Cycling and Pedestrian Transportation
- Reducing automobile use in order to alleviate traffic congestion in cities
- Expanding public transport

In addition, the Turkish Transportation and Communication Strategy 2023 and the National Intelligent Transportation Systems Strategy Document (2014-2023) contain articles that support the National

Energy Efficiency Action Plan. Bağcılar Municipality's 2020-2024 Strategic Plan includes “A1. Under the strategic objective of "Strengthening and Developing the Urban Infrastructure of Bağcılar", the objective of H1.1 is to construct new roads with priority for pedestrians and disabled people, to improve existing roads and to facilitate transportation". Fuel use breakdown of the transportation sector, which is the second largest emission source in the 2018 greenhouse gas inventory, is shown in **Figure 40**.

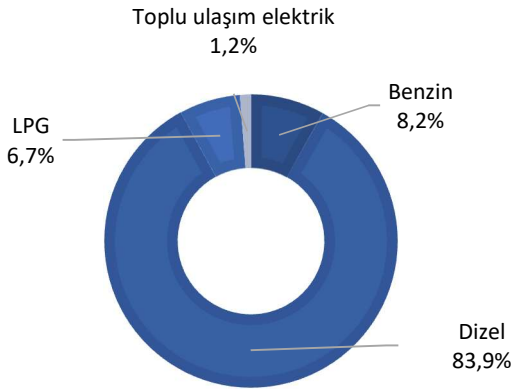


Figure 40: *Bağcılar district transportation greenhouse gas inventory, 2018*

The biggest share in transportation-related greenhouse gas emissions comes from diesel consumption with 83.9%. Respectively, gasoline, LPG and electricity for public transportation are the sources that make up the other transportation greenhouse gas inventory. However, when industry, industrial process emissions and fuel consumption for electricity production (for their own consumption) that the local government cannot interfere with are excluded from the inventory, share of the transportation in the total emission inventory rises to 20.3%. It is predicted that the measures to be taken regarding transportation will have a high impact on reducing the emissions of the district.

Industry Goal: With integrated and efficient solutions, public transportation for the transportation sector, pedestrianization by increasing the rate of bicycle use, replacement of municipality and service vehicles with low-carbon alternatives, smart signaling and optimization studies, smart parking, etc. It can be said that working on shared vehicle use and electric vehicle incentives with applications, the change of public transportation in energy-efficient vehicles, and providing a behavioral change in reducing fuel consumption by providing training to drivers who actively use vehicles on economical driving techniques. For transportation, 1.172.009 MWh and 267.151 tons of CO2e greenhouse gas reduction are targeted for the year 2030.

Action Details

The energy efficiency and GHG reduction mitigation measures for transportation sector of Bağcılar are presented in **Table 22, Table 23, Table 24, Table 25, Table 26, Table 27, Table 28** and **Table 29.**

Table 22*: Use of energy efficient vehicles in municipal vehicles*

Action 2.1	**Use of energy efficient vehicles in municipal vehicles**
Current Situation/Purpose	When Bağcılar's greenhouse gas inventory for 2018 is analyzed, transportation is seen as the biggest emission source after buildings (30%). When the municipality vehicles are analyzed only for the transportation sector, their share in the inventory

	is 0.2%. With this action, it is aimed to provide energy saving and greenhouse gas reduction by choosing vehicles with high energy efficiency over municipal vehicles.
Relationship to Existing Plans	IDEP 2011-2023 Action U5.1
Priority Level	Middle
Action Steps	✓ Carrying out feasibility studies and determining priority municipal vehicles so that low-carbon vehicles can be preferred in municipal vehicles. ✓ Ensuring the gradual substitution of municipal vehicles with vehicles with high energy efficiency ✓ Use of electric cars, scooters
Action Type	Investment (public and private) and Plan/Strategy
Savings Amount	In 2030, a total of 942 MWh energy savings and 327 tCO2e greenhouse gas reduction can be achieved.
Responsible	Bagcilar Municipality
Stakeholders	Iller Bank, vehicle manufacturers and vehicle maintenance companies
Contribution of the Municipality	Practitioner and mentor
Cost	The cost varies due to the foreseen cooperation with the private sector.
Timing	2022-2030
Risks	High investment costs, inability to change citizen behavior patterns

***Table 23**: Increasing the rail system connections with public transportation vehicles*

Action 2.2	**Increasing the rail system connections with public transportation vehicles**
Current Situation/Purpose	When the emissions excluding industry are analyzed in Bağcılar 2018 greenhouse gas inventory, the share of public transportation vehicles in the total inventory is 0.6%. Considering the transportation sector in particular, this rate is 1.8%. With this action, it is aimed to increase the connection of public transportation vehicles with rail systems and to provide energy saving and greenhouse gas reduction.
Relationship to Existing Plans	BKGSEP Action 5.5.3 İBB 2020-2024 Strategic Plan Target 2.1
Priority Level	Middle
Action Steps	✓ Determination of public transportation vehicles that can make additional trips to the stations of the rail system lines according to their density ✓ Ensuring the connection of public transportation vehicles with the stations of the rail systems gradually ✓ Ensuring cooperation with relevant stakeholders for the planning of public transport routes
Action Type	Investment (public)
Savings Amount	In 2030, a total of 297,390 MWh energy savings and 78,814tCO2e greenhouse gas reductions can be achieved.
Responsible	Istanbul Metropolitan Municipality and Bağcılar Municipality
Stakeholders	Ministry of Transport and Infrastructure, IETT
Contribution of the Municipality	Practitioner
Cost	No predictions have been made regarding the cost.
Timing	2022-2030
Risks	High initial investment costs, very limited sample applications in the current situation

***Table 24:** Increasing pedestrian and bicycle paths*

Action 2.3	**Increasing pedestrian and bicycle paths**
Current Situation/Purpose	In Article 703 of the 11th Development Plan, the expression "construction of new bicycle paths" is included. Although the increase of these roads is limited due to the geographical features of Bağcılar, it may be possible to gain new areas with urban

	transformation activities and to use these areas as pedestrian and bicycle paths. With this action, it is aimed to increase the use of pedestrian and bicycle paths and to reduce energy consumption and greenhouse gas formation caused by other transportation preferences.
Relationship to Existing Plans	11. Development Plan Articles 703.3 and 703.4 IDEP 2011-2023 Target U1.3, U3.1, U3.2 and U4.1 UEVEP 2017-2023 Action U3 and U4
Priority Level	High
Action Steps	✓ Determining the areas that can be considered as new pedestrian and bicycle paths in the district and carrying out feasibility studies ✓ Prioritizing areas that can be considered as pedestrian and bicycle paths ✓ Ensuring that certain routes are closed to traffic in order to make the roads pedestrian and bicycle friendly ✓ Establishment of incentive mechanisms to increase environmentally friendly roads
Action Type	Investment (public) and Plan/Strategy
Savings Amount	In 2030, a total of 165,216 MWh energy savings and 43,786 tCO2e greenhouse gas reduction can be achieved.
Responsible	Bagcilar Municipality
Stakeholders	Istanbul Metropolitan Municipality, Ministry of Transport and Infrastructure, Iller Bank, financial institutions, people of Bağcılar
Contribution of the Municipality	Practitioner
Cost	The cost of bicycle and pedestrian paths varies according to the material to be used and the topographic structure.
Timing	2022-2030
Risks	Citizens do not prefer roads, need for financial resources and difficulty in changing passenger habits

Table 25: *Expanding the use of smart transportation systems for the optimization of traffic signaling systems*

Action 2.4	**Expanding the use of smart transportation systems for the optimization of traffic signaling systems**
Current Situation/Purpose	The importance of the use of traffic lights with sensors is emphasized by stating that frequently positioned traffic lights cause an increase in vehicle-induced greenhouse gas emissions. In addition, this situation poses a problem in terms of both safety and fuel consumption at intersections with a lack of signaling. In the Smart Transportation Systems Strategy Document (2020-2023), under the title of "intelligent transportation systems mobile communication tools detection technologies traffic management systems", "adaptation of Intelligent Transportation Systems information and communication technologies to transportation due to the citizens' search for comfort, speed, low cost and safety in transportation" stands out. With this action, it is aimed to increase the optimization of traffic flow and signaling systems and to provide energy saving and greenhouse gas reduction.
Relationship to Existing Plans	IDEP 2011-2023 Target U2.2, U4.1 UEVEP 2017-2023 Action U4 İBB 2020-2024 Strategic Plan Target 2.4
Priority Level	Middle
Action Steps	✓ Switching to smart signaling to optimize traffic signaling systems ✓ Ensuring traffic flow by creating smart intersections in intersection planning ✓ Ensuring that the information of smart transportation systems is displayed with the necessary signboards and signs
Action Type	Investment (public) and Plan/Strategy
Savings Amount	In 2030, a total of 126,720MWh energy savings and 33,847 tCO2e greenhouse gas reductions can be achieved.
Responsible	Bağcılar Municipality and Istanbul Metropolitan Municipality
Stakeholders	Ministry of Transport and Infrastructure, General Directorate of Highways

Contribution of the Municipality	Practitioner
Cost	The cost of installing an Intelligent Traffic management system is approximately 2,000,000 ₺.
Timing	2022-2030
Risks	Communication infrastructure problems, lack of qualified personnel and high investment cost

Table 26: *Dissemination of electric and hybrid public transport vehicles*

Action 2.5	**Dissemination of electric and hybrid public transport vehicles**
Current Situation/Purpose	In the Integrated Urban Development Strategy and Action Plan prepared by the Ministry of Development, the expression "making public transport systems environmentally friendly" is included under Action 5.5.3. Although this action is not directly under the responsibility of Bağcılar Municipality, if support is provided to various incentive campaigns, there may be a potential for the public to increase their preference for electric vehicles. With this action, it is aimed to popularize electric and hybrid public transportation vehicles (dolmus etc.).
Relationship to Existing Plans	BKGSEP Action 5.5.3 YMEP Action 6.4.1
Priority Level	Middle
Action Steps	✓ Identification of those who are older than the public transportation vehicles ✓ First of all, feasibility studies are carried out to ensure the transition of public transportation vehicles, which are determined to be old, to electric and biofuel-consuming vehicles. ✓ Ensuring cooperation with relevant institutions and organizations for the replacement of electric and hybrid vehicles in public transportation
Action Type	Investment (public)
Savings Amount	In 2030, a total of 1006 MWh energy savings and 273tCO2e greenhouse gas reductions can be achieved.
Responsible	Bağcılar Municipality and Istanbul Metropolitan Municipality
Stakeholders	Ministry of Transport and Infrastructure, IETT, Metro Istanbul A.Ş.
Contribution of the Municipality	Practitioner
Cost	The cost of electric buses decreases as they become more widespread and the price difference decreases with diesel equivalent vehicles. It is seen from different local government experiences that deals are made at very advantageous prices in bulk purchases. The cost of 1 electric charging station is approximately 40.000 ₺.
Timing	2022-2030
Risks	High initial investment costs and very limited sample applications in the current situation

Table 27: *Making rail system and highway connection arrangements*

Action 2.6	**Making rail system and highway connection arrangements**
Current Situation/Purpose	When the emissions excluding industry are analyzed in the 2018 greenhouse gas inventory of Bağcılar, the share of electric public transportation vehicles in the total greenhouse gas inventory corresponds to 0.4%. Providing connections of public transportation vehicles with other used roads can enable to reach the destination faster and prefer public transportation vehicles instead of using private vehicles. With this action, it is aimed to make high-speed train connection and highway arrangements.
Relationship to Existing Plans	11. Development Plan Article 702.1. UEVEP Target U2.1.1

Priority Level	Low
Action Steps	✓ Strengthening rail and highway connections ✓ Carrying out necessary infrastructure works
Action Type	Investment (public)
Savings Amount	In 2030, a total of 190.079MWh energy savings and 50.770 tCO2e greenhouse gas reductions can be achieved.
Responsible	Bağcılar Municipality and Istanbul Metropolitan Municipality
Stakeholders	Ministry of Transport and Infrastructure, TCDD, General Directorate of Highways
Contribution of the Municipality	Practitioner
Cost	No predictions have been made regarding the cost.
Timing	2022-2030
Risks	High initial investment cost and lack of qualified personnel

Table 28: *Expanding the use of electric vehicles*

Action 2.7	**Expanding the use of electric vehicles**
Current Situation/Purpose	The fact that many European cities have aimed not to allow other fossil fuel vehicles to enter their centers in the short and medium term, and the successive statements that vehicle manufacturers will restrict their diesel vehicle production underline the importance of this issue. It is also noteworthy that this issue has recently entered the agenda of Türkiye. The fact that the domestic car being produced is also an electric vehicle gives important clues in this regard. With this action, it is aimed to popularize the use of electric vehicles.
Relationship to Existing Plans	IDEP 2011-2023 Target U4.1 and U4.2 UEVEP 2017-2023 Action U1
Priority Level	Middle
Action Steps	✓ Determining the potential of electric vehicle use in the district ✓ Conducting feasibility studies for the creation of e-charging stations for electric vehicles in central locations ✓ Events etc. to promote the use of electric vehicles. organization of studies ✓ Ensuring cooperation with relevant institutions and organizations for the dissemination of electric vehicles
Action Type	Investment (public & private) and Plan/Strategy
Savings Amount	In 2030, a total of 257,003 MWh energy savings and 41,198 tCO2e greenhouse gas reduction can be achieved.
Responsible	Istanbul Metropolitan Municipality and Bağcılar Municipality
Stakeholders	Ministry of Transport and Infrastructure, Ministry of Energy and Natural, Iller Bank, vehicle manufacturers, vehicle manufacturers, vehicle maintenance companies and e-charging station operators
Contribution of the Municipality	Practitioner
Cost	Cooperation with the private sector is envisaged. Operating e-charging station companies have different membership conditions and ways of working.
Timing	2023-2030
Risks	Limited sample applications, high costs and distrust of vehicle ranges

Table 29: *Conducting awareness studies on economical driving techniques*

Action 2.8	**Conducting awareness studies on economical driving techniques**
Current Situation/Purpose	Providing economic driving techniques training to taxi drivers, all commercial vehicle and private vehicle owners, especially public transport vehicle drivers, will contribute to the reduction of fuel consumption of vehicle users. Various studies have concluded that economic driving training provides up to 10% fuel savings in vehicle fuel

	consumption. With this action, it is aimed to carry out awareness studies on economical driving techniques.
Relationship to Existing Plans	IDEP 2011-2023 Target U4.1
Priority Level	High
Action Steps	✓ Preliminary information meeting on economic driving techniques for municipal public transport, minibus, taxi and logistics vehicle drivers ✓ Informing the transportation and cargo companies in Bağcılar about the subject and organizing joint programs with educational institutions. ✓ Cooperation with İBB and neighboring districts on the subject
Action Type	Behavioral
Savings Amount	In 2030, a total of 133,653 MWh energy savings and 18,136 tCO2e greenhouse gas reductions can be achieved.
Responsible	Bagcilar Municipality
Stakeholders	Bagcilar Municipality
Contribution of the Municipality	Practitioner and mentor
Cost	The cost of training in economic driving techniques throughout Türkiye is approximately 300 TL/person. (Source: interviews with private education institutions) It is planned that approximately 2,000 drivers will receive training by the public, considering that it will start with the municipality, minibus, taxi and shuttle drivers using public transportation. The private sector can also provide training especially to drivers who use logistics vehicles.
Timing	2022-2030
Risks	Inability to allocate time for trainings, inability to change citizen behavior patterns

3.4.3 Waste and Wastewater

In the National Waste Management and Action Plan (2016-2023), periodic waste management activities planned to be carried out until 2023, investments and financing needs for waste management have been determined. In the medium and long term, according to the action plan, in 2023, the rate of packaging waste collected will be 12%, the recovery rate of municipal wastes by biological methods will be increased to 4%, the recovery rate of municipal wastes by mechanical biological processes will be increased to 11%, and thermal methods will increase the rate of municipal waste with the target of increasing its recovery to 8%. In addition, the target of reducing the disposal rate of municipal wastes to 65% by storage method in 2023 is stated. The stated targets are minimum and further improvement of these targets can be made by implementing new plans and regulations.

Bağcılar Municipality's 2020-2024 Strategic Plan includes “A2. Under the strategic objective of "Creating a More Livable, Environmentally Friendly District by Extending Sustainable Environmental Services", the goal of "supporting H2.3 Recycling activities and carrying out Zero Waste Project studies" is stated. The wastewater of Bağcılar district is delivered to İSKİ's Ataköy Advanced Biological Wastewater Treatment Plant and İSKİ Yenikapı Pre-treatment Plant. Amount and ratio of waste and wastewater sector in Bağcılar greenhouse gas inventory are shown in **Figure 41**.

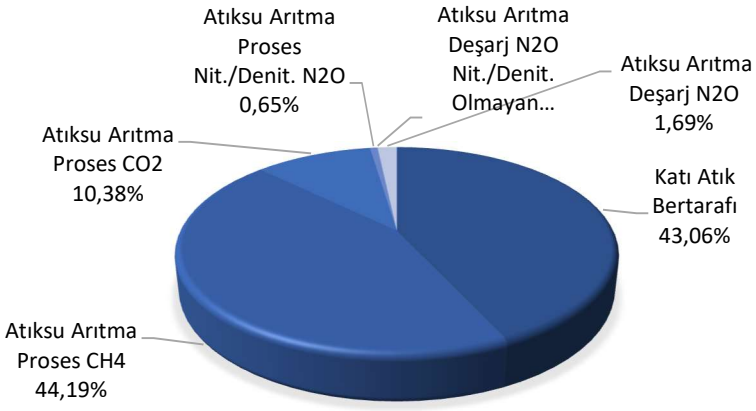


Figure 41: *Greenhouse gas emissions from solid waste disposal and wastewater treatment in Bağcılar district, 2018*

Goals related to the waste sector are generally aimed at determining the waste collection potential in local businesses and taking measures to improve waste management, improving wastewater treatment facilities and raising awareness. The reduction of GHG emissions by waste and wastewater actions by 2030 is targeted at 138,649 tons **CO2e.**

Action Details

The energy efficiency and GHG reduction mitigation measures for the transportation sector of Bağcılar are presented in **Table 30, Table 31** and **Table 32**.

Table 30: *Making improvements in solid waste management*

Action 3.1	**Making improvements in solid waste management**
Current Situation/Purpose	When Bağcılar 2018 greenhouse gas inventory is analyzed, the share of emissions from solid waste disposal corresponds to 5.4% in the total inventory excluding industry. With this action, it is aimed to make improvements in solid waste management.
Relationship to Existing Plans	Bağcılar Municipality 2020-2024 Strategic Plan Target 2.3 İBB 2020-2024 Strategic Plan Target 3.1
Priority Level	Middle
Action Steps	✓ Carrying out studies to reduce the amount of waste in Bağcılar district ✓ Developing incentive mechanisms to increase the recycling rate ✓ University, etc. for sustainable and innovative waste management. Developing exemplary projects by collaborating with organizations ✓ Ensuring cooperation with relevant institutions and organizations in order to reduce greenhouse gases in the facilities where wastes are transmitted.
Action Type	Plan/Strategy
Savings Amount	In 2030, a total of 102,170 tCO2e greenhouse gas reduction can be achieved.
Responsible	Bağcılar Municipality and Istanbul Metropolitan Municipality
Stakeholders	Ministry of Environment, Urbanization and Climate Change, Istanbul Provincial Directorate of Environment, Urbanization and Climate Change, financial institutions and universities
Contribution of the Municipality	guide and implementer
Cost	No predictions have been made regarding the cost.
Timing	2022-2030

Risks	Inability to improve waste management by enterprises and industrial facilities, insufficient increase in recycling and recovery rates, difficulty in implementation and lack of cooperation due to high costs

Table 31: Reducing emissions from wastewater treatment processes

Action 3.2	**Reducing emissions from wastewater treatment processes**
Current Situation/Purpose	In Bağcılar 2018 greenhouse gas inventory, emissions from wastewater treatment processes have a share of 7.1% in the total inventory excluding industry. With this action, it is aimed to reduce emissions from wastewater treatment processes.
Relationship to Existing Plans	Bağcılar Municipality 2020-2024 Strategic Plan H2.3 İBB 2020-2024 Strategic Plan Target 3.1
Priority Level	Middle
Action Steps	✓ Preliminary studies are carried out to ensure the use of more sustainable and nature-friendly systems for the entire facility, which is managed within the metropolitan authority and where the wastewater of the district is transmitted. ✓ The use of advanced environmental technologies to ensure process efficiency in the facility where the wastewater of the district is transmitted. ✓ Carrying out R&D studies with universities in order to develop efficient and emission-preventing practices for the wastewater treatment plant. ✓ Ensuring cooperation with relevant institutions and organizations to improve the process emissions for the facility where the wastes are transmitted.
Action Type	Investment project (public)
Savings Amount	In 2030, a total of 36,479 tCO2e greenhouse gas reductions can be achieved.
Responsible	Bağcılar Municipality and Istanbul Metropolitan Municipality
Stakeholders	İSKİ, Governorship of Istanbul, Provincial Directorate of Environment, Urbanization and Climate Change and universities
Contribution of the Municipality	Practitioner and mentor
Cost	No predictions have been made regarding the cost.
Timing	2022-2030
Risks	Difficulty in implementation and lack of cooperation due to high costs

Table 32: Conducting awareness studies on waste & wastewater

Action 3.3	**Conducting awareness studies on waste & wastewater**
Current Situation/Purpose	On the subject of waste & wastewater, Bağcılar Municipality also organizes seminars for schools on zero waste, recycling and recovery. Greenhouse gas reduction can be achieved by ensuring the continuity of the work done and increasing the area of influence. With this action, it is aimed to carry out awareness studies to reduce emissions from waste and wastewater.
Relationship to Existing Plans	Bağcılar Municipality 2020-2024 Strategic Plan H2.3 National Waste Management Action Plan 5.6
Priority Level	High
Action Steps	✓ Organizing incentive campaigns and competitions for waste reduction ✓ Establishing policies to reduce the use of single-use plastics ✓ Ensuring increasing interest in the subject in competitions related to recycling to be organized in schools ✓ Online public release of annual/monthly environmental bulletin ✓ Establishing an incentive mechanism for the implementation of zero waste policy and recycling measures in commercial and public institutions
Action Type	Behavioral
Savings Amount	No reduction amount is foreseen for this activity, which will affect the reduction indirectly, and it is related to the savings in Action 3.1 and Action 3.2 defined under the waste heading.
Responsible	Bagcilar Municipality

Stakeholders	Ministry of Environment, Urbanization and Climate Change, Ministry of National Education, Istanbul Metropolitan Municipality and schools
Contribution of the Municipality	Practitioner and mentor
Cost	No predictions have been made regarding the cost.
Timing	2022-2030
Risks	Inability to allocate time for trainings, inability to change citizen behavior patterns

3.5 MITIGATION MONITORING PLAN

The basis of the reduction part is the targets determined by the stakeholders at the workshop to reduce emissions resulting from energy consumption in different sectors. In order to successfully implement climate change mitigation policies and activities, it is important to develop clearly articulated evaluation and reporting requirements and to develop monitoring methods that will provide performance evaluations. In order for cities to reach their greenhouse gas reduction targets, which they have set with the aim of reducing the effects of climate change, they should meticulously handle the efforts to measure the progress in the implementations and the teams that will carry out studies on this issue should work in harmony with different departments, organizations, NGOs, the private sector and citizens.

The most important basis of this report, which is a district-scale greenhouse gas inventory, is the reports prepared by Bağcılar Municipality, Istanbul Metropolitan Municipality or different institutions regarding the future of the district, and the visions put forward by city stakeholders for the future of the city constitute the starting point of this action plan. Promoting the better development of urban climate policy networks, particularly involving the participation of regional and local civil society stakeholders at various stages of policy progress, can deepen local scientific knowledge and integrate local perspectives in the design and implementation of coordinated and integrated greenhouse gas reduction strategies.

The necessity of including the examination and monitoring of data sources for inventory calculation in the performance evaluation process comes to the fore. Considering that data quality is vital to the monitoring process, some necessary data are given in general terms in **Table 33**. Areas for improvement can be developed with data diversity and new regulations.

Table 33. *Some datasets that should be followed in the monitoring process*

Sector	Required Data	Responsible Unit (Data, Mitigation)	Data Collection Frequency	Areas for Improvement
Buildings and Facilities				
Municipal Buildings/Facility	All fuel and electricity	Bağcılar Municipality Support Services Directorate, Transportation Services Directorate	Yearly	Regular data collection by creating templates for data collection from the units, warning the relevant units when fuel and electricity consumption increases, ensuring the reduction of consumption, supporting it with training, encouraging reduction with rewards
Tertiary Building	All fuel and electricity	Bağcılar Municipality Directorate of Environmental Protection	Yearly	Obtaining more information about building stock (Year of

		and Control, Directorate of Urban Transformation, Directorate of Zoning and Urbanization, Directorate of Science Affairs, Directorate of Parks and Gardens, Directorate of Building Control,		construction, building features, m2, fuel type etc.)
Housing	All fuel and electricity	Bağcılar Municipality Directorate of Environmental Protection and Control, Directorate of Urban Transformation, Directorate of Zoning and Urbanization	Yearly	More information on building stock (year of construction, building characteristics, m2, fuel type etc.), reducing uncertainty on solid fuel consumption
Street Lighting	Electric	Bağcılar Municipality Directorate of Environmental Protection and Control, Directorate of Science Affairs, Directorate of Parks and Gardens, General Directorate of Highways, Ministry of Transport and Infrastructure, İBB, Electricity Administration	Yearly	Increasing the number of lighting poles and ensuring the change of current
Transportation				
Municipal Fleet	All fuel and electricity	Bağcılar Municipality Environmental Protection and Control Directorate, Transportation Services Directorate	Yearly	Implementing a system for data collection and storage within Bağcılar Municipality, supporting it with training
Public transport	All fuel and electricity	Bağcılar Municipality Environmental Protection and Control Directorate, Transportation Directorate	Yearly	Increasing efforts to encourage public transport
special vehicles	All fuel and electricity	Bağcılar Municipality Environmental Protection and Control Directorate, Transportation Directorate	Yearly	Carrying out studies on the dissemination of the purchase of electric vehicles
Other Resources				
Solid waste	Waste amount	Bağcılar Municipality Environmental Protection and Control Directorate, Cleaning Works Directorate	Yearly	Making improvements in data collection and storage systems
Waste water	Waste water amount	Bağcılar Municipality Environmental Protection and Control Directorate, Directorate of Science Affairs, İSKİ	Yearly	Making improvements in data collection and storage systems
local energy generation	Solar, wind, biogas, geothermal, etc.	Bağcılar Municipality Directorate of Environmental Protection and Control, Directorate of Science Affairs,	Yearly	Requesting production quantities from the distribution company, Requesting data from EMRA regarding

		Directorate of Zoning and Urbanization, Directorate of Urban Transformation, Directorate of Plans and Projects, Directorate of Parks and Gardens		licensed and unlicensed installations

4. ADAPTATION TO CLIMATE CHANGE

Istanbul is a city that is frequently faced natural hazards such as floods, droughts, hail, sudden heat and cold air waves. It is essential to understand how climate change will worsen the city's risks and vulnerabilities due to extreme weather conditions, and to develop priority strategies to ensure the resilience and sustainability of the city. In this respect, the evaluation of the city in terms of risk and vulnerability lays the groundwork for discussions in the society about how the problems that may be encountered in the future can be handled.

In the 6th evaluation report published recently by the IPCC, it was stated that the Mediterranean Basin, which includes Türkiye, is among the regions that will be most affected by climate change. In addition, according to the İstanbul climate change action plan report, how climate change can affect the city has been revealed with different scenarios. When we look at Istanbul specifically, there are predictions and scenarios about how the changes in temperature and precipitation patterns expected to occur in the coming years will affect the city. According to this scenario, precipitation changes are expected to lead to an increase in the frequency and intensity of storm and hail events. However, the risk of flooding will increase in the city and the water quality will weaken. The long-term rainless days expected to occur in the summer months and the increase in the extremely hot days accompanying this situation will pose a serious risk for the city. Changes in such precipitation and temperature patterns will seriously threaten to the urban infrastructure and built environment. Moreover, extreme hot weather and changes in precipitation regimes will pose a threat to public safety. The structure, dynamics and productivity of natural and agricultural systems located outside of urban areas will also be affected by changes in temperature and precipitation regime. Together with these risks, the deterioration of water quality and the increased allergens' effects will directly become a serious public health problem.

As a result, the assessment of Bağcılar in terms of risk and vulnerability will be a starting point for developing adaptation strategies against climate change. Within the scope of this study, the current situation of Bağcılar district in the fields of infrastructure systems, transportation, green infrastructure, water management, disaster management, public health and waste management will be examined and an assessment of risk and vulnerability in the context of climate change will be made. Then, adaptation actions will be determined according to the identified risks and effects, and a study will be created to increase the district's social, economic and physical resilience of the district against climate change.

4.1 KEY FINDINGS FOR BAĞCILAR IN THE CONTEXT OF HARMONY

Although Bağcılar district has an area of only 22.40 km2, it has a population of 734,206 people according to TUIK data for 2020. In addition, Bağcılar is the third largest district of Istanbul. In the town on the European side 100. Yıl, 15 Temmuz, Bağlar, Barbaros, Çınar, Demirkapı, Fatih, Fevzi Çakmak, Göztepe, Güneşli, Hürriyet, İnönü, Kazım Karabekir, Kemalpaşa, Kirazlı, Mahmutbey, Merkez, Sancaktepe, Yavuz Selim, Yenigün, Yenimahalle and Yıldıztepe neighborhoods. There are 22 neighbourhoods in total. The very high population density of the Bağcılar district and the density of construction in certain neighbourhoods require the district to be handled meticulously in terms of climate change risks. In this context, the basic findings of the district on infrastructure and superstructure, transportation, green infrastructure, water management, public health and disaster management and waste management were discussed under this heading, and the risk and vulnerability assessment were completed.

Urban Heat Island Effect

Buildings, roads, and other infrastructure systems absorb more of the sun's heat than natural areas such as green spaces, forests, and bodies of water. Urban areas, where these structures are very dense and green areas are limited, become islands that reach higher temperatures than other areas. Islands that absorb heat so much are called urban heat islands. The urban heat island effect, on the other hand, is the differentiation of climatic characteristics on a local or regional scale by changing meteorological parameters.

The reduction of natural landscape areas in urban areas, the intensive use of urban materials, the geometric structure of cities, human density and activities, and climate and geographical features cause the formation of urban heat islands.

4.1.1 Infrastructure Systems

Although climate change is a global phenomenon, most of its effects are more severe at the local scale. Therefore, all infrastructure systems and investments in cities are very important in order to reduce vulnerability to climate change and adapt to changes. Infrastructure systems also play an important role in managing risks and minimizing the negative effects of climate change. Physical effects such as temperature increases due to climate change, changing rain patterns, increased intensity and frequency of extreme weather events, and rising sea levels will affect all kinds of infrastructure. For this reason, infrastructure systems should be prepared by anticipating changing climatic conditions and designed and built to adapt to them.

Issues related to energy, built environment, critical infrastructure and transportation are discussed in detail in the mitigation part of the report. It is extremely important to address these issues in the context of climate adaptation and to conduct risk and vulnerability analysis related to the topics, in terms of developing adaptation strategies. **Table 34** provides a summary of impacts of climate change on infrastructure. It is necessary to evaluate the current state of the city's infrastructure and investments from a higher scale, within the scope of Istanbul borders and regional borders. Because the sustainability of such infrastructure systems can be achieved with upper scale decisions. In this respect, the main action for adapting these systems to climate change is to introduce legal

regulations that will encourage practices that will make existing and planned infrastructure systems and structures resistant to climate change. Measures to reduce urban heat island effects, especially in areas with high building density, are particularly important in the context of climate change adaptation. In addition, effective and timely investments in infrastructure sectors will reduce climate change risks and determine the direction of strategies along with adaptation actions.

Transportation infrastructure is at the forefront in terms of climate change mitigation activities. Because one of the most important factors that create greenhouse gas emissions is transportation activities. The transportation issue, which is explained in detail in the mitigation section, should also be evaluated in the context of harmonization. Increasing walking paths, providing incentives for clean energy transportation vehicles, providing eco-driving training to corporate drivers, and converting public transportation to rail systems are practices that indirectly facilitate adaptation to climate change.However, they are considered within the scope of greenhouse gas reduction targets. For this reason, to integrate the transportation issue into the development plans of cities with the context of the effects of climate change, to organize land use decisions according to transportation principles, all investments in the context of built environment, buildings, energy, critical infrastructure and transportation are thought as long-term investments. These sectors, which should not be handled only within the district boundaries, should be carefully evaluated in terms of both disaster risks and sustainability and should be made resistant to the climate. It should not be overlooked that the cost of making such infrastructure systems resilient by making them nature-based, flexible and innovative can be cheaper than traditional approaches. Global research on this issue reveals that the benefits of investing in urban resilience far outweigh the damage in a possible disaster scenario or risk.[47]The effect of such climatic events, which can turn into disasters, on infrastructure systems is shown in **Table 34**.

***Table 34**: Impact of climate change on infrastructure*[48]

<table>
<tr><th rowspan="2">Affected sectors</th><th colspan="4">Impacts of Climate Change</th></tr>
<tr><th>Temperature changes</th><th>Increase in sea levels</th><th>Changing precipitation models</th><th>Changing storm models</th></tr>
<tr><td rowspan="3">Buildings</td><td>High demands for cooling, affecting operation of buildings</td><td>Risk of collapse due to flooding</td><td>Risk of collapse due to flooding</td><td>Structural damage from wind</td></tr>
<tr><td>Creating heat island effects</td><td>Lost value</td><td>Lost value</td><td>Reduced building lifetime</td></tr>
<tr><td>Reduced durability of building materials</td><td>Risk of water entry of building elements</td><td>Risk of water entry of building elements</td><td></td></tr>
<tr><td rowspan="3">Transport</td><td>Melting of road surfaces and buckling railway lines</td><td rowspan="3">inundation of coastal infrastructures such as ports, roads or railways</td><td>Traffic disruption due to flooding</td><td>damage to assets such as bridges</td></tr>
<tr><td>damage to roads due to seasonal frost or permafrost</td><td rowspan="2">changing water levels disrupt transmission in inland waterways</td><td rowspan="2">disruptions at ports and airports</td></tr>
<tr><td>changing port demands for new sea routes due to melting arctic glaciers</td></tr>
</table>

[47]OECD. (2018). Climate-resilient Infrastructure. Policy Perspectives. OECD Environment Policy Paper No. 14. 14.
[48]OECD. (2018). Climate-resilient Infrastructure. Policy Perspectives. OECD Environment Policy Paper No. 14. 14.

Energy	Decreased efficiency of solar panels	Submersion of coastal infrastructure systems such as generation, transmission and distribution	Decreased output in hydropower generation	damage to assets such as wind farms and distribution networks
	lower efficiency from thermal power plants due to limitations in cooling water temperatures		interruption of energy supply due to flooding	Increasing economic losses due to power cuts
	increased demand for cooling		insufficient cooling water	
Telecommunication	Increasing need for cooling for data centers	Submersion of coastal infrastructure such as telephone exchanges	flooding the infrastructure damage to infrastructure due to collapse	Damage to infrastructure systems such as radio masts
Urban development	increase in cooling demand	increased risk of flooding and flooding	increased risk of drought	damage to buildings
	decrease in heating demand	changes in land use due to displacement of people living in vulnerable areas	increased risk of flooding	increase in deaths and injuries
Water	Increasing need for treatment	flooding of flooded coastal infrastructure	increased capacity requirement for water storage	increased damage to assets
	Increased evaporation in reservoirs	increase in salinity in water resources	increased likelihood of river embankments being toppled over	inadequate standards of flood protection systems
		fall in coastal protection standards		

As a result, the development of disaster-resilient infrastructure systems indirectly affects public health and welfare. In order to eliminate and minimize the risks in a possible scenario, the current situation of Bağcılar should be analyzed, appropriate actions should be determined and then implemented.

Key Findings for Bağcılar

It is possible to say that the effects of climate change will be seen as diverse and severe in a mega city like Istanbul. Therefore, some regions require increased investments to adapt infrastructure systems such as water storage, flood protection, water supply stations and sanitation mechanisms to climate change. In addition, existing building stocks, transportation infrastructures and energy systems also need to be addressed and adapted to the climate. In this context, under this title, the basic findings of the Bağcılar district regarding the infrastructure are discussed and the current situation is revealed.

The possible earthquake loss estimations report (2020) prepared by Istanbul Metropolitan Municipality in cooperation with Boğaziçi University Kandilli Observatory and Earthquake Research Institute also includes building information for Bağcılar district. In the district, 15% of the buildings built before 1980, 67% of the buildings built between 1980-2000 and 18% of the buildings built after 2000 (**Figure 42**). However, 43% of these buildings have 1-4 floors, 56% have 5-8 floors, and 1% have 9-19 floors. On the map (**Figure 43**)., the buildings in the district are coloured according to their construction years. According to the map, it is seen that the buildings in Yenigün, Yıldıztepe, Kazım Karabekir, Barbaros, Hürriyet and Çınar neighbourhoods are generally built before 1980. It is possible to say that the district, especially these neighbourhoods, is in a risky position in terms of building stock and building quality in general, both in terms of earthquakes and especially against the effects of climate change, which has increased in recent years. The high number of buildings built before 1980 and between 1980 and 2000, and the moderate and poor weight of the existing building conditions are among the factors that increase this risk.

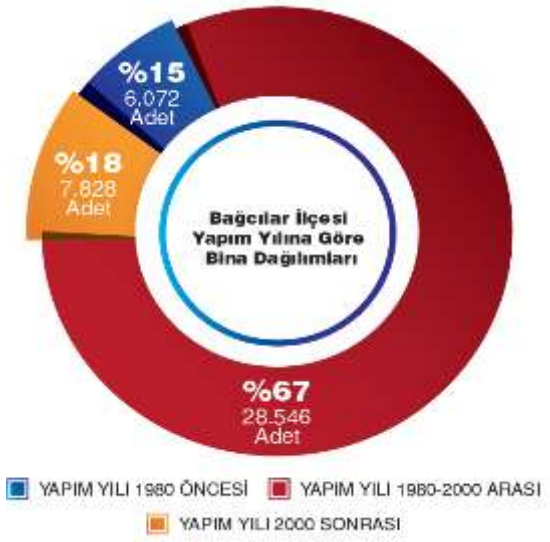


Figure 42: *Distribution of buildings by year of construction in Bağcılar district*

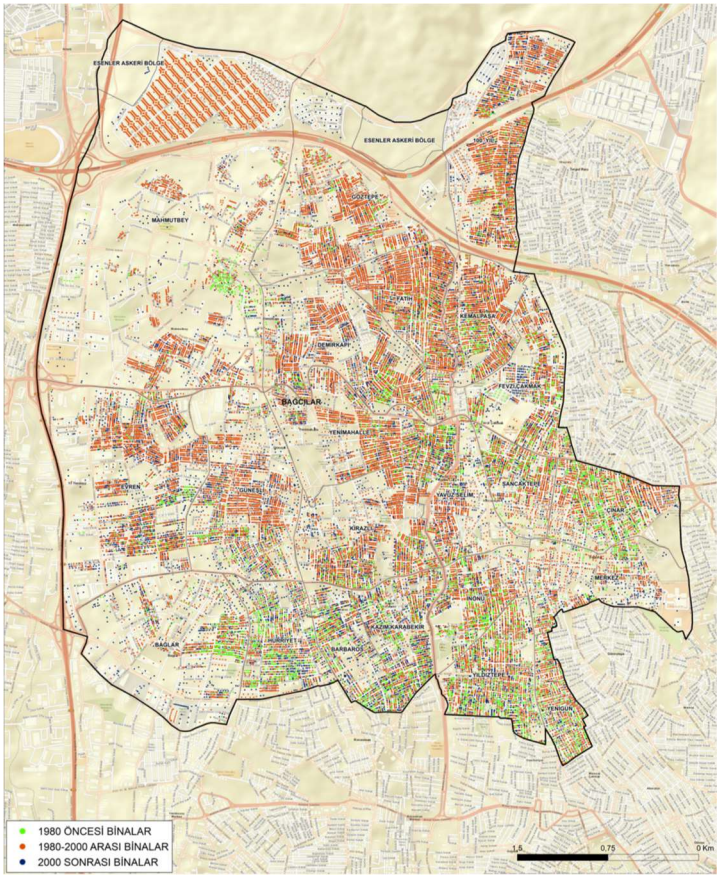


Figure 43: Building distribution map of Bağcılar district by year of construction

The study prepared by Istanbul Planning Agency according to the Project for Updating Earthquake Loss Estimates is shown in **Figure 44**. According to this study, it is revealed that the building density of Bağcılar before 2000 is quite high compared to the general Istanbul. Together with the difficulty in adapting the old buildings to the climate, the urban heat island effect is high in the areas with dense construction and the housing of people above the capacity in a small area increases the risk in terms of climate change. is one of the factors. Since the majority of the building stock situation in Istanbul is unhealthy and not capable of responding to needs, it is essential that the urban transformation laws be revised and implemented immediately both in the context of climate change risks and in terms of seismicity.

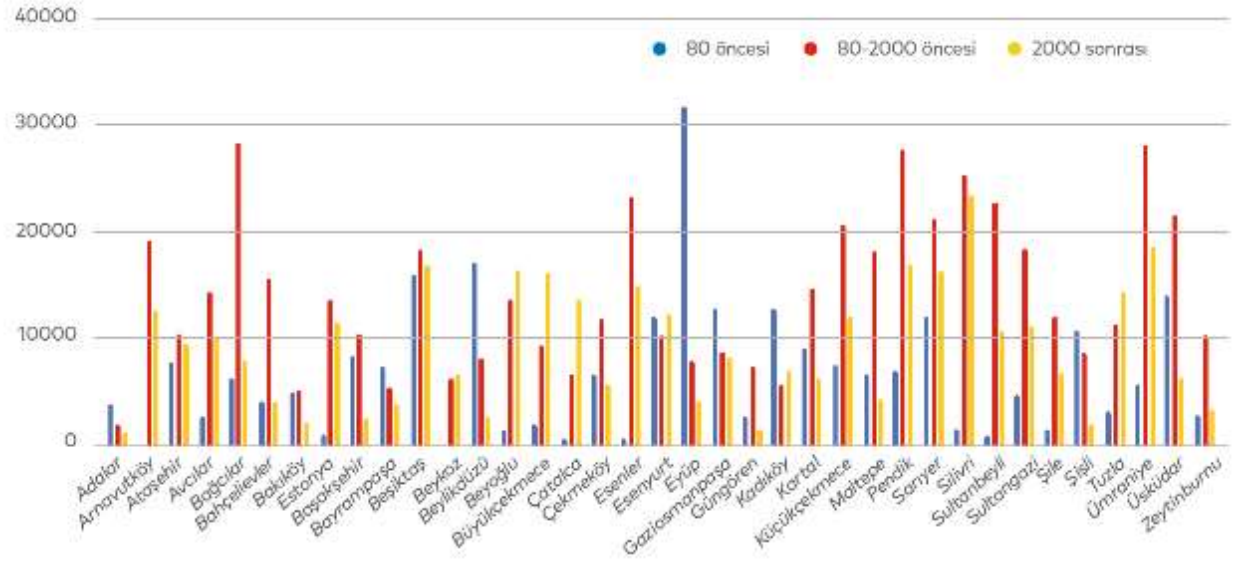


***Figure 44**: Distribution of buildings in İstanbul by year of construction and by district*[49]

When we consider the transportation sector, which is another issue for Bağcılar, it is possible to reach the district both by tram, metro, road and connecting sea. Adapting the transportation infrastructure to climate change is extremely important for Bağcılar, one of the most populated districts of Istanbul.

Apart from these, the district's dense construction and dense population increase the need for green areas at the same rate. The number of green spaces, which are extremely important for public health and to minimize the effects of climate change, should be increased. It is a necessity for Bağcılar to adapt the drainage systems in the areas close to the Tavukçu and Ayamama creeks passing through the district, as well as in other areas within the stream bed flood boundaries, according to the highest precipitation projections and integrate them with green areas. It is of great importance that the public spaces and parks in the whole district, especially the areas at risk of flooding and its İBBediate surroundings, are covered with permeable surfaces.

4.1.2 Green Infrastructure

The green infrastructure system includes applications based on spatial planning and regional development strategies for protecting and developing the natural environment and natural processes. While the green infrastructure system can be designed to provide a wide variety of ecosystem services in both rural and urban areas, it can also be expressed as a network of planned natural and semi-natural areas with environmental management features. Moreover, green infrastructure aims at multifunctionality, unlike the grey infrastructure approach, which is designed and built to serve a single purpose. Its purpose is to provide many valuable ecosystem services and products for climate change adaptation and mitigation, while contributing to the protection of biodiversity in a social, economic and environmental context. As a result, green infrastructure, materials, clean water, clean air, ecosystem services such as pollination, climate regulation, flood and flood prevention. The benefits of these ecosystem services are particularly important in densely populated urban areas and at the periphery of these areas.[50] Therefore, green infrastructure systems

[49] Housing Problem Survey: Current Situation in Istanbul and Proposals*r, Istanbul Planning Agency*
[50]*https://www.eea.europa.eu/themes/sustainability-transitions/urban-environment/urban-green-infrastructure/what-is-green-infrastructure, Date of access:January,2022.*

are an issue that must be emphasized while examining the city's current situation in the context of climate change and determining adaptation strategies.

In this case, urban green spaces, parks, nature-based solutions, green ecosystems within the city can be considered in the green infrastructure category. In this context while urban green areas are very beneficial in terms of society and the environment, they also contribute to the aesthetics of the city. Urban areas, which consist of natural and semi-natural areas planned with a green infrastructure system, integrate with the environment and increase the welfare level of the people living on them. In addition, urban green spaces and green infrastructure systems purify the air and water by dampening the effects of extreme weather events. In addition, green infrastructure practices also contribute to climate change adaptation by reducing noise.[51]

One of the biggest impacts of climate change in cities is the urban heat island effect, resulting from dense construction, urbanization effect and green space scarcity. Therefore, while developing a strategy to reduce the urban heat island effect, it is necessary to develop a new approach with green infrastructure systems and nature-based solutions, considering the city's land use change. It is very important to increase the green areas that are actively used in Bağcılar district, where intense construction and commercial usage areas are increasingdaily. Considering the whole of Istanbul, land use decisions should be made with the principle of adapting to climate change. However, it is a necessity to implement green infrastructure applications in districts such as Bağcılar where dense construction and population are high. Green roof, green wall, rain gardens.

Although Türkiye still acts with the approach of the amount of green space per capita, the amount of green space per capita for Istanbul in general is 2.67m2, well below the 15m2 standard. In Bağcılar district, this amount is 0.5 m2 according to 2018 data.

Key Findings for Bağcılar

Integrated green areas and green corridors cannot be observed throughout Istanbul, which are resistant to climate, where the natural areas in and around the city are protected and the sustainability of the ecological balance is ensured. With the effects of climate change, a holistic and sensitive to climate change green areas approach is adopted instead of the approach to the amount of green areas per capita in the world. In this regard, Bağcılar district is one of the districts that suffer from green space deprivation. The population and the high density of buildings increase the need for green space in the district. The land use map of the district, which has a very low amount of green space even in the current situation is shown in **Figure 45**.

It is known that there were no children's parks within the borders of Bağcılar Municipality until 1993. According to the data in 2018, 159 playgrounds were added to the district. Again, according to the data of the same year, the amount of green space per capita was measured as 0.5m2.[52]. This rate is extremely low both in terms of public health and in terms of reducing the effects of climate change and adapting to its effects.

[51]Tabanoğlu, O., Climate Change Adaptation Strategies Proposal for Antalya, Istanbul Technical University, Master Thesis, 2018, p:77

[52] *http://m.bagcilar.bel.tr/icerik/35/140/bagcilar-ve-parklar.aspx, accessed on: January, 2022*

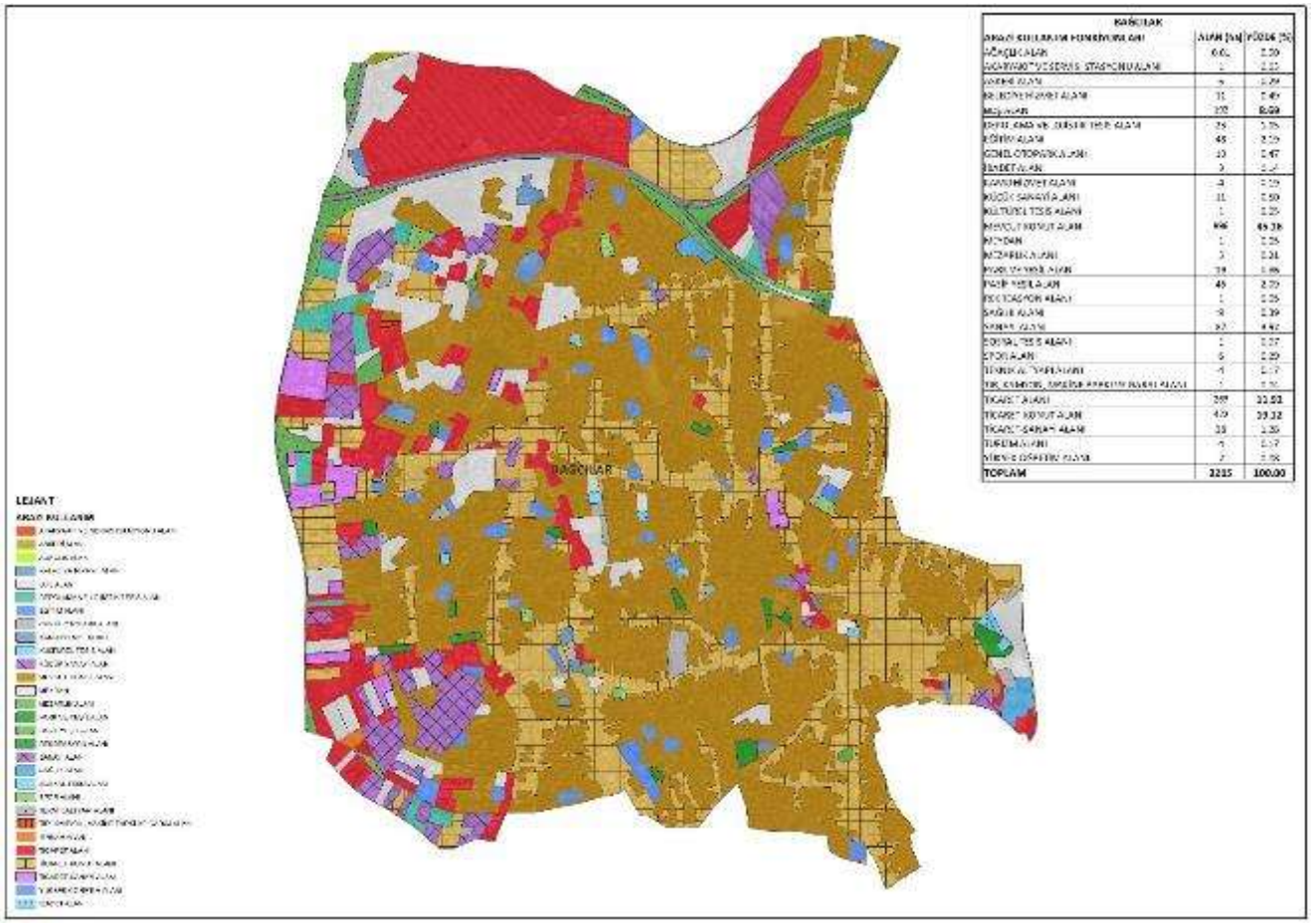


Figure 45: *Bağcılar land use map*[53]

As a result, a city's green accessibility and actively used green space capacity are very important in combating climate change. In this respect, one of the primary goals of Bağcılar district is to increase green infrastructure applications throughout the district and to increase the resilience of the district against climate. Establishing green corridors and connecting green areas, especially in areas where transportation axes and stream beds are located, should be among the practices that need to be addressed first.

4.1.3 Water Management

While water is a prerequisite for life on earth, it is one of the basic building blocks for sustainable development. Safe drinking water and sanitation[54] care is a basic human right. Clean water is critical to socio-economic development, food security and healthy ecosystems. However, clean water is a vital requirement for reducing the global disease burden and improving and protecting community health, well-being and productivity. Another issue that scientific studies have revealed and that we have started to experience frequently in recent years is that climate change increases the variability in the water cycle. While this situation reduces the estimates of the amount of available water resources and the predictability of water demand, it affects water quality, increases water scarcity

[53] *https://sehirplanlama.ibb.istanbul/bagcilar-ilcesi/, Retrieved January 2022*
[54] *Ensuring the continuity of hygiene conditions*

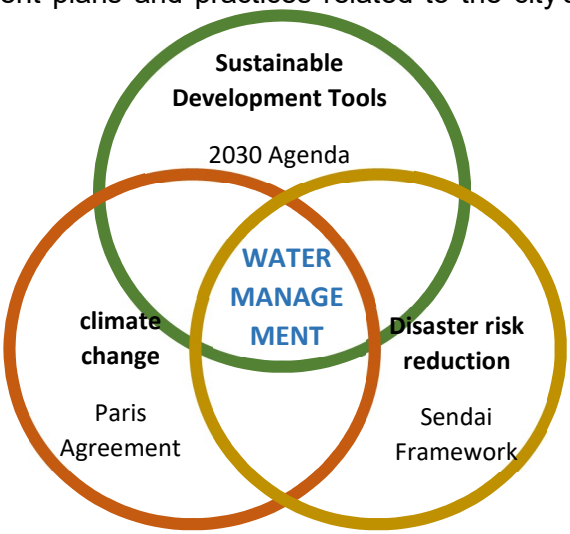
and threatens sustainable development. Poor and vulnerable communities are disproportionately affected by these hazards.

The issue that the climate change crisis is felt most intensely by the whole society is water. The decrease or pollution of water used in many sectors such as energy, industry, agriculture, food, health, transportation creates an environment that directly affects the structure of the society and public health. Population growth, urbanization, uncontrolled migration, land use changes , economic developments, declining soil health, population growth, accelerated and uncontrolled groundwater extraction, widespread ecological degradation and losses in biodiversity reduce water supply and increase water demand, thus posing a major risk in terms of sustainability of resources. In addition, the land use changes that these developments will create will lead to environmental, natural and geomorphic changes and create environments that will trigger the differentiation of climatic events and the transformation of these events into crises.[55]

Water Systems

The importance of water is emphasized in many international conventions and framework programs prepared in the context of climate change. Moreover, it is stated that attempts to adapt water resources such as fresh water, coastal water, groundwater and rivers to climate change should be put forward as the first priority. Therefore, building water climate resilience in the national context and ensuring the management of water resources should be among the priorities of adaptation.

Considering all these, investments in water systems and water management and efforts to adapt these systems to climate change will create a serious opportunity for the protection of water resources. In order to consider the water management strategies of cities in the context of adaptation to climate change, it is necessary to make evaluations at both the urban and regional scales. The management and protection of water resources should primarily be provided by laws on a national scale, and climate resilience at lower scales should be ensured with a holistic approach. In this respect, watershed protection plans, water management plans and practices related to the city's water management should be considered together and meticulously and evaluated according to climate adaptation criteria.



Considering the district of Bağcılar, where the construction density of Istanbul is quite high, in these contexts, water management should be provided in accordance with climate change.

Key Findings for Bağcılar

According to the latest studies of MGM, the Marmara Region and the province of Istanbul are at extreme risk in terms of drought and flooding. It is important to provide climate resilience at the basin scale, at the regional scale and at the urban scale related to these two issues that directly concern water management, and to revise the necessary legislation in terms of water management in the context of harmonization. As a result of the urbanization process of the region and the fact that Istanbul continues to grow by turning into a city without an end, it requires an upper-scale evaluation of the use of water resources and water management. The preservation

[55]Climate Change and Water UN-Water Policy Brief, 2019

of natural habitats and the protection of existing natural water resources are extremely important in terms of resilience to the negative effects of climate change and water management.

Therefore, it would be more accurate to analyze the main findings of water management for Istanbul and Bağcılar starting from the basin scale. Within the scope of this study, the Project of Preparation of the Marmara Basin Flood Management Plan, Strategic Environmental Assessment Scoping Report (2021) is discussed. The report prepared by the Ministry of Agriculture and Forestry discusses the current environmental, economic and social aspects of the basin. Existing risks and related issues explored for the watershed protection plan covered in the report is provided in **Table 35**.

In the Marmara Basin, where the entire district of Istanbul and therefore Bağcılar is located; Balıkesir, Bilecik, Bursa, Çanakkale, Edirne, Kırklareli, Kocaeli, Sakarya, Tekirdağ and Yalova provinces are all and/or partially included. Çanakkale constitutes 28.24% of these rates, İstanbul (22.76%), Kocaeli 13.04%, Kırklareli 8.37%, Tekirdağ 8.11%, Bursa 7.62%, Balıkesir borders 5.82%, Yalova 3.39%, Edirne 2.25%, Sakarya 0.23% and Bilecik 0.18%. The total population of the basin was determined as 19,042,576 according to TUIK data (2020). However, the population density across the basin has been calculated as 810 persons/km2, which is well above the Türkiye average of 109 persons/km2.[56]. When we approach the Istanbul part of the Marmara Basin, the streams passing through the city and nearby cities is shown in
Figure 46. The part where Bağcılar is located can be seen on the map number two in the figure.

Table 35: *Watershed protection plan potential key issues and special considerations[57]*

Potential Key Issue	Special Concerns
Water resources	• The flood disaster changes the physical and chemical properties of the existing surface and ground waters,
	• The impact of the flood disaster on structures connected to water resources (dam, pond, irrigation canal, etc.),
	• The spread of pollution caused by unconscious agriculture and intensive use of pesticides as a result of flood disaster.
Population and Human Health	• Effects of pollution spreading due to flood disaster on human health,
	• Loss of life and property (housing, workplace, etc.) as a result of flood disaster,
	• Failure to form a collective memory about flood,
	• Effect of flood disaster on drinking and utility water.
Socio-Economy	• Economic losses due to flood disasters (agricultural areas, industrial areas, industrial areas, workplaces, property losses),
	• Unemployment triggered by the economic activity affected by the flood disaster,
	• Negative impact of tourism elements due to flood disaster.
Climate Change	• Periodic changes in the hydrometeorological structure triggered by the flood disaster
	• Water holding structures (dam, reservoir, dam, etc.) built to prevent flood disaster trigger climate change.
Geology and Soil	• Formation of soil pollution due to flood disaster
	• Creation of rift,
	• Flood and landslide disasters trigger each other,
	• The effect of the flood disaster on topographic features,
	• Loss of topsoil due to flood disaster.
Land Use and Infrastructure	• Unplanned and uncontrolled urbanization
	• Inadequate urban infrastructure,
	• Filling problems at the points where streams reach the sea,
	• Building structures that can change the river regime,

[56]Agriculture, PTC, & Forestry, VE (2021). Strategic environmental assessment scoping report for the Marmara Basin flood management plan preparation project.
[57]Agriculture, PTC, & Forestry, VE (2021). Strategic environmental assessment scoping report for the Marmara Basin flood management plan preparation project.

	• Restriction of sloping areas suitable for settlement, low sloping areas generally located on alluvial soils,
	• Increasing negative effects of flood disasters as a result of human interventions in stream beds and structuring in these beds,
	• Incomplete cadastral plans,
	• Defects in power sharing between institutions in expropriation studies,
	• Artworks built without considering long-term meteorological data,
	• Unplanned agricultural production areas (predominantly tea and hazelnut production areas).
Weather	Due to the destruction of industry and industrial establishments as a result of the flood disaster
	The emergence of unexpected emissions.
Ecosystems and Biodiversity	Habitat and species destruction/loss due to flood disaster,
	• Destruction/destruction of endemic/protected/sensitive species and/or habitats in the region due to flood disaster,
	• Affecting the aquatic ecosystem due to the changing river characteristics as a result of the flood disaster,
	• Impact of flood prevention structures on terrestrial and aquatic biodiversity.
Historical and Cultural Heritage	• The destruction of cultural and historical heritage sites and structures by the flood disaster.
Landscape	• The destruction of the landscape elements in urban areas by the flood disaster,
	• Neglecting (eg destroying) landscape elements when constructing flood prevention structures.

According to the report prepared by Istanbul Development Agency in 2020; 1.5 million people live in the city's vital water basins. However, the irregularly built settlement area was calculated as 8,829,37 hectares.

When we look at the city scale from the basin scale, it is seen that the Istanbul Drinking Water and Sewerage Master Plan Preparation Work for Istanbul, the Draft Scoping Report (2021) was prepared by İSKİ. The purpose of the report is to make water, rainwater, and wastewater services environmentally sustainable within the provincial borders of Istanbul, and to develop these services in the long term in the context of social benefit and to contribute to this development financially and institutionally.

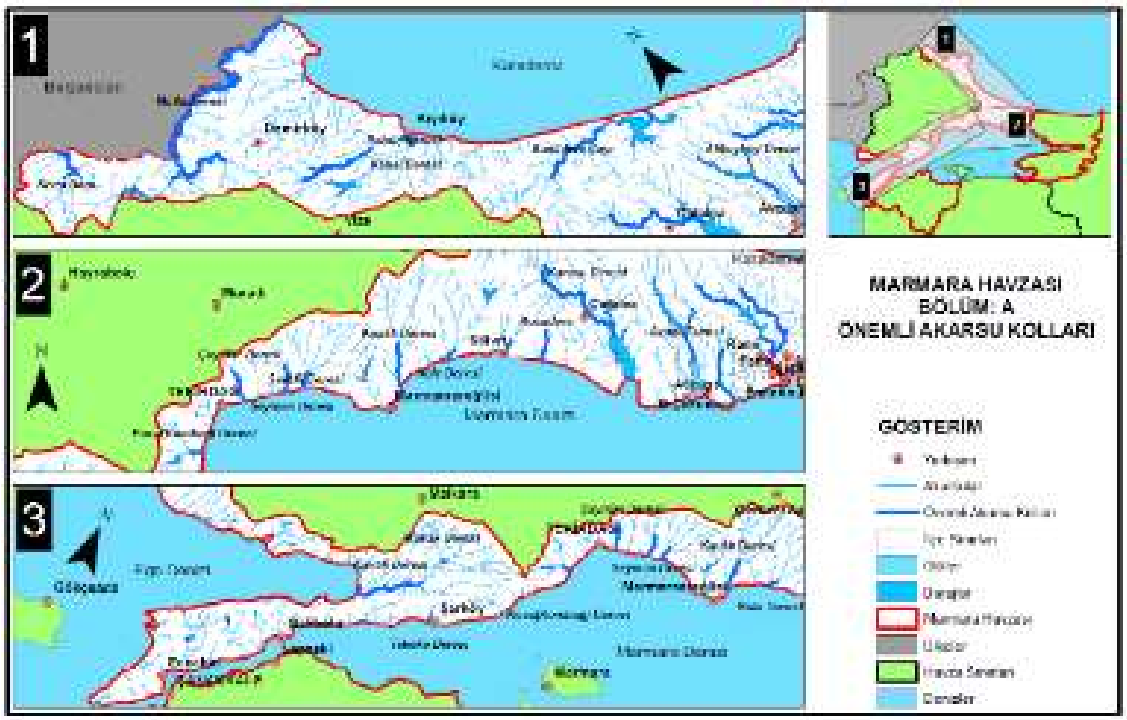


Figure 46: Important rivers in the Marmara Basin

According to this report prepared by İSKİ, 98% of all water resources within the provincial borders of Istanbul consist of above-ground resources. There are 14 of these above-ground springs as Darlı, Ömerli, Elmalı-2, Alibeyköy, Sazlıdere, Büyükçekmece, Terkos, Düzdere, Kuzuldere, Büyükdere, Elmalıdere, Sultanbahçe, Kazandere, Pabuçdere (**Table 36**). These water sources supply water to the city with storage and/or regulators. In addition to this, the map of underground water resources within the borders of Istanbul is shown in **Figure 47**.

Table 36: Accumulation volume, water amount and occupancy rates of water resources (31.12.2019), Istanbul 2019 EDP, 2020

Water supply	Maximum Storage Volume (million m3)	Amount of Available Water (million m3)	Solidity ratio (%)
Elmalı	9.6	6,502	67.73
Terkos	162.3	79,937	49.27
Alibeyköy	34.1	14,852	43.5
Ömerli	235.4	90,162	38.31
Darlık	107.5	52,398	48.74
Büyükçekmece	148.9	50,597	33.97
Sazlıdere	88.7	29,344	33.07
Istrancalar	6.2	1,544	24.78
Kazandere	17.5	0.785	4.51
Pubuçdere	58.5	1,753	3
Total	**868.7**	**327,874**	**37.74**

In addition to underground resources, many water wells are used for irrigation, industry, utility and drinking water in the province. There are 902 water wells on the Asian side and 2405 water wells on the European side. Finally, there are 21 drinking water treatment plants in Istanbul. The network line length is 19,518 km.

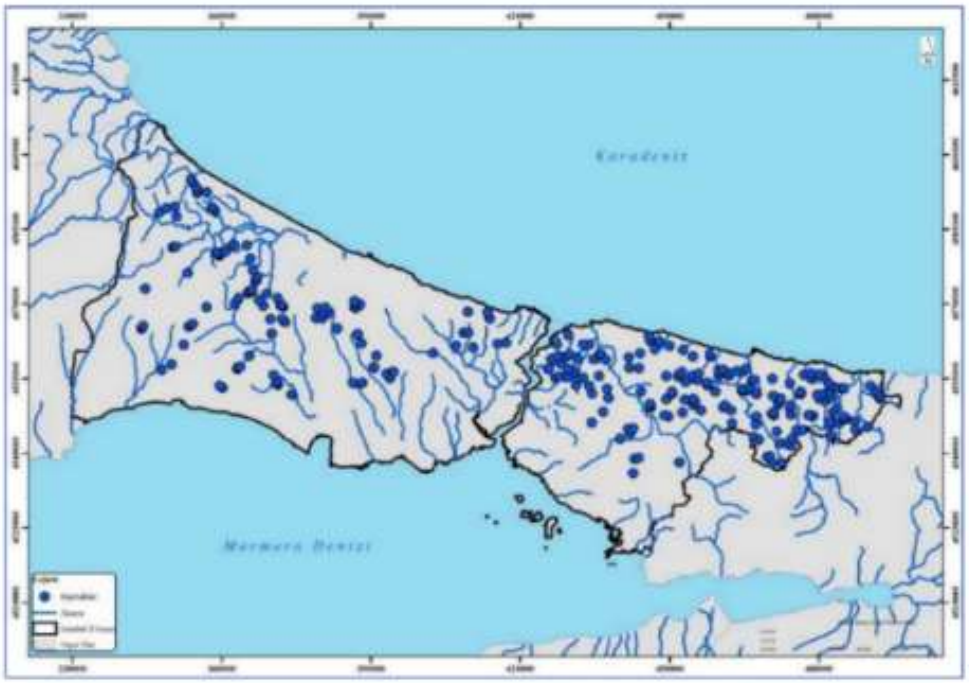


Figure 47: *Groundwater resource map*[58]

The altitude of the region where Bağcılar district is located increases towards north. As you go south, ridges separated by valleys are observed (**Figure 48**). The water beds passing through the mentioned valleys are the Ayamama Stream and Tavukçu Stream, Çinçin Stream, Ayvalidere and Cicoz Stream passing through the western border of Bağcılar. Alibey Dam and Pond, one of the important drinking water resources of Istanbul Province, is also located within the boundaries of the region.

According to the results, İSKİ's data[59] an average of 2 million 800 thousand m3 of water is consumed per day in Istanbul. It is stated that this figure is around 3 million 100 m3 in summer months and 2 million 800 thousand m3 in winter months. According to the examinations made by İSKİ, the district with the highest water consumption in Istanbul was determined as Küçükçekmece. Küçükçekmece district, Ümraniye district and Bağcılar district follow it. It is stated that the monthly water consumption of the three districts corresponds to 13.43% of the monthly water consumption of Istanbul.

[58]Ortak, MP (2021). Preparation of Istanbul drinking water and sewerage master plan. 5.

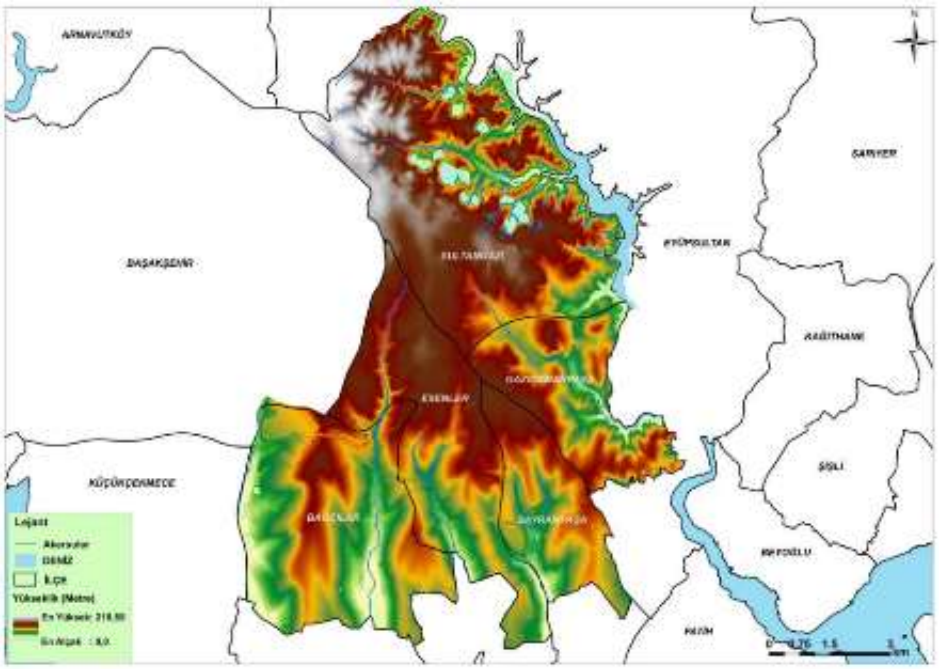


Figure 48: *Digital elevation model of the region, Landslide Awareness Booklet, İBB, 2020*

4.1.4 Waste Management

Waste management, one of the basic services provided by every local government, is affected by climate change both directly and indirectly. Inappropriate waste management makes it difficult to cope with climatic disasters, and negatively affects the adaptability and climate resilience of the city. For example, drainage systems that are clogged due to wastes as a result of excessive precipitation cause the floods to intensify. Therefore, all new and existing waste management systems should be designed to be resistant to climate change. The effect of climatic events that occur with the effects of climate change on waste management is shown in **Table 37.** This table shows the effects of temperature change, flood, sea level rise, storm and wind news on waste management, which Istanbul is frequently faced with and which is expected to increase in frequency. According to this table, it is seen that all areas related to waste management such as transportation, infrastructure and public health are exposed to these effects throughout the whole process. In addition to this table, wastewater systems are the most vital issues in waste management . While wastewater systems provide a critical service to society, they are also very important in direct public health, vulnerability and clean water availability issues against the effects of climate change.

The effects of climate change on wastewater systems are many and varied (**Table 37**). According to the study by Hughes et al. (2020), three main climate change impact themes for wastewater networks are revealed. These effects are severe flood leakages and odor, deterioration of water quality due to increased uncontrolled discharges and damage to infrastructure systems. It is stated that the İBBediate and long-term effects are likely to occur in social, economic, cultural and environmental areas.[60]Therefore, making wastewater systems resistant to climate is extremely important both in terms of environmental awareness and public health.

[60]Hughes, J., Cowper-Heays, K., Olesson, E., Bell, R., & Stroombergen, A. (2021). Impacts and implications of climate change on wastewater systems: A New Zealand perspective. In Climate Risk Management (Vol. 31). Elsevier BV https://doi.org/10.1016/j.crm.2020.100262

Table 37: The effect of climatic events on waste management[61]

Climatic events	The effect of climatic events on the waste process		
	Waste collection	Waste management	Waste disposal
Heat	• As odor and pest activity increase, the frequency of waste collection also increases. • Vehicles are damaged as a result of overheating of collection vehicles	overheating of separation equipment	• Waste decomposition rates may be affected. • Maintenance and construction costs may increase due to changes in the soil. • The risk of fire increases in landfills, especially during periods of drought.
	workers are more exposed to flies, which are the main cause of infectious diseases (flies breed more in hot weather and are attracted to organic wastes)		
Flooding	• The inundation of collection roads and storage access roads renders them inaccessible. • Stress is increasing on collection vehicles and workers due to waste. • Waste thrown out to be collected flows into the streets and waterways.	Increasing need for closed or semi-enclosed separation plants	• Increased risk of flooding in and around waste facilities • The leachate that needs to be collected and treated is increasing. • Due to heavy rain, the rate of leakage and leakage in landfills increases.
Sea level rise	• Waste collection routes can be narrowed • The fact that people move their living spaces in urban areas to higher altitudes potentially causes an increase in waste in a dense area.	• Processing plants close to sea level suffer damage. • The need for sorting and recycling is increasing to minimize waste storage needs.	• Deterioration of the impermeable lining occurs. • Water seepage into the pit causing possible waste overflow.
Storm and wind	• Collection, processing and disposal infrastructure can be permanently submerged. • Roads, railroads and ports may overflow for waste collection, separation and disposal, temporarily reducing access to them. • Facilities may close due to infrastructure damage. • Waste can be dispersed from collection areas and vehicles, from handling areas and landfills. • Access to collection and storage routes is reduced due to damage and debris. • Significant waste generation may occur due to damage, debris and emergency response (tent, disposable materials, etc.) • Extreme events can also pose a risk by affecting other infrastructure systems to which a waste facility or system is connected. Ex. Electricity is needed to follow computer-based processes such as waste collection and access to facilities. If the electrical infrastructure is damaged, these processes are also interrupted.		

As a result, waste management and waste systems are issues that need to be systematically improved and developed in terms of limited consumption of natural resources, production of energy

[61] *https://www.c40knowledgehub.org/s/article/Reducing-climate-change-impacts-on-waste-systems?language=en_US. Accessed on: October, 2021*

from waste and making waste systems resistant to climate. In the eyes of the society, it is necessary to determine the policies to create the least waste in homes, workplaces and institutional structures. It is also important in terms of social awareness and motivation that local municipalities carry out campaigns and practices related to this. As a result of all these, both public health will be protected and in case of a possible disaster, if the harmonization process is carried out, less danger will be encountered and repairs will be provided at less cost.

Key Findings for Bağcılar

Planning and implementing waste management in a way that is sensitive to climatic risks is very important for cities such as Istanbul with a large population. It is important to adapt the waste disposal processes to the climate at the optimum level and to generate energy from the residues by creating suitable conditions. The waste can be recycled in several ways, including resell, reuse, and donation. Recycling is an effective way of reducing the cost of collecting, transporting, and treating the waste, as well helps preserve the environment and decreases resource depletion. Recycling increases the life of landfills or an incinerator used for solid waste treatment and generates revenue for recyclers.[62] . District municipalities such as Bağcılar, waste disposal processes gain importance in terms of garbage collection, waste separation and transportation of wastes to facilities. It is also important to raise citizens' awareness on waste separation and recycling and to carry out campaigns that emphasize the importance of ensuring waste separation at home.

According to the report of İSKİ, there are 88 wastewater treatment plants under the responsibility of İSKİ within the borders of Istanbul. Wastewater reaches the waste water treatment plants through tunnels and collectors. The treated water is discharged from 6 of these facilities to the Bosphorus, 30 to the Black Sea, 18 to the Marmara Sea and 34 to lakes or ponds. These discharge details are quoted from the report. It is shown in **Table 38**. However, in the report of İSKİ, it is stated that there is a waste water collection system in most of the European Side, including Bağcılar.[63]

__Table 38__: Increasing type of treatment plants, capacity distribution according to discharge method (IMP-OG, 2020c)

Discharge point and discharge type	Biological treatment (m3/day)	Advanced biological treatment (m3/day)	Pre-treatment (m3/day)	Total (m3/day)
Bosphorous			3.614.600	3.614.600
Deep sea discharge			3.614.600	3.614.600
Black Sea	24.150	200.000	46.000	270.150
Sea discharge	24.150	200.000		224.150
Deep sea discharge			46.000	46.000
Marmara Sea	14.450			
Sea discharge	14.450	1.000.000		1.014.450
Deep sea discharge		539.000	354.000	893.000
TOTAL (m3/day)	38.600	1.739.000	4.014.600	5.792.200

[62] Soomro, Y.A.; Hameed, I.; Bhutto, M.Y.; Waris, I.; Baeshen, Y.; Al Batati, B. What Influences Consumers to Recycle Solid Waste? An Application of the Extended Theory of Planned Behavior in the Kingdom of Saudi Arabia. Sustainability 2022, 14, 998. https://doi.org/10.3390/su14020998

[63] İSKİ wastewater report

In addition to waste water systems, Istanbul Metropolitan Municipality Waste Management Directorate provides city-wide information about the solid waste disposal process . A total of four transfer stations, namely Baruthane, Halkalı, Yenibosna and Silivri, on the European Side where Bağcılar district is located; There are also two regular storage areas, Odayeri and Seymen, where solid wastes are transported. In addition, the scheme showing the collection and separation of the wastes of the district municipalities within their borders and then the İBB taking over the service is shown in **Figure 49**.[64]

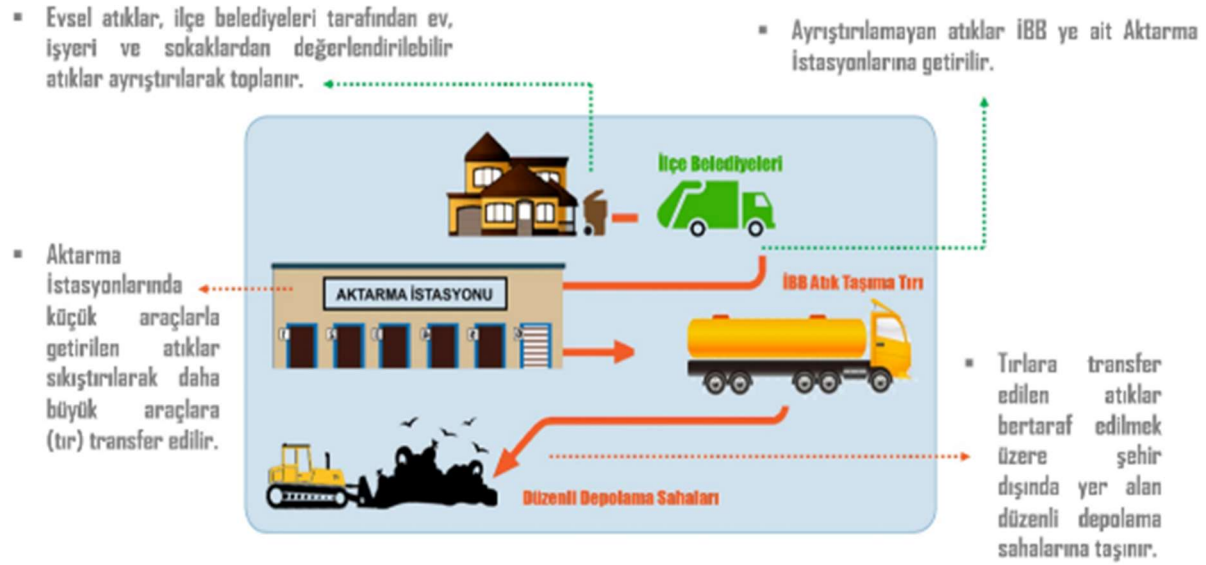


Figure 49: *Waste transportation services in İstanbul*

According to the information obtained from the waste management website of the Istanbul Metropolitan Municipality, it is possible to access the information that electricity can be produced from landfill gas. In this context, the electricity produced in 4 different facilities meets the electricity of 300 thousand households.

There are also studies for recyclable wastes in Bağcılar District. Bağcılar Municipality carries out studies to eliminate the damage caused by Waste Vegetable Oils to nature and to obtain bio-energy fuel. As a result of the studies carried out by the local administration on this subject, all tables in the district were notified and they were provided with an annual vegetable waste oil contract. It is stated that studies for households are at the project stage. Within the scope of the Packaging Waste Recycling Project, a Packaging Waste Implementation Plan has been prepared so that packaging waste can be collected separately at the source, in line with the Packaging Waste Control Regulation of Bağcılar Municipality. In line with this plan, Packaging wastes are collected from all public institutions, neighborhood mansions, hospitals and health units, schools, large shopping malls and housing estates and from all households (**Table 39**). Studies are carried out within the scope of raising awareness in schools in the region where the study was conducted; It is stated that 166.775 students have been informed since 2006.

[64]https://atikyonetimi.ibb.istanbul/atik-yakma-ve-enerji-uretim-tesi/

Table 39: Amount of packaging collected within the scope of Packaging Waste Recycling Project, Bağcılar Municipality

Year	Amount of Packaging Waste Collected (kg)
2006	539,514
2007	1,293,415
2008	2,033,618
2009	2,935,884
2010	5,365,290
2011	5,742,978
2012	8,661,495
2013	11,000,606
2014	11.331.202
2015	15,832,838
2016	18.959.169
2017	20,804,540
2018	21,023,840

Within the scope of the collection of recyclable wastes, the local government works on different types of waste.[65]. In this context, studies are carried out in the district for the recycling of end-of-life tires (ÖTL), clothing and battery waste. The studies carried out for 49 ÖTL producers in the region to enter into contracts with licensed recycling facilities and the waste clothes piggy banks placed in the neighborhoods throughout the district can be given as examples of these studies. Within the scope of the Garment Waste Collection Project initiated by Bağcılar Municipality in 2020, 292,930 kg of clothing waste was collected. Thus, waste clothes are collected to be used as secondary raw materials in the textile industry. Studies are carried out on the separate collection of batteries by placing waste battery boxes in schools, headman's offices, health centers, hospitals, cultural center and presidential building. In order to encourage students to collect waste batteries,

It is aimed to carry out studies on waste separation and recycling within the scope of the district with existing and new projects and to support these studies with training and information.

4.1.5 Public Health and Disaster Management

Climate change has both indirect and direct effects on public health. Extreme weather events as a result of climate change, infectious diseases, natural disasters, scarcity of water and food resources have serious and negative effects on human health. Extreme weather events such as heat and cold air waves directly impact, affecting human health and even causing sudden death. In addition, we need to show air pollution and allergens as a direct effect. Air pollution causes an increase in asthma, COPD and cardiovascular diseases, but also increases deaths. The allergens in the environment are extremely risky for human health if they are inhaled and eaten when contaminated with food.

It is possible to show infectious diseases and natural disasters as indirect effects on climate change. Changes in the ecosystem affect human health by leading to the proliferation of vectors, causing both the formation of new diseases and the re-distribution of declining infectious diseases. Another effect is the spread of infectious diseases, which can occur with the decrease in water resources

65 http://www.bagcilar.bel.tr/icerik/163/320/omrunu-tamamlamis-lastiklerin-geri-donusumu.aspx, Accessed: 27.1.2022

and the deterioration of aquatic ecosystems. Climate news such as floods, storms, and excessive precipitation that occur as a result of climate change cause injuries and deaths to people, but also increase property losses.[66]. In this context, it is essential to take more precautions in cities related to increasing natural disasters and changing disaster characteristics due to global climate change.

According to IPCC's report on disaster management (2020)[67]disasters are defined as serious changes in the normal functioning of the community or society due to dangerous physical events that interact with each other. These changes have economic, social and environmental impacts, increasing vulnerability and creating the need for urgent response and support for recovery to meet critical human needs.

The most critical risk that will occur due to increasing natural disasters and changing disaster weather events is loss of life. This is driven by lack of infrastructure, unplanned construction and poor quality of construction, while the risk will be higher for groups dependent on social support networks or restricted mobility (eg the elderly, children and the disabled). As observed in the hail event on 28 July 2017 in Istanbul, extreme weather events can also cause injuries. More severe heat waves and the increase in the need for summer cooling are other issues that will trigger health problems for groups at risk. Events such as floods and floods will facilitate the spread of diseases transmitted through food and water, while increasing temperatures will facilitate the spread of diseases transmitted by vectors. It may be possible to see new infectious diseases specific to tropical climates.

As can be seen in **Figure 50**, the occurrence of climatic events, the effects of events and exposure situations constitute disaster risk. In order to eliminate these risks or to minimize the effects of risks, it is necessary to reduce the greenhouse gas emission rates that increase the effects of climate change. In addition, it is very important to prepare and implement disaster risk management plans, and ultimately to implement climate change adaptation studies.

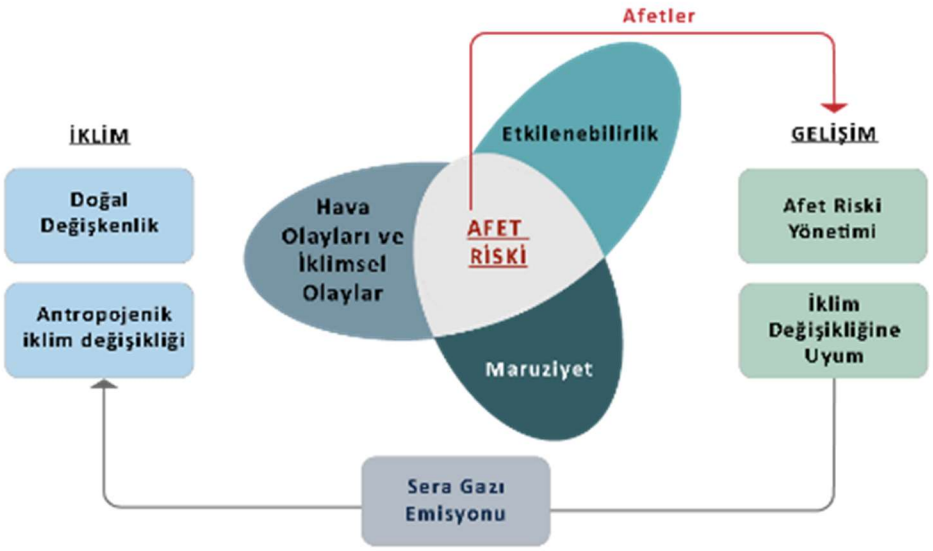


Figure 50: *Demonstration of the relationship between disaster risk management and adaptation to climate change with basic concepts*[68]

[66]Atik H., Global Warming, Climate Change and Its Socio-economic Effects, Nobel Academic Publishing, 2017, p:17.
[67]Dokken, D. (ND). Special Report of the Intergovernmental Panel on Climate Change Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation.
[68]Special Report of the Intergovernmental Panel on Climate Change Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation

Key Findings for Bağcılar

Considering Bağcılar district in terms of public health and disaster data is more difficult due to the lack of data compared to the city limits. However, albeit limited, data related to public health in Istanbul can be examined,. In this context, it is possible to make an inference for the air quality that affects human health both directly and indirectly by evaluating the measurements specific to Istanbul and Bağcılar. According to the report prepared by Istanbul Development Agency in 2020, although there are 30 measurement stations in the city of Istanbul, adequate measurements are not made for air quality. It is stated that since 2017, the highest number of deaths due to air pollution occurred in Istanbul. In addition, it was determined that 3,761 people lost their lives due to air pollution in 2019.

According to the statistics of the İBB Fire Brigade Department (2020), as of the end of 2020, 870 floods were intervened in Istanbul. It is seen that there is an increase of 37.4% compared to the previous year and 5.6% compared to 2016 (**Table 40**).

Table 40: *Demonstration of the relationship between disaster risk management and adaptation to climate change with basic concepts*[69]

Event	Year/Number						
	2016	2017	2018	2019	2020	Proportional Change	
						Year 2019-2020	Year 2016-2020
Flood/Inundation	824	1578	1280	633	870	37.4%	5.6%

Disaster management is extremely important for Bağcılar district, where construction is intense. In addition to meteorological and hydrological disasters, geological disasters such as landslides and earthquakes triggered by extreme weather events such as storms, tornadoes and excessive precipitation; While it has negative effects on public health, it also causes economic damage and service interruption on urban infrastructures (energy, transportation, etc.).

Using the data of Istanbul Province, "Landslide Information Inventory Project (2020)" prepared by Istanbul Metropolitan Municipality, Earthquake Risk Management and Urban Improvement Department in 2020; In the Landslide Awareness Booklet (2020), which evaluates the mass movements developing in the region consisting of Bağcılar, Bayrampaşa, Esenler, Gaziosmanpaşa and Sultangazi districts, detailed maps have been prepared, which have been examined according to the activity status and movement type of landslide areas. It is stated that earthquake hazards may be higher due to the fact that the region is also close to the North Anatolian Fault Line. Considering that one of the triggers of landslides is earthquakes, It is emphasized that taking precautions against landslides becomes more important especially in the southern parts of the region, where mass movements are more intense and where weak soils are located, and that ground collapses and slides should be investigated in built-up areas. Within the scope of the Landslide Information Inventory Project, 30 locations with mass movement in the region were determined. 13 of these locations are in Bağcılar district. Maps showing the movement type and activity status of the locations determined within the scope of the study were prepared.

From the locations determined in the region, it was determined that 27 mass movements developed in the heavily weathered rocks showing ground and ground characteristics, and 3 mass movements

[69]Special Report of the Intergovernmental Panel on Climate Change Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation

developed on the slopes represented by the rock environments. Within the scope of the studies, the movement types of 30 mass movements that were determined to develop in soil and rock environments; 24 slips, 2 flows, 2 falls and 2 combined; according to the activity status, 1 active and 1 sensitized; 19 remains (fossils), 1 under control and 8 potential sites were identified. The movement type of all mass movements within the boundaries of Bağcılar district is slip.(**Figure 51**); It is seen that the activity states are determined as residues (fossils).(**Figure 52**).

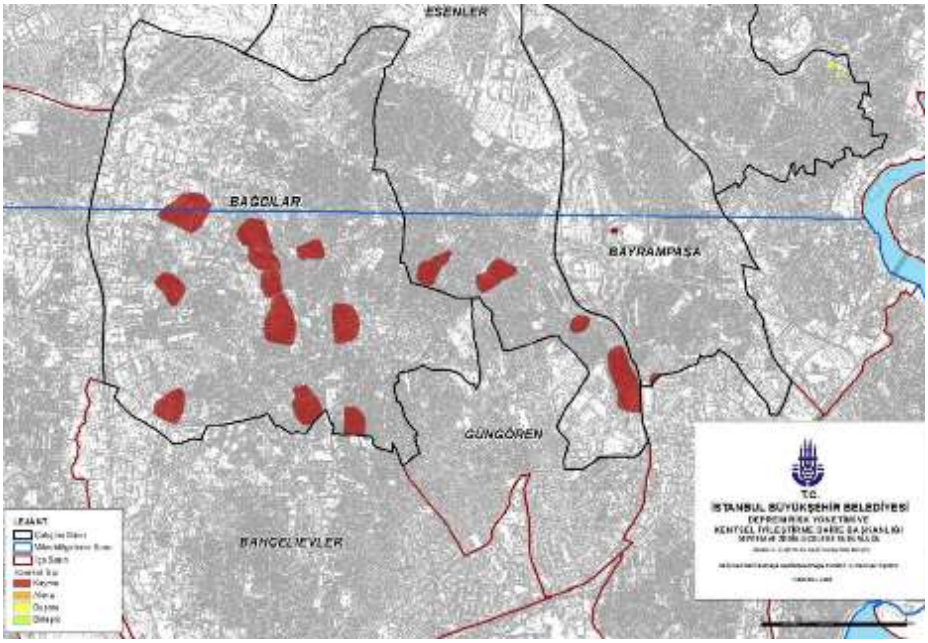


Figure 51: *Landslide Map by Action Type, Landslide Awareness Booklet, İBB, 2020*

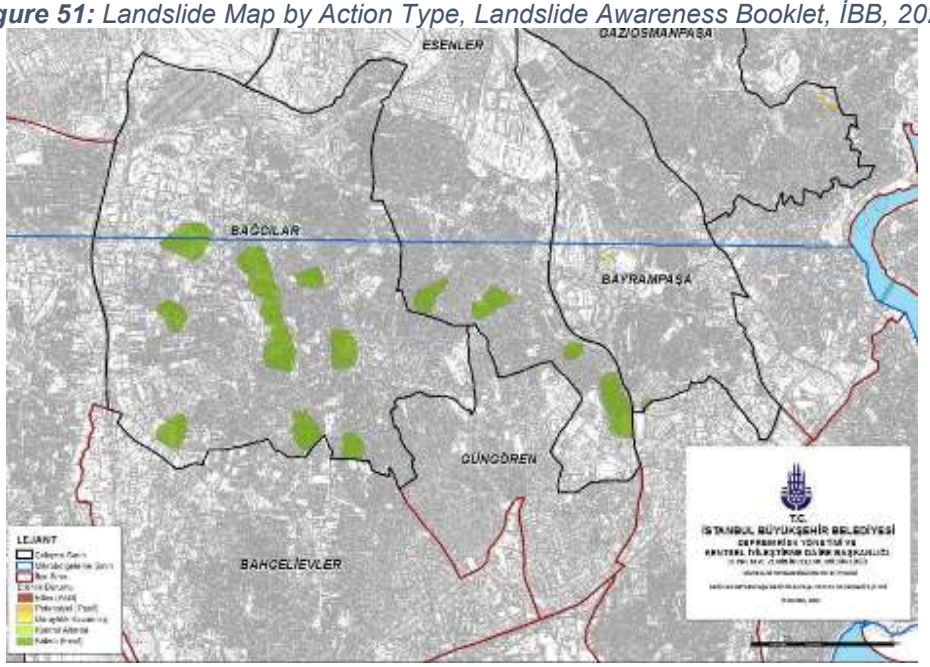


Figure 52: *Landslide Map by Activity Status, Landslide Awareness Booklet, İBB, 2020*

In 2020, Istanbul Metropolitan Municipality, Earthquake Risk Management and Urban Improvement Department, Earthquake and Soil Investigation Directorate, using the "Istanbul Province Probable Earthquake Loss Estimates Update Project (2019)" data, the earthquake hazard analyzes of Bağcılar District, urban superstructure and infrastructure elements were evaluated. “Istanbul

Province Bağcılar District Probable Earthquake Loss Estimates Booklet", has been prepared in which loss estimates are studied. In the study, the deterministic approach was taken as a basis and the results were created by using the earthquake scenario with a magnitude of Mw= 7.5.

According to the earthquake scenario in question, analysis of building damage and loss of life, the vulnerability of infrastructure systems (natural gas, drinking water and waste water pipeline), road closure analyzes and temporary shelter area need analyzes were carried out. With this study, priority risk areas and critical neighborhoods in Bağcılar were revealed and guiding data were produced in all steps of decision makers to reduce disaster risk. It has been determined that there will be 769 very severely damaged, 1825 heavily damaged, 8001 moderately damaged and 15,397 slightly damaged buildings. When the neighborhood-based building damage estimates are examined, it is seen that the most heavily damaged buildings (51-70 units) are located in Evren, Kirazlı and Yıldıztepe neighborhoods. The neighborhoods where heavily damaged buildings are concentrated (101 to 150 units) are in Evren.

Implementation of adaptation activities such as increasing urban green areas and rainwater storage within the scope of adaptation to climate change, taking into account the earthquake disaster, contributes to urban and social resilience. Within the scope of this study, the number of families that will need emergency shelter has been estimated by using the number of households in very heavy, heavy and moderately damaged houses after a possible Istanbul earthquake. It is important for Bağcılar to implement practices to increase the amount of green space within the scope of adaptation to climate change, taking into account the earthquake risk and the findings of studies on this subject. As a matter of fact, within the scope of the earthquake scenario with a magnitude of Mw= 7.5 for the region, it was predicted that a total of 59,513 people would be in need of temporary shelter in case of a possible earthquake (**Figure 53**), Yıldıztepe (4,367 ki), Güneşli (4,189 ki), Kirazlı (4,099 ki) and Demirkapı (3,443 ki) neighborhoods stand out in terms of temporary shelter needs. In terms of access to clean water for these areas, rainwater storage practices for the sustainability of water resources within the scope of adaptation to climate change can also be evaluated in terms of access to clean water within the scope of disaster management in these areas. The poor condition of the existing building stock in areas under high earthquake risk causes these areas to be more vulnerable to disaster risk and to be at high risk in terms of climate change risks. Therefore, in terms of both climatic and geological disasters, it is necessary to implement practices in Bağcılar and throughout the Metropolitan Area. In **Figure 55**, disaster risk areas in Bağcılar are shown.

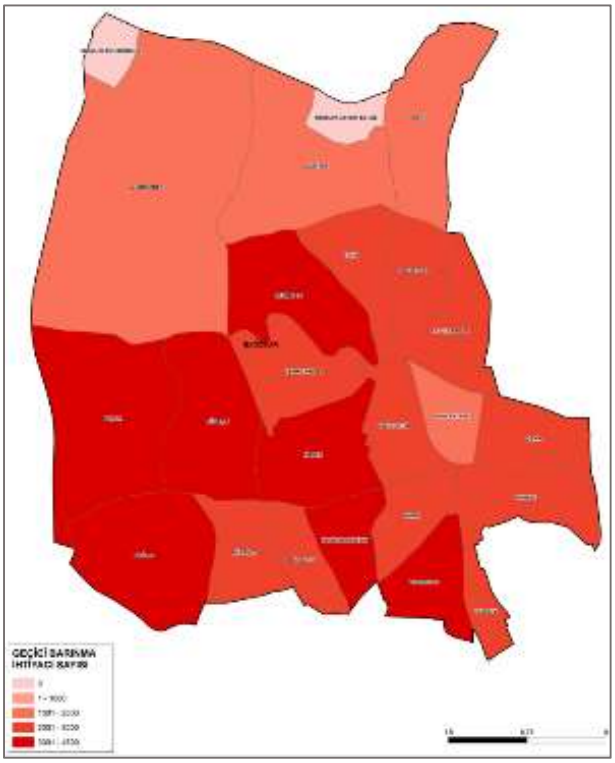


Figure 53: *Distribution Map of the Need for Temporary Housing in Bağcılar District for the Mw=7.5 Scenario Earthquake, Landslide Awareness Booklet, İBB, 2020*

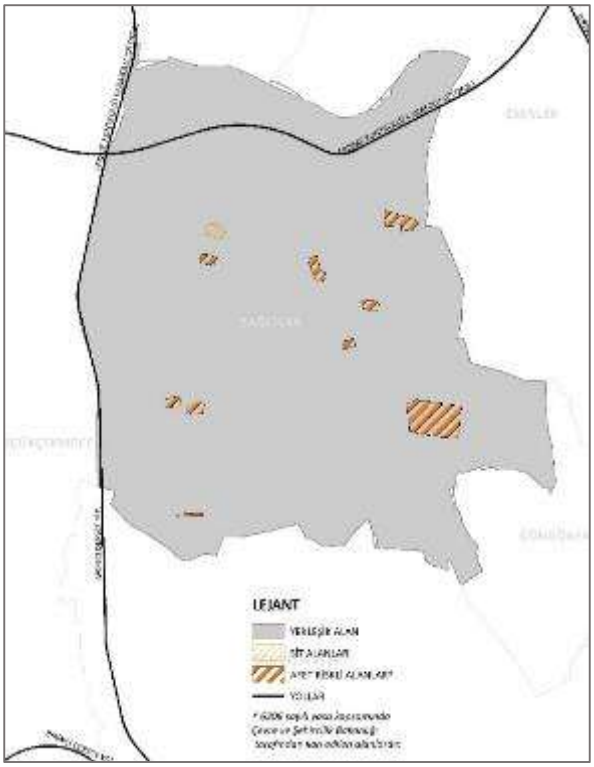


Figure 54: *Bagcilar disaster risk areas*[70]

[70] *https://sehirplanlama.ibb.istanbul/bagcilar-ilcesi/, Retrieved January 2022.*

4.2 RISK AND VULNERABILITY ASSESSMENT FOR BAĞCILAR

In terms of revealing the current situation of Bağcılar in the context of climate change; Information on infrastructure systems, green infrastructure, water management, waste management, public health and disaster management related to the basic situation of the district is given in the previous section. A detailed risk and vulnerability analysis is needed in line with the main findings in order to reveal the risks and impact areas that climate change will create in the future. The purpose of risk and vulnerability analysis is to provide an understanding of the current and future climate risks facing cities. However, this analysis will be the first step towards the development of adaptation targets and actions within the scope of climate action plans.

Climate risk arises from the combination of hazard, exposure and vulnerability. In other words, climatic hazards become climate risks when vulnerable societies or communities are exposed to a particular danger. Therefore, the need for climate adaptation plans arises. By implementing climate adaptation actions, regions and cities will develop resistance to climate-related shocks and stresses and increase their adaptation capacity. However, before developing such adaptation actions, it is necessary to analyze the risks of the region or the city and develop an understanding specific to that area. In this context, the scheme prepared by the IPCC also is shown in **Figure 55**.[71]

Therefore, a risk and vulnerability analysis has been carried out for Bağcılar district, taking into account certain flood and flood risk, extreme weather events, sea level rise, flood and drought risk headings. As a result of this analysis, the issues that need urgent action will be determined, climate adaptation actions will be determined and suggestions will be put forward for Bağcılar to adapt to climate change.

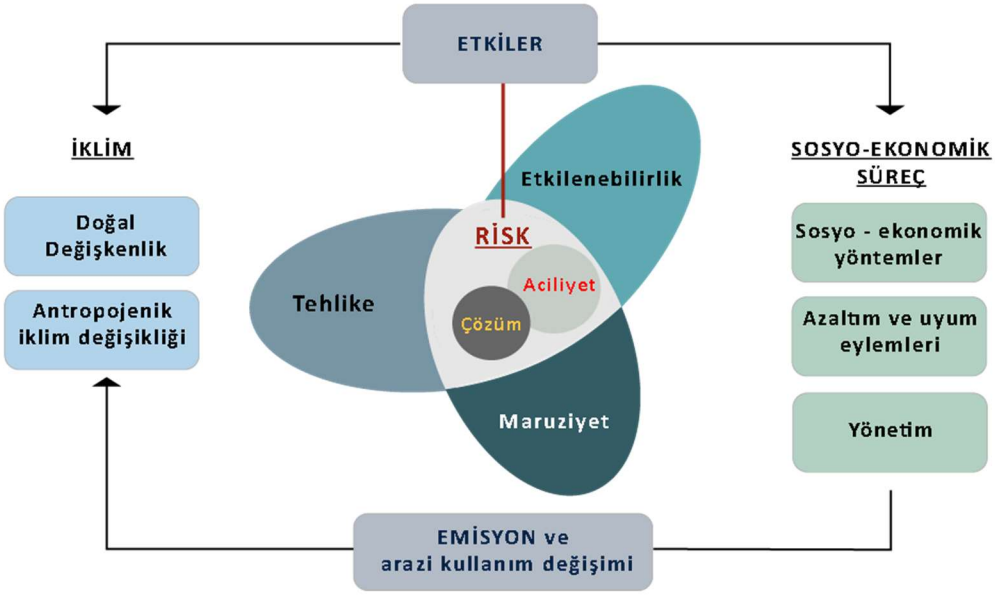


Figure 55: *Demonstration of a combination of climate risk, hazard, exposure and vulnerability (IPCC, 2012)*[72]

[72] *Climate Risk and Vulnerability Assessment Methodology Climate Risk and Vulnerability Assessment (CRVA) Methodology, https://toolkit.climate.gov/tools*

4.2.1 Methodology

The methodology to be applied in this study was determined according to the CoM risk and vulnerability assessment and climate change risk and vulnerability assessment methodologies used in the Ireland – Fingal Climate Change Action Plan 2019-2024. The first step for climate change risk and vulnerability analysis is to present a projection for different climatic disasters. These climatic disasters are listed in detail in section 2.1 of the report. Istanbul – The climatic events handled for Bağcılar have been chosen considering the the district's and Istanbul's risks. In this direction, disaster titles are determined as extreme weather events caused by variables such as hail and storm affecting Bağcılar, and flood and overflow risk. In addition to these, although Bağcılar district does not have a coastline,

The areas and sectors where these climatic events will be effective have been discussed in detail in the previous section where the current situation of Bağcılar is revealed. These sectors and areas were identified as infrastructure systems and transportation, green infrastructure, water management, waste management, and public health and disaster management. These selected areas also reflect the action areas to be addressed within the scope of the climate change action plan. The result of the risk and vulnerability analysis will determine priority issues for Bağcılar and guide the development of actions for emergency response areas. In this regard, in order to reveal risky situations for Bağcılar, the probability of occurrence of the hazard and the exposure situation should be evaluated. With this assessment, the level of risk will be obtained.

Risk is a function of the probability of a hazard effect and the overall outcome of the exposure situation (Risk = Exposure x Probability). Accordingly, it is ensured that the systems, assets and groups most at risk are prioritized by focusing on the most vulnerable.

Exposure Score	**x**	**Probability Score**	**=**	**Risk Level**

The results can also be expressed as an estimate of the disruptions caused by climatic disasters and variables. The scoring matrix for this formulation is shown **Table 41**. The methodology calcifies risk levels are calculated by assigning points from 1 to 5 to both probabilities and exposures. The exposure score shows the effects that will occur as a result of climatic events. These impacts were rated as mild, moderate, significant and critical. On the other hand, the degree of probability , expresses the predictions of the occurrence of the climatic event. These rating values are stated as rare, unlikely, possible, likely, and almost certain. Finally, the level of risk revealed by the evaluation of these two situations, reveals the areas of the district that need to be addressed urgently. The risk level is graded with 1-6, 7-14 and 15-25 point intervals, which is obtained by multiplying the exposure and probability situations scored from 1 to 5.[73] The status of the risk level is shown according to the colors in **Figure 56**.

[73]The calculation method and methodology details in this section; Adapted from the climate change action plan report made between the years 2019-2024, it was transferred to Ireland- Fingal.

Table 41: Exposure scoring matrix

Consequences of damage and/or risks caused by a climatic event:			*Probability of risks occurring in the future:*			*Level of risk that means it needs to be addressed urgently:*	
Exposure Score			**Probability Score**			**Risk Level**	
Critical	5	x	Almost certain	5	=	High	[15-25]
Important	4		Probable	4		Middle	[7-14]
Medium	3		Possible	3		Low	[1-6]
Low	2		Unlikely	2			
Negligible	1		Rare	1			

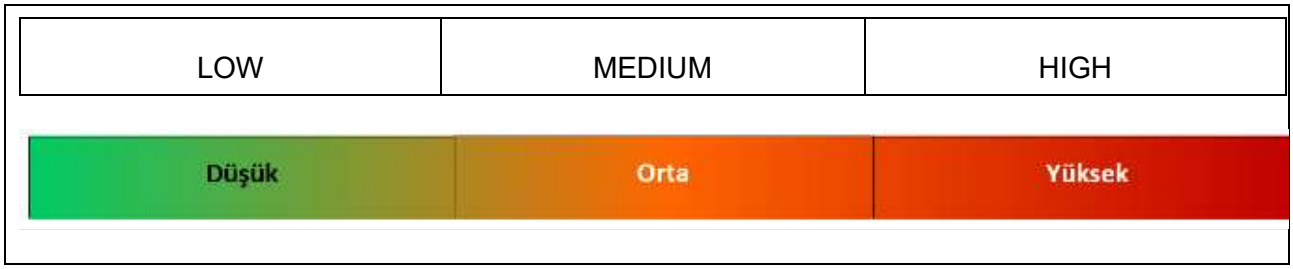


***Figure 56:** Risk level by grading color*

The impacts of the identified risks are provided in**Table 42**.

4.2.2 Conclusion

Bağcılar's climate change risk and vulnerability analysis table determined in conjunction with the workshop held on 29 December 2021. In the workshop, where the methodology of risk and vulnerability assessment was explained in detail, the participants were able to determine the risk and impact areas for Bağcılar. Issues such as heat and cold weather waves, extreme weather events, water scarcity, indirect and direct effects on public health, and sea level rise were also evaluated as climatic hazards. As a result of this study and the main findings, Bağcılar's risk and efficacy assessment results rated are given in the tables **Table 43**, **Table 44** and **Table 45**.

Table 42: Climate risk matrix to identify future risks

CONCLUSION					
	Asset damage/ Engineering casualties	**Health & Security**	**Environment**	**Priority of Service**	**Reputation**
Critical (5)	Disaster that causes the asset or property to shut down or collapse.	Single or multiple deaths and permanent injuries occur.	Critical and significant damage caused by widespread impact. In this case, recovery takes more than one year, and full recovery is unlikely.	Failure to provide priority services.	It has national and long-term effects that have the potential to affect the stability of the government.
Important (4)	Critical event where only extraordinary or emergency activities can be sustained.	Major and multiple significant injuries occur resulting in long-term disability.	Significant damage by local impact. In this case, the recovery takes more than a year and adaptation to the environmental order cannot be achieved.	It has a major impact on the provision of priority services.	It is negatively featured in the national press and has a bad influence on public opinion.
Medium (3)	Serious event in which continuity can be ensured in activities requiring emergency.	Moderate injuries or multiple minor injuries occur that require professional attention.	Moderate damage with medium impact. In this case, improvement is achieved in one year.	It has a moderate impact (positive or negative) on the provision of priority services.	It is featured in the national press and has an adverse effect on public opinion.
Low (2)	Adverse events in which activities can be carried out.	Minor injuries occur that require minimal intervention or treatment.	Events that act within certain limits. In this case, measurable improvement is achieved within a month after the effect.	It has minor impact (positive or negative) on the delivery of priority services.	It has a short-term impact on public opinion for a particular segment.
Might be Neglected (1)	Affects the normal continuation of activities.	Only minimal injuries that require first aid occur.	The environment has no influence on the key findings. Point source uses are available, and no improvement is needed.	It has a positive effect on the service or priority service.	It has a temporary effect on public opinion for a certain segment.

Table 43: Table of risk and vulnerability analysis in the context of extreme weather events

AREA OF IMPACT	EXPLANATION	VARIABLES	EXPOSURE	POSSIBILITY	RISK LEVEL	
Infrastructure Systems	The predicted increases in temperature, wind speeds, cold weather and precipitation create stress especially on the environment. Critical infrastructure systems (such as electricity, communication networks) and residential areas (especially the living areas of the vulnerable population) appear as areas of influence.	Cold Weather Wave.	3	3	9	Middle
		Heat wave	2	4	8	Middle
		Excessive precipitation	5	5	25	High
		Hail	5	4	20	High
		Snowfall	4	3	12	Middle
		Strong winds	5	5	25	High
Transportation	Increases in wind speeds, cold weather and precipitation put pressure on transportation networks, which can cause disruption of transportation services and property damage during extreme weather events.	Cold Weather Wave.	2	2	4	Low
		Heat wave	2	2	4	Low
		Excessive precipitation	4	5	20	High
		Hail	4	5	20	High
		Snowfall	4	3	12	Middle
		Strong winds	5	4	20	High
Green Infrastructure	Projected increases in temperature, wind speeds, cold waves and precipitation are increasing damage, habitat loss and the prevalence of invasive species, putting further pressure on biodiversity.	Cold Weather Wave.	1	2	2	Low
		Heat wave	2	3	6	Low
		Excessive precipitation	2	3	6	Low
		Hail	2	3	6	Low
		Snowfall	2	3	6	Low
		Strong winds	3	4	12	Middle
Water Management	Projected increases in temperature, cold weather waves and precipitation affect the flow and quality of water resources. While temperature increases and dry days cause a decrease in water resource availability, cold weather waves can cause water services to deteriorate.	Cold Weather Wave.	2	2	4	Low
		Heat wave	4	5	20	High
		Excessive precipitation	4	4	16	High
		Hail	3	4	12	Middle
		Snowfall	3	4	12	Middle
		Strong winds	2	3	6	Low
Waste Management	Projected increases in temperature, heat waves, and drought can increase the risk of fire in landfills, while creating vermin and odor problems.	Cold Weather Wave.	1	1	1	Low
		Heat wave	1	1	1	Low
		Excessive precipitation	3	3	9	Middle
		Hail	2	2	4	Low
		Snowfall	2	2	4	Low
		Strong winds	2	2	4	Low
Public health	The negative effects of extreme weather events and related disasters on natural resources and environmental degradation have negative effects on human health. Changes in air, soil and water quality have a direct impact on human health, such as quality of life and food security.	Cold Weather Wave.	4	3	12	Middle
		Heat wave	5	5	25	High school
		Excessive precipitation	4	5	20	High school
		Hail	3	4	12	Middle
		Snowfall	2	3	6	Low
		Strong winds	4	4	16	High school

EXPOSURE	POSSIBILITY				
	Rare	Unlikely	Possible	Probable	Almost certain
Critical	5	10	15	20	25
Important	4	8	12	16	20
Medium	3	6	9	12	15
Low	2	4	6	8	10
Negligible	1	2	3	4	5

Table 44: Risk and vulnerability analysis table in the context of flood and overflow

AREA OF IMPACT	EXPLANATION	VARIABLES	EXPOSURE	POSSIBILITY	RISK LEVEL	
Infrastructure Systems	Flooding from coastal, stream and precipitation places additional stress and risk to the built environment. This additional risk can be caused to businesses, residences, critical infrastructure, etc.	Sudden Surface Floods	4	5	20	High
		Groundwater Floods	3	3	9	Middle
Transportation	Increases in coastal, river and precipitation-induced floods cause road damage and interruptions in all transportation services.	Sudden Surface Floods	5	4	20	High
		Groundwater Floods	3	3	9	Middle
Green Infrastructure	Impermeable surfaces in green areas increase the risk of flooding. The increase in extreme flood events can cause loss of habitats and ecosystems damage.	Sudden Surface Floods	2	2	4	Low
		Groundwater Floods	2	2	4	Low
Water Management	Increases in flooding events place greater pressure on water systems, which are often at lower altitudes and therefore at higher risk of flooding.	Sudden Surface Floods	4	5		High
		Groundwater Floods	3	3	9	Middle
Waste Management	The effect of flood water on landfills increases the risk of surface and groundwater pollution.	Sudden Surface Floods	3	3	9	Middle
		Groundwater Floods	1	2	2	Low
Public health	The increase in surface and groundwater pollution due to flooding poses a risk to human health, such as the spread of water-borne infectious diseases. Flood waters pose a life-threatening risk to the society.	Sudden Surface Floods	5	5	25	High
		Groundwater Floods	3	4	12	High

Table 45: Risk and vulnerability analysis table in the context of drought and water scarcity

AREA OF IMPACT	EXPLANATION	VARIABLES	EXPOSURE	POSSIBILITY	RISK LEVEL	
Infrastructure Systems	The water scarcity that comes with drought poses a serious risk in terms of providing a clean water source to urban environments.	Water scarcity	4	3	12	Middle
		pollution of water	2	2	4	Low
Green Infrastructure	The scarcity of water, which is the source of life for living things, negatively affects biodiversity. The decrease in biodiversity has negative effects on ecosystem services.	Water scarcity	5	5	25	High
		Pollution of water	2	3	6	Low
Water Management	Drought causes a decrease in water resources by affecting the underground and surface water systems. This situation poses a risk for the sustainability of water resources.	Water scarcity	5	5	25	High
		Pollution of water	4	4	16	High
Waste Management	Water scarcity caused by drought makes it essential to reuse wastewater and make it suitable for different uses. This situation increases the need for the technology used and the infrastructure of waste systems be harmonized.	Water scarcity	4	4	16	High
		Pollution of water	2	2	4	Low
Public health	Water scarcity makes it difficult to access clean water, which is the source of life. Difficulty in accessing clean water jeopardizes the sustainability of life, but worsening hygiene conditions increase the risk of health problems.	Water scarcity	5	5	25	High
		Pollution of water	5	4	20	High

Considering the basic findings and risk table results of Bağcılar, it is possible to say that the district is in a very critical position in terms of climate risks in general. The fact that the green areas of the district, which is one of the most crowded districts of Istanbul and experiencing İmmigrant problems, are extremely low, creates a serious problem. The scarcity of green areas, population density and the density of the textile industry in the district are among the factors that may lead to excessive air and water pollution. However, the district is very risky in terms of floods and overflows. There is a risk of groundwater flooding, especially in Fatih Neighborhood, since groundwater flow is intense in areas of the district with sloping terrain. However, Fatih, Mahmutbey, Yavuz Selim, Bağlar, Göztepe, Yıldıztepe, Kazım Karabekir, The risk of sudden surface floods is high in İnönü and Yenigün neighborhoods. The fact that the stream bed passes through the borders of Yıldıztepe Neighborhood necessitates the priority of this region in the context of climate adaptation. Infrastructure-oriented adaptation studies should also be carried out in areas where there are streams and creek beds that are not active today but existed in the past. In addition to the flood and overflow risk, the risk of water pollution in the neighborhoods of 15 Temmuz, Mahmutbey, Yavuz Sultan Selim and Güneşli draws attention. Although the risk of drought poses a very serious risk for all of Istanbul and Bağcılar, it is seen that Bağlar Mahallesi is more risky in terms of drought. This creates the need to prioritize this region in the context of climate adaptation. Infrastructure-oriented adaptation studies should also be carried out in areas where there are streams and creek beds that are not active today but existed in the past. In addition to the flood and overflow risk, the risk of water pollution in the neighborhoods of 15 Temmuz, Mahmutbey, Yavuz Sultan Selim and Güneşli draws attention. Although the risk of drought poses a very serious risk for all of Istanbul and Bağcılar, it is seen that Bağlar Mahallesi is more risky in terms of drought. This creates the need to prioritize this region in the context of climate adaptation. Infrastructure-oriented adaptation studies should also be carried out in areas where there are streams and creek beds that are not active today but existed in the past. In addition to the flood and overflow risk, the risk of water pollution in the neighborhoods of July 15, Mahmutbey, Yavuz Sultan Selim and Güneşli draws attention. Although the risk of drought poses a very serious risk for all of Istanbul and Bağcılar, it is seen that Bağlar Mahallesi is more risky in terms of drought. The risk of water pollution in Yavuz Sultan Selim and Güneşli neighborhoods is also noteworthy. Although the risk of drought poses a very serious risk for all of Istanbul and Bağcılar, it is seen that Bağlar Mahallesi is more risky in terms of drought. The risk of water pollution in Yavuz Sultan Selim and Güneşli neighborhoods is also noteworthy. Although the risk of drought poses a very serious risk for all of Istanbul and Bağcılar, it is seen that Bağlar Mahallesi is more risky in terms of drought.

Heavy rains, strong winds, heat and cold air waves that occur within the scope of extreme weather events also pose a risk for Bağcılar. Strong winds mostly affect Mahmutbey, 100. Yıl, Bağlar and Göztepe districts. July 15 and Sancaktepe neighborhoods are also affected by the strong wind. The heat wave affects Kemalpaşa and 100. Yıl neighborhoods due to its narrow streets and dense construction. In addition, Demirkapı, Güneşli and Fatih neighborhoods are also affected by the heat wave. The cold air wave also poses a serious risk for the 100.Yıl Mahallesi, where frost events are frequently seen. Intense construction and the density of İmmigrants make the effects of cold air waves risky for the district in general.

As a result, the intensity of the risks and vulnerability that arise with climatic events are determined by the region’s spatial density and socio-economic status. The socio-economic development status of the district in general is below the average at C and D points. While the socio-economic status of Sancaktepe, Merkez, Güneşli, Hürriyet, Mahmut Bey and Bağlar neighborhoods was at C level, the status of all other neighborhoods remained at C level. In this respect, D-status neighborhoods, which are predicted to be at high risk for each climatic event and are less developed socio-economically,

are in a more risky position. Neighborhoods such as Fatih, Kemalpaşa, Demirkapı and Göztepe, where İmmigrants are concentrated, are in a more risky position in this respect. However, considering the current situation and deficiencies of the whole district, it is possible to conclude that climatic risks and vulnerability are valid for the whole district, but may be higher in some neighborhoods. In this context, the risk and vulnerability matrix prepared for the whole district is shown in **Table 46**.

Table 46: *Bağcılar's risk and vulnerability matrix in the context of areas of climatic hazards*

Climatic Dangers		Sectors and Areas						
		Infrastructure Systems	Transportation	Green Infrastructure	Water Management	Waste Management	Public health and Disaster Management	
Extreme Weather Events	Cold snap							
	Heat wave							
	Excessive Precipitation							
	Snowfall							
	Hail							
	Extreme Winds							
Flood Risk	Sudden surface floods							
	Subterranean water floods							
Drought	Water scarcity							
	Water pollution							

4.3 DETERMINING ADAPTATION STRATEGIES

Climate change adaptation action plan studies are extremely important in order to make cities resistant to climate change. Bağcılar's current greenhouse gas inventory calculations, which is presented in the reduction section, is one of the most important steps in revealing the reduction scenarios and commitments.

In addition, the issue of developing adaptation actions by reconsidering cities and increasing the social, economic and environmental resilience of the city through these actions should be kept on the agenda, despite the inevitable situations and effects that may arise due to climate change.

In this context, the climate change adaptation actions of Bağcılar district are evaluated together with the other strategic plans of the city and presented as a solution proposal. These actions are

presented under certain main headings in parallel with Türkiye's climate change adaptation plans prepared on a national scale. These titles have been determined as infrastructure systems, green infrastructure, water management, public health and disaster management, taking into account the risk and vulnerability analysis results of Bağcılar, to be examined within the scope of harmonization. In the previous section, information about the current situation of Bağcılar was presented under the headings, and the risk and vulnerability analysis for Bağcılar was completed. According to the results of the risk and vulnerability analysis obtained from the workshop, it is necessary to determine the needs of the district in the climatic context and the actions to eliminate or minimize the risks faced. In this section, the current situation of Bağcılar and its actions are presented by taking into account the risk and vulnerability analysis. These actions were determined within the scope of the workshop where the internal and external stakeholders of Bağcılar came together in the context of raising public awareness and were discussed in this study.

4.3.1 SOCIAL AWARENESS

In recent years, it has been widely accepted internationally that climate change poses a great threat to both human health and ecological order. According to the scientific data and studies obtained by the IPCC, identification and dissemination of social responsibilities in the context of climate change risks is an urgent necessity. Governments, the business world, and other institutions and organizations have started to cooperate to reduce the effects of climate change and adapt to the climate.

One of the most important criteria for reducing the effects of climate change and adapting to the climate is to ensure the change of individual behavior and personal preferences in the social context. This sensitive change is possible with the creation of public awareness. However, one of the biggest challenges related to climate change is to create public awareness, ensure that the society accepts climate risks, and create inclusive policies and services to eliminate them. For this, the regulations and policies of the central government are extremely important. Based on this, public awareness surveys can be conducted to investigate the society's awareness regarding climate change and its risks. According to the results, these studies should be completed at different scales and measures should be developed to raise public awareness. For this, institutions and organizations such as city councils, local governments, NGOs, business world, chambers of commerce should cooperate. Apart from public institutions, the way of the business world in combating climate change should not be denied. For this reason, incentive systems should be developed in order for the whole business world to participate in the studies carried out within the scope of combating climate change, and it should be ensured that they take part as a stakeholder in the studies. Apart from public institutions, the way of the business world in combating climate change should not be denied. For this reason, incentive systems should be developed for the whole business world to participate in the studies carried out within the scope of combating climate change, and it should be ensured that they participate as a stakeholder in the studies. Apart from public institutions, the way of the business world in combating climate change should not be denied. For this reason, incentive systems should be developed for the whole business world to participate in the studies carried out within the scope of combating climate change, and it should be ensured that they also participate as a stakeholder in the studies.

On the other hand, technological developments and innovations that have increased rapidly in recent years, covering large scales, have increased the greenhouse gas emission rates together with the need for energy use at the same rate. Therefore, the use of sustainable energy becomes more important in order to reduce the effects of climate change, which is the first part of this study. In this respect, public support is one of the most important tools in the fight against climate change, which

is provided according to the criteria determined by laws and regulations. Some policies can be determined in a way that commits to providing direct public support. Information campaigns on climate change, efforts to determine economic policies by consensus, such as climate change workshops, it is aimed at increasing public awareness and providing individual behavior change. For example, the fact that a citizen who took part in information activities is more careful about the energy consumption at home is only one effect of the information and awareness activities.[74]

In this context and within the scope of this study, a detailed information meeting and a workshop with the participation of various institutions and organizations were organized in order to raise public awareness and identify risks and actions through common sense.

4.3.1.1 Workshop Methodology and Scope

One of the most important stages in the preparation process of Bağcılar SECAP is to bring together the internal and external stakeholders in the local government; informing them about the climate change process and ensuring that the actions are selected after the risks and actions regarding adaptation are determined through common sense. In this context, a climate adaptation workshop was held on 29 December 2021 under the leadership of Bağcılar Municipality Environmental Protection and Control Directorate.

Within the scope of the workshop, primarily informative presentations were made to the participants on climate change, the adaptation process to climate change, and climate change risk and vulnerability. After that, the action areas determined to eliminate the risks and effects of climate change and the current situation of Bağcılar regarding these areas are explained. Action areas determined within the scope of the workshop were determined in accordance with the report content: Infrastructure systems, transportation, green infrastructure, water management, public health, disaster management and waste management. The participants were divided into three groups during the workshop to receive their contribution and ideas. One of these groups is the areas of infrastructure systems, transportation and waste management, the other is the areas of water management and green infrastructure,

After the informative presentations were completed, the second part of the workshop was started. In the second part, determining the risks and vulnerabilities of Bağcılar against climate change and choosing actions to eliminate these risks; Then, a visual workshop was designed to determine the actions to eliminate these risks.

Preparation of the workshop

A map was prepared for the workshop to show Bağcılar's urban density, green areas, district and district borders and transportation axes. For this map, numerical data of existing and proposed green areas, buildings, water areas, road areas and neighborhood boundaries within the borders of Bağcılar, provided by Bağcılar Municipality, were used. The map showing the existing and proposed green areas, roads, buildings, neighborhood boundaries and the line crossing the stream is shown in **Figure 57** also.

Then the Risk and Vulnerability Assessment Risk cards were created according to the climatic event titles in the section. These are primarily designed to select the areas that will be affected by the climatic risk. The workshop results of the stage of identifying risks and vulnerabilities are discussed in detail in the conclusion section of this report's risk and vulnerability assessment.

[74] *https://books.google.com/books?id=lgRry63mfZMC&printsec=frontcover&hl=en&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false, Retrieved December 2021*

After risk and vulnerability assessment, action cards were prepared to select actions to eliminate these risks. The action card shown in **Figure 58** is designed to determine the implementation capacity and level of importance for adaptation to climate change by the participants.

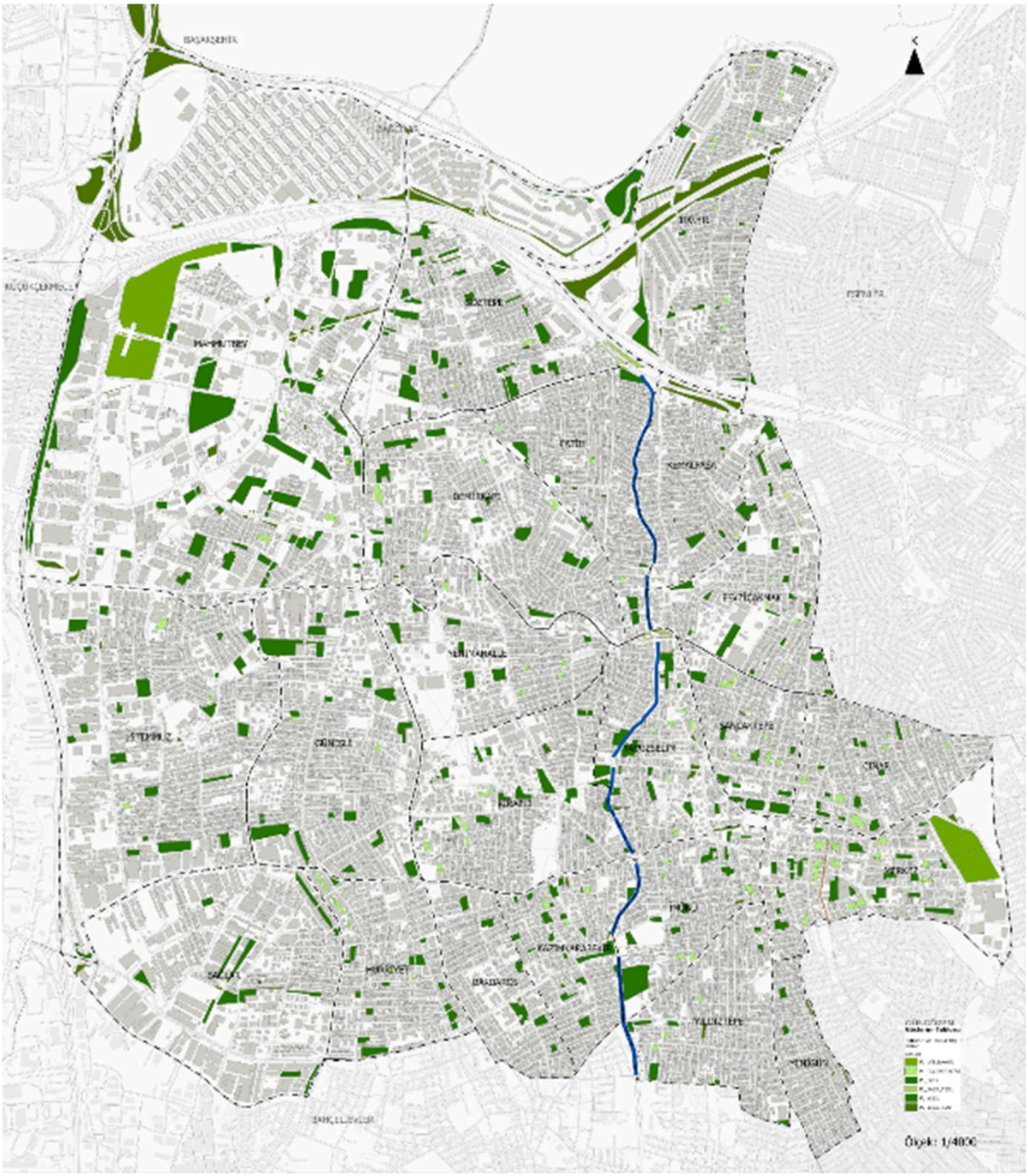


***Figure 57**: Bağcılar map prepared for the workshop*

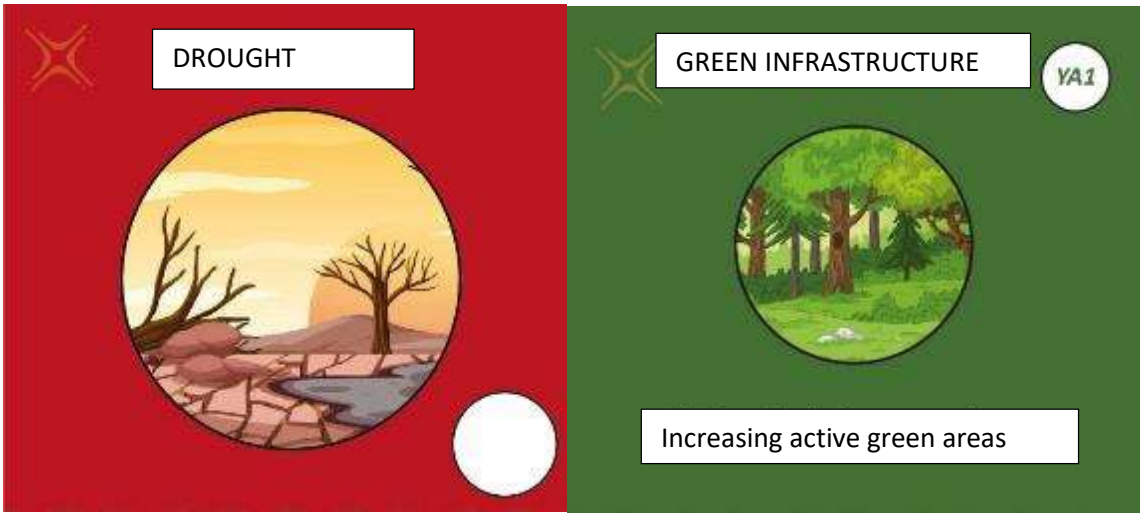


Figure 58: Risk and action card

In the first part of the workshop, informative presentations were made. In the next part, the participants determined the risk and vulnerability status for Bağcılar through risk cards in the consultation environment. During the determination of the risks, the participants determined the risky areas and placed their risk cards on the Bağcılar map printed at 1/4000 scale. Thus, more risky areas in Bağcılar were determined. In the next stage, the participants chose the actions to eliminate the risks. Likewise, the implementation areas of the actions are marked on the common map. Thus, it was possible to determine the neighborhoods requiring priority intervention in the context of the risks and actions needed within the scope of the workshop and to exchange ideas with the participants.

4.4 ADAPTATION ACTIONS

In the workshop held within the scope of Bağcılar Sustainable Energy and Climate Action Plan, the participants were divided into three groups and determined the actions. The first of these groups represents the areas of infrastructure systems and transportation, waste management, the other represents the areas of green infrastructure, water management, and the last represents the areas of public health and disaster management.

The actions determined according to the fields are shown in detail under each field title. These tables show the details of the action for the actions, the priority level of the action, the capacity to implement the action, the duration of the action, the impact areas of the action and the regions where the action should be applied as a priority. During the workshop, the participants placed the actions they determined according to the risks and the current situation in the areas that should be applied first on the map. However, the general opinion of the participants about implementing the actions was that the selected actions should be implemented primarily in some neighborhoods or regions, as well as dissemination within the boundaries of all Bağcılar districts.

4.4.1 Infrastructure Systems and Transportation

For Bağcılar, infrastructure, built environment and transportation issues need to be handled meticulously together with upper-scale decisions and practices. It is revealed that the severity of the hazards that are foreseen to occur as a result of climatic events are directly related to the infrastructure capacity. Although climatic events such as extreme weather forecasts and those that

pose the risk of floods and floods indirectly put public health at risk, it is possible to determine the severity of the impact of the events according to the infrastructure capacity of the district.

On the other hand, although the boundaries of districts and neighborhoods are certain in a metropolitan city like Istanbul, it is expected that the solutions of climatic risks will be supported by upper scale decisions. In particular, action decisions related to infrastructure systems, built environment and transportation areas, which are directly related to urban planning, need to be reinforced with upper scale and central management decisions.

- It was emphasized that with the rapid increase in the number of residences in the district, the need for road, waste water, sewerage, natural gas, electricity and communication infrastructures also increased. In this context, it was stated that the risks of climate change should also be evaluated during the investment process of infrastructures.

In addition to these, priority actions are taken to ensure that Bağcılar is adapted to climate change in the field of infrastructure systems is shown in **Table 47Hata! Başvuru kaynağı bulunamadı.**. Accordingly, 4 different actions were selected as priority from the action pool. It was emphasized that the actions should generally be implemented within the borders of the entire Bağcılar district. It has been revealed that the actions of using light-colored materials in floor coverings, which are recommended to be applied to adapt the infrastructure systems to the climate and to reduce the risk of urban heat island, should be applied especially for the whole of Istanbul.

Table 47: *Actions determined regarding infrastructure systems*

INFRASTRUCTURE SYSTEMS												
					Action impact areas							
Action Code	**Action**	**Timeframe**	**Importance**	**Applicability**	**Adaptation**	**Reduction**	**Resilience**	**Public awareness**	**Environmental**	**Economic**	**Social**	**Priority application area**
AY1	Adapting infrastructure systems to climate change	Medium term	High	Medium	×		×		×	×		İstanbul in general
AY2	Using light colors in floor coverings	Short term	High	High	×	×	×		×			İstanbul in general
AY4	Raising public awareness about energy savings	Short term	High	High	×	×	×	×	×	×	×	Bağcılar in general
AY6	Increasing water permeable surfaces (sidewalks, roads, pedestrian areas, parks)	Medium term	High	Medium	×		×					Bağcılar in general

During the workshop, from the field of transportation the following points were made for Bağcılar:

- It was emphasized that the solution of Bagcilar's transportation problems should be handled with a high-scale approach.
- In the context of climate change, it was stated that traffic calming practices should be expanded within the district and the integration of pedestrian roads with green should be ensured.

In addition to these, actions to be taken for Bağcılar is shown in **Table 48**. Encouraging the use of electrified and hybrid vehicles to mitigate the effects of climate change and training public sector drivers for eco-driving practices are also important in terms of climate adaptation if implemented throughout Istanbul. It was also stated that during the implementation of the actions related to transportation, it should be implemented in cooperation with the Istanbul Metropolitan Municipality and the central government. First of all, for Bağcılar in general, actions to increase traffic calming practices and to ensure the integration of pedestrian roads with green were selected. The building density and recent spatial decisions show that the construction of continuous bicycle paths is not possible, at least for now.

Table 48: *Actions determined regarding the transportation area*

TRANSPORTATION												
					Action impact areas							
Action Code	**Action**	**Timeframe**	**Importance**	**Applicability**	**Adaptation**	**Reduction**	**Resilience**	**Public awareness**	**Environmental**	**Economic**	**Social**	**Priority application area**
UL1	Increasing traffic calming practices	Medium term	High	Low		×	×		×		×	Bağcılar in general
UL2	Stabilizing the integration of pedestrian roads with green infrastructure	Short term	High	Medium	×	×	×		×		×	Bağcılar in general

Stakeholders who are expected to take part in the necessary cooperation for the implementation of the actions determined in the field of infrastructure systems and transportation:

- İstanbul Metropolitan Municipality - İBB
- Ministry of Transport and Infrastructure
- Ministry of Environment, Urbanization and Climate Change
- State Hydraulic Works- DSI
- İstanbul Water and Sewerage Administration- İSKİ
- Universities
- Civil society organizations
- Private sector
- City councils
- Neighboring local municipalities

4.4.2 Waste Management

Waste management is an issue that can be handled within the scope of jurisdiction of district municipalities. Government agencies, municipalities, and non-governmental groups should collaborate to improve the environment and promote recycling operations through public awareness. Government and companies should launch campaigns promoting recycling, consumption behaviour, packaging reuse etc. Educational and promotional campaigns can help increase public awareness and comprehension of recycling. The most effective ways to reduce the environmental impact is reduce food consumption, change it more to favor organic fruits and vegetables, and to avoid goods that have been transported by air on both individual and institutional [75]. In this context, it is important to organize various campaigns on issues such as raising public awareness and mitigating the effects of climate change with a minimum waste approach. Considering the socio-economic situation of Bağcılar, one of the most populated districts, raising awereness about waste is of great importance. In addition to this, especially for Istanbul in general, the issue of wastewater emerges as an issue that needs to be addressed separately. In this context, during the workshop, following points were underlined for waste management:

- The public should be aware of waste in Bağcılar, which is one of the most crowded districts of Istanbul.
- The importance of applying water saving methods and practices throughout Istanbul against the risk of drought.
- The wastes of commercial units such as restaurants and cafes within the boundaries of the district should be collected and separated separately.

Accordingly, selected actions on waste management for Bağcılar is shown in **Table 49**.

***Table 49:** Actions determined in the field of waste management*

WASTE MANAGEMENT												
					Action impact areas							
Action Code	**Action**	**Timeframe**	**Importance**	**Applicability**	**Adaptation**	**Reduction**	**Resilience**	**Public awareness**	**Environmental**	**Economic**	**Social**	**Priority application area**
AT1	Minimizing food waste	Medium term	Medium	Low	×	×		×	×	×	×	Bağcılar in general
AT2	Raising awareness about waste	Short term	High	Medium	×	×	×	×	×	×	×	İstanbul in general
AT3	Putting recycling bins in parks and other public spaces	Long term	Medium	High	×			×	×		×	Bağcılar in general
AT4	Ensuring water savings in buildings to reduce waste water	Medium term	High	Low	×		×	×	×	×	×	İstanbul in general

75 *Lucia Reisch, Ulrike Eberle & Sylvia Lorek (2013) Sustainable food consumption: an overview of contemporary issues and policies, Sustainability: Science, Practice and Policy, 9:2, 7-25, DOI: 10.1080/15487733.2013.11908111.*

AT5	Expanding the use of green procurement products	Medium term	High	Medium	×	×	×	×	×	×		Bağcılar in general
AT6	Separate collection of restaurant and cafe waste (Cooperation with İBB or neighboring municipalities)	Short term	High	High		×	×	×	×	×	×	Bağcılar in general

Stakeholders who are expected to take part in the necessary cooperation for the implementation of the actions determined in the field of infrastructure systems and transportation:

- İstanbul Metropolitan Municipality - İBB
- Ministry of Environment, Urbanization and Climate Change
- Educational institutions
- Universities
- Civil society organizations
- Private sector
- City councils
- Neighboring local municipalities

4.4.3 Green Infrastructure

The issue of green infrastructure includes highly functional applications in terms of climatic conditions, especially for crowded cities and regions with intense urbanization. Considering the green areas capacity and urbanization density of Bağcılar district, it is seen that there is a very sterile and intense urbanization in terms of active green areas. Increasing the use of green spaces by citizens living in Bağcılar is extremely important both in terms of public health and in terms of adapting to the climate. In this way, it is foreseen that the social and physical resilience of Bağcılar in terms of climate will also increase.

In this context, from the green infrastructure field the foolowing points were made for Bağcılar:

- It has been emphasized that the amount of green areas is quite low compared to the population and building density, therefore, active green areas should be increased.
- It has been stated that the urban heat island effect is high in the whole district due to dense construction, and therefore urban heat island vulnerability maps should be made.
- It was stated that it is extremely important to implement nature-based solutions for the built environment and buildings in the entire district, especially in the Merkez District.
- It has been revealed that the surrounding of the Tavukçu Stream passing through the district should be afforested despite the risk of flooding.
- It was stated that the transportation axes in the entire district, especially the transportation axes in Demirkapı, Göztepe and Mahmutbey neighborhoods, where new housing development is intense, should be integrated with green.
- It was emphasized that 8 fruit orchards in the district as of 2021 should be increased.

- It was stated that there are no air corridors in Fatih, Fevzi Çakmak, Kemalpaşa and Demirkapı neighborhoods, and that the green areas in these neighborhoods should be connected with each other.

In line with these discussions and suggestions, the actions determined in the workshop on green infrastructure were given in **Table 50Hata! Başvuru kaynağı bulunamadı.**. A total of ten actions were selected from the action pool on green infrastructure. In general, it was thought that green infrastructure actions should be implemented throughout Bağcılar and Istanbul. However, it was emphasized that some actions started to be implemented in a few neighborhoods first and then expanded to the whole district.

***Table 50**: Actions identified regarding the green infrastructure area*

GREEN INFRASTRUCTURE												
					Action impact areas							
Action Code	**Action**	**Timeframe**	**Importance**	**Applicability**	**Adaptation**	**Reduction**	**Resilience**	**Public awareness**	**Environmental**	**Economic**	**Social**	**Priority application area**
YA1	Increasing active green spaces	Medium term	High	Medium	×	×	×	×	×		×	İstanbul in general
YA2	Implementing nature-based solutions in the built environment and buildings	Long term	High	High	×	×	×		×			Central district
YA3	Preparation of vulnerability maps in the context of urban heat island	Medium term	High	Medium	×	×	×		×			Bağcılar in general
YA4	Green facade applications	Medium term	High	High	×	×	×		×	×		Demirkapı, Güneşli, 100.Yıl, Fatih, Kemalpaşa districts
YA6	Afforestation of stream banks and floodplain boundaries	Medium term	High	Medium	×	×	×		×			The surrounding of Tavukçu creek should be greened by solving the private property problem
YA7	Connecting green spaces	Medium term	High	Medium	×	×	×	×	×	×	×	Fatih, Fevzi Çakmak, Kemalpaşa, Demirkapı neighborhoods where there is no air corridor

YA8	Gaining green corridor function by providing green infrastructure integration to transportation axes	Medium term	High	Medium	×	×	×		×			Regions where the increase in new housing is high, Demirkapı, Göztepe, Mahmutbey
YA9	Establishment of orchards in the city	Medium term	Medium	Medium	×	×	×	×	×	×	×	By 2021, the number of 8 orchards in the district should be increased.

Stakeholders who are expected to take part in the necessary cooperation for the implementation of the actions determined in the field of green infrastructure:

- İstanbul Metropolitan Municipality - İBB
- Ministry of Environment, Urbanization and Climate Change
- Ministry of Agriculture and Forestry
- Educational institutions
- Universities
- Civil society organizations
- Private sector
- City councils

4.4.4 Water Management

It is very important for the city of Istanbul to protect water resources and ensure that water management is adapted to the climate. As revealed in the risk and vulnerability assessment, the risk of drought for Istanbul in the near future is quite high. Therefore, without exception, measures regarding drought and water scarcity should be increased in every part of Istanbul. For this reason, it is necessary to develop climate-compatible water management policies and to implement new practices for water recycling practices.

In this context, regarding water management for Bağcılar following conclusions were drawn:

- It was emphasized that rain collection pools should be built in certain areas, especially in Fatih, Mahmutbey, Yavuz Selim, Bağlar, Göztepe, Yıldıztepe, Kazım, Karabekir, İnönü and Yenigün neighborhoods.
- It has been stated that precautions against flood and overflow risk should be increased since the stream bed crosses the borders of Yıldıztepe District.

In line with these discussions and suggestions, actions determined in the workshop on water management were given in **Table 51**. The importance levels of the selected actions related to water management were determined as high and medium. It is obvious that in Istanbul, where the risk of drought seriously threatens public health, careful work should be done on the protection of water resources and actions should be taken quickly.

Stakeholders who are expected to take part in the necessary cooperation for the implementation of the actions determined in the field of water management:

- İstanbul Metropolitan Municipality - İBB
- Ministry of Environment, Urbanization and Climate Change
- Ministry of Agriculture and Forestry
- State Hydraulic Works- DSI
- İstanbul Water and Sewerage Administration- İSKİ
- Universities
- Civil society organizations
- Private sector
- City councils
- Neighboring local municipalities

Table 51: *Actions identified in the field of water management*

WATER MANAGEMENT												
					Action impact areas							
Action Code	**Action**	**Timeframe**	**Importance**	**Applicability**	**Adaptation**	**Reduction**	**Resilience**	**Public awareness**	**Environmental**	**Economic**	**Social**	**Priority application area**
SU1	Constructing rain gardens and water pools in areas with many impermeable surfaces	Short term	High	High	×		×		×	×		Fatih, Mahmutbey, YavuzSelim, Bağlar, Göztepe, Yıldıztepe (creek), Kazım Karabekir, İnönü, Yenigün neighborhoods
SU2	Expanding the use of water-saving mechanisms	Short term	High	Low	×	×	×	×	×	×	×	İstanbul in general
SU3	Using a penalty and incentive system for the protection of water resources	Medium term	Medium	Medium	×	×	×		×	×		İstanbul in general
SU4	Establishing guidelines for water savings in commercial buildings/enterprises	Short term	Medium	Medium	×		×	×	×	×	×	İstanbul in general
SU5	Accelerating awareness-raising activities in dry periods	Short term	High	High	×		×	×	×	×	×	Bağcılar in general

4.4.5 Public Health and Disaster Management

It is revealed that Bağcılar district, with a population of close to 750 thousand, is in a risky situation in terms of public health due to climate change. In a district where population density and construction are so high, the problem of air pollution draws attention. In this context, it is very important to minimize the direct harmful effects of air pollution on human health and to raise

awareness of the society on this issue. On the other hand, it should be noted that epidemic diseases such as the corona virus epidemic, which started at the beginning of 2020 and continued as of 2022, will become more widespread with the risks of climate change and will affect metropolitan cities such as Istanbul more. For this reason, accelerating the data collection processes related to public health,

In this context, regarding public health for Bağcılar, following notes were taken during the workshop:

- It was stated that it is important to determine the neighborhoods and regions where the fragile population is concentrated.
- Due to the high density of the fragile population throughout the district, it was emphasized that healthy public spaces should be created in terms of public health.
- The importance of raising the awareness of the people of the district in terms of preventing communicable diseases and water and food-borne diseases was emphasized.

In line with the topics and suggestions discussed at the workshop, 6 actions were determined for Bağcılar in the field of public health. It is noteworthy that all of his actions have a high degree of importance. It is very important to disseminate social awareness activities throughout the district, starting from the districts with lower socio-economic status. At the same time, measures should be taken against a possible epidemic disease risk throughout the district where unplanned urbanization is intense. The implementation of all actions on public health, starting from the more vulnerable population groups, throughout the district and even the province, is important in terms of building urban and social resilience in the face of climate change.

In line with these discussions and suggestions, actions determined in the workshop on water management were given in **Table 52Hata! Başvuru kaynağı bulunamadı.**. Climatic disasters negatively affect public health indirectly and directly. In the event of a possible flood, flood or storm, inadequate infrastructure and built environment conditions can put human health at risk. For example, constructions in flood areas can cause loss of life and property in a possible flood disaster, and building objects such as flying roofs and awnings in a storm can harm people.

Table 52: *Actions identified in the field of public health*

PUBLIC HEALTH												
					Action impact areas							
Action Code	**Action**	**Timeframe**	**Importance**	**Applicability**	**Adaptation**	**Reduction**	**Resilience**	**Public awareness**	**Environmental**	**Economic**	**Social**	**Priority application area**
HS1	Providing information about diseases caused by climate change and prevention methods	Long term	High	High	×		×	×		×	×	İstanbul in general
HS2	Urban planning to prevent vector reproduction	Medium term	High	Low	×		×	×	×	×	×	İstanbul in general
HS3	Identifying groups that may be affected by climate change	Long term	High	High			×	×		×	×	Bağcılar in general

HS4	Prevention of water and food borne diseases and raising awareness on this issue	Medium term	High	Medium	×		×	×	×	×	×	Bağcılar in general
HS5	Creation of healthy public spaces	Medium term	High	Medium	×		×	×	×	×	×	Bağcılar in general
HS6	Monitoring air quality values and developing a warning system	Medium term	High	Low	×	×	×	×	×	×		İstanbul in general

In this context, during the workshop, in the field of disaster management for Bağcılar, below conclusion was derived:

- It has been revealed that Bağcılar district, which is one of the most crowded districts of Istanbul, has a high risk in terms of climatic events. In this context, the necessity of developing geographic information systems-based risk maps throughout the district and the importance of rapidly putting into practice the solutions to be developed against these risks were emphasized.

In line with the topics and suggestions discussed at the workshop, a total of 6 actions were determined for Bağcılar in the field of disaster management (**Table 53**). Just like in the fields of public health and water management, it is seen that the level of importance of all these actions determined in the field of disaster management is high. It is very important to develop disaster management policies and ensure inter-institutional cooperation in order to minimize and even eliminate climatic risks. For this reason, it is very important to implement and disseminate all the actions for the whole district and even the whole province, starting from the regions with fragile populations.

Table 53: *Actions determined in the field of disaster management*

DISASTER MANAGEMENT												
					Action impact areas							
Action Code	**Action**	**Timeframe**	**Importance**	**Applicability**	**Adaptation**	**Reduction**	**Resilience**	**Public awareness**	**Environmental**	**Economic**	**Social**	**Priority application area**
AY1	Making concrete action plans (by establishing cooperation between institutions) for sudden climate events	Medium term	High	Medium	×		×	×		×		İstanbul in general
AY2	Detection of vulnerability to extreme heat,	Short term	High	High	×		×	×		×	×	Bağcılar in general

	precipitation, cold and weather events											
AY3	Development of GIS-based risk maps	Short term	High	High	×	×	×		×	×		Bağcılar in general
AY4	Ensuring food and nutrition security against the risk of drought	Short term	High	Medium	×		×		×	×	×	İstanbul in general
AY5	Explaining the risks of climatic disasters to the public	Short term	High	Medium	×		×	×	×	×		İstanbul in general
AY6	Development of early warning systems	Short term	High	High	×	×	×	×		×	×	Bağcılar in general

Stakeholders who are expected to take part in the necessary cooperation for the implementation of the actions determined in the field of public health and disaster management:

- İstanbul Metropolitan Municipality - İBB
- Disaster and Emergency Management Presidency - AFAD
- Search and Rescue Association- AKUD
- Fire Brigade Departments
- Ministry of Environment, Urbanization and Climate Change
- Ministry of Agriculture and Forestry
- State Hydraulic Works- DSI
- İstanbul Water and Sewerage Administration- İSKİ
- Universities
- Hospitals
- Civil society organizations
- Private sector
- City councils
- Neighboring local municipalities

4.5 COMPLIANCE MONITORING PLAN

In order to ensure that Bağcılar's adaptation process is both effective and sustainable over time, it is necessary to regularly evaluate the progress of planned and implemented actions. However, it is important to periodically check the current situation by comparing it with the targets set in the context of harmonization. By evaluating the monitoring results, a more effective way of adapting to climate change can be followed by making necessary adjustments in some actions and making changes such as adding new actions.

It should not be forgotten that compliance indicators are an important part of the monitoring and evaluation process. The selection of indicators suitable for the district is a necessity in terms of collecting and evaluating information to guide actions. For this reason, it is important to conduct interviews and establish cooperation with stakeholder institutions and organizations regarding the selection of appropriate indicators and the collection of necessary data.

In this context, there are some indicators defined for the SECAP process within the scope of the Presidents' Agreement. However, it is possible for local governments to create their own indicators and continue their monitoring activities according to these indicators. Within the scope of the CoM process, it is emphasized that it is very important to determine and monitor at least one adaptation indicator for each important action in climate action plans.

In **Table 54Hata! Başvuru kaynağı bulunamadı.**, the adaptation indicators defined within the scope of the CoM are shared in order to create a roadmap for the monitoring activities in Bağcılar's climate adaptation process. These indicators can be used, or they can be created and used in different indicators that are suitable for data access.

***Table 54**: Compliance indicators*

Area/Sector	Indicators of impact
Buildings	Number or % of buildings damaged by extreme weather conditions/events (public/residential/non-residential)
Transportation Energy, Water, Waste, Civil Defense and Emergency	Number or % of transport/energy/water/waste/ICT infrastructure damaged by extreme weather conditions/events
Land Use	% of gray/blue/green areas affected by extreme weather/events (eg, Heat Island Effect, Flood, Rockfall and/or Landslide, Forest/Land Fire)
Transportation Energy, Water, Waste, Civil Defense and Emergency	Number of days of utility outages (eg, energy/water supply, health/civil protection/emergency services, waste)
Transportation Energy, Water, Waste, Civil Defense and Emergency	Average length (in hours) of utility interruptions (e.g. energy/water supply, public transport traffic, health/civil protection/emergency services)
Public health	Number of people injured/recovered/relocated due to extreme weather event(s) (e.g. heat or cold waves)
Public health	Number of deaths associated with extreme weather event(s) (eg, heat or cold waves)
Civil Defense & Emergency	Average response time of police/fire/emergency services in case of extreme weather events (in minutes)
Public health	Number of water quality warnings issued
Public health	Number of air quality alerts issued
Environment and Biodiversity	% of area affected by soil erosion / soil quality degradation
Environment and Biodiversity	% of habitat loss due to extreme weather event(s)
Environment and Biodiversity	% change in number of native species
Environment and Biodiversity	% of native (animal/plant) species affected by diseases associated with extreme weather conditions/events
Agriculture and Forestry	% of agricultural loss from extreme weather/events (eg drought/water scarcity, soil erosion)
Agriculture and Forestry	% loss of stock due to extreme weather conditions
Agriculture and Forestry	% change in crop yield / evolution of annual pasture productivity
Agriculture and Forestry	% loss of stock from pests/pathogens
Agriculture and Forestry	% of timber loss from pests/pathogens
Agriculture and Forestry	% change in forest composition
Agriculture and Forestry	% change in water extraction
Finance	Annual direct economic loss in euros from extreme weather event(s) (e.g. in commercial, agricultural, industrial/tourist sectors)

Area/Sector	Indicators of impact
Finance	Annual compensation amount received in euros (e.g. insurance)
Climate	Number of days/nights with extreme temperatures (based on day/night reference annual/seasonal temperatures)
Climate	Frequency of heat/cold waves
Climate	Number of days/nights with heavy precipitation (based on reference annual/seasonal precipitation during day/night)
Climate	Number of consecutive days/nights without rain
Socio-economic	Comparison of current population and projections 2020/2030/2050
Socio-economic	Population density (based on national/regional average in country/region X in year X)
Socio-economic	% share of vulnerable population groups (eg old (65+)/young (25-) people, lone pensioners, low-income/unemployed households) - compared to national average in country X in year X
Socio-economic	% of population living in at-risk areas (eg, flood/drought/heat wave/forest or land fire)
Socio-economic	% of areas not accessible to emergency / fire services
Physical and Environmental	% change in average annual/monthly temperatures
Physical and Environmental	% of change in average annual/monthly precipitation
Physical and Environmental	Length of transport network (eg road/rail) located in at-risk areas (eg flood/drought/heat wave/forest or land fire)
Physical and Environmental	Length of coasts/streams affected by extreme weather conditions/soil erosion (without adaptation)
Physical and Environmental	% of areas at low altitude or elevation
Physical and Environmental	% of areas on coasts or streams
Physical and Environmental	% of protected areas (ecologically and/or culturally sensitive) / % of forest cover
Physical and Environmental	% of areas at risk (eg residential/commercial/agricultural/industrial/touristic) (eg flood/drought/heat wave/forest or land fire)
Physical and Environmental	Comparison of current energy consumption per capita and projections 2020/2030/2050
Physical and Environmental	Comparison of current water consumption per capita and projections 2020/2030/2050
Socio-economic	% of land area hosting industry/agriculture in areas at risk of climate hazards (flood, drought, heat wave, forest fire or fire that is hard to extinguish)
Socio-economic	Percentage of public funds available to address a climate hazard and its effects (eg fire, flood, heatwave, etc.)
Socio-economic	% share of vulnerable population groups (eg old (65+)/young (25-) people, lone pensioners, low-income/unemployed households) - compared to national average in country X in year X
Socio-economic	Number of households who received training on energy / water / waste management
Socio-economic	Population density (based on national/regional average in country/region X in year X)
Socio-economic	Percentage of population living in at-risk areas (eg flood / drought / heat wave / forest or land fire)
Management and Corporate	Change in the green / blue infrastructure / areas of the city (%)
Physical and Environmental	Length of transport network (eg road/rail) located in at-risk areas (eg flood/drought/heat wave/forest or land fire)
Physical and Environmental	Average time required to reach a healthcare facility (min/h)
Physical and Environmental	% of areas at risk (eg residential/commercial/agricultural/industrial/touristic) (eg flood/drought/heat wave/forest or land fire)
Physical and Environmental	Percentage of areas inaccessible for emergency responses (e.g. firefighting services)
Information and Technology	Time required to inform the population about a risk through an early warning system (min/h)

5. CONCLUSION

As a result of this study to reduce the effects of climate change in Bağcılar district, both climate change mitigation and adaptation to climate change approaches are focused. The mitigation approach aims to reduce the current and future greenhouse gas effects in order to mitigate the effects of climate change. It has been stated that it is possible to achieve this goal through actions such as reducing energy use, transitioning to renewable energy sources, and creating carbon sink areas. The issue of adaptation, which is another approach in the fight against climate **Hata! Başvuru kaynağı bulunamadı.** in change, is the effect of the news that occur with the changing climatic conditions and which are predicted to happen in the future. It has been pointed out that the goals of adaptaton to climate change can be achieved by implementing actions such as protecting floodplains, adopting green infrastructure strategies, and adapting infrastructures.

Elimination of climate change risks for Bağcılar or reducing their effects is only possible with a comprehensive implementation process. As can be seen in **Figure 59**, the most important topics covering reduction activities are public transportation, energy use, circular economy and human behavior. The most critical activities in adaptation activities are implementing disaster-resistant urban design practices, emergency response plans, adapted infrastructure systems, climate-appropriate urban design practices and green infrastructure systems in order to make the region climate-resilient.

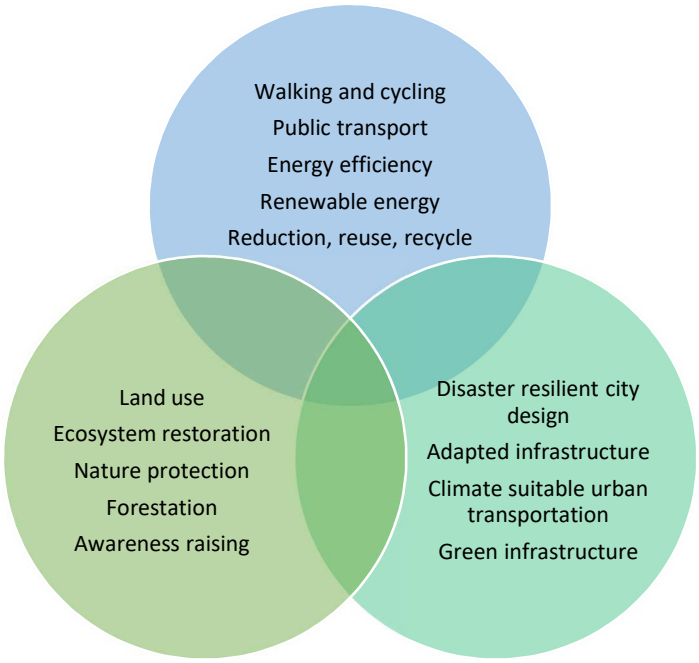


Figure 59: *Mitigation and adaptation template*

5.1 CLIMATE MITIGATION RESULTS

This section sets out the targets for reducing emissions from energy consumption and greenhouse gases in different sectors, determined with the participation of Bağcılar district stakeholders. The most important pillars of this report, the starting point of which is the district-scale greenhouse gas inventory, are the reports prepared or commissioned by Bağcılar Municipality and different institutions regarding the future of the district, and the visions of the city stakeholders for the future of the city.

In the total inventory of Bağcılar, excluding the industry, calculated for 2018, the base year, there is an energy consumption of 5,410,901 MWh and a greenhouse gas emission of 1,851,712 tons of CO2e (**Table 55**). According to the calculations, 57.5% of total emission comes from buildings, 30% is from transportation, and 12.5% is from solid waste and wastewater sectors. It is seen that the per capita emission (2.52 tCO2) is well below the Türkiye average (6.6 tCO2) as of the end of 2018.

***Table 55**: Distribution of Bağcılar district greenhouse gas emission inventory excluding industry, 2018*

Sector	Bağcılar Greenhouse Gas Emission (tCO2e)
Buildings	1,064,616
Transportation	555,440
Waste and wastewater	231,656
Total	**1,851,712**
Total (per capita)	**2.52**

With the reduction measures put forward in the sectors, it has been determined that a reduction of approximately 41% can be achieved in Bağcılar's per capita emissions by 2030 compared to 2018. Bagcilar's BAU (Business as Usual or Continuation of the Current Situation) scenario was determined by evaluating the projections made by different institutions regarding population and sectoral growth, and 2030 emissions were calculated as 2,211,992 tCO2e. It is predicted that the population will be 752,084 in 2030 according to this scenario.

According to the BAU scenario, per capita emissions are expected to increase from 2.52 tCO2e to 2.94 tCO2e. With the reduction measures put forward in each sector, it is seen that Bağcılar's per capita emissions can be reduced to 1.48 tCO2e by approximately 41% in 2030 compared to 2018 (Figure 63).

Current Situation Scenarios are evaluated on the basis of “Buildings and Energy”, “Transportation” and “Other” sectors. Renewable energy investments foreseen to be established in the district have been evaluated within the buildings sector. With the actions detailed under the title of 3.3.2 Contents of Actions, it is aimed to reduce 525,717 tCO2e in the buildings sector, 267,151 tCO2e in the transportation sector, and 138,649 tCO2e in waste and wastewater sectors by 2030.

According to preliminary calculations, in order to achieve the SECAP targets, by 2030 an average of 1,100,000 m2/year of buildings will be needed to renovate the building stock, which wil require an investment of 300 million EUR/year.

Also, significant investment into renewables especially solar PV will be needed till 2030. Around 210 MW of new installations of PV on the ground and on buildings roofs should be installed to generate 284 GWh of electricity annually and to save 143,735 tCO_2. To achieve this. a target investment of 210 million EUR or 21 million EUR/year will be needed.

The aims, objectives and actions set forth in this study should be considered as the first step taken by Bağcılar Municipality in the fight against climate change. In the district's view of the subject, in case of changes in the data, the objectives and actions must be reviewed and updated.

5.2 CLIMATE ADAPTATION RESULTS

The climate adaptation strategy developed for Bağcılar aims to alleviate the perceived effects of climate change and to increase urban life quality. Considering the effects of climate change on the city, it includes evaluations to cover the preparedness for increasing temperatures, water resources management, weather events such as storms and hail, disasters such as floods, landslides, and sea level rise, and recommends the preparation of emergency plans. As a matter of fact, it is important to create a sustainable and durable city structure against long-term and sudden effects in the fight against climate change in cities. Risk and vulnerability assessment, was carried out to determine the risks that the city will face against climate hazards and the areas and social groups that may be more affected by these hazards.

Sectoral risks have been tried to be determined by considering climate hazards such as hot and cold air waves, excessive precipitation, hail, snowfall, storms, drought, flood and overflow. Climate adaptation actions have been determined by considering these risks and vulnerabilities. Since earthquake disaster is a great risk for the whole of Istanbul, it is important that practices for climate adaptation actions are integrated with earthquake disaster management plans.

Climate adaptation actions have been prepared within the scope of the findings of the studies conducted at the scale of Istanbul, the examination of the relevant national reports, the information obtained from the stakeholder participation workshop and the information obtained from the local government. The local government determines the said actions; and prioritize them by evaluating according to some environmental, social, economic and institutional criteria.

The findings obtained throughout the study indicate that the amount of green space should be increased within the scope of objectives such as reducing the urban heat island effect and improving air quality. In this context, it is important to prepare a green infrastructure strategy. It has been suggested to establish a relationship with green in the improvement works carried out in the existing water channels and protection bands, and to create green corridors throughout the city. Creating an urban green belt, applying nature-based solutions in areas where the heat island effect is most felt, adopting pedestrian-bike-public transportation priority development forms constitute the basis of the strategy proposed for adaptation to climate change. Protecting water resources and biodiversity, supporting behavior change within the scope of measures to reduce water consumption,

Integration of design approaches and tools such as "water sensitive urban design", "green infrastructure strategies", "nature-based solutions" with spatial planning is important for those living in the city in urban design applications. In this context, Bağcılar climate adaptation strategy recommends that design principles be established and implementations should be made by considering these principles.

In order to carry out harmonization actions effectively, it is important to monitor periodically with determined indicators and to make improvements according to the findings. Going forward, it is recommended that Bağcılar Municipality continue to coordinate the objectives, results and monitoring procedures of its various strategic plans. This presents an opportunity to establish joint resource management and cooperation networks, and support the goal of providing an integrated and holistic approach to the sustainable management of resources, urban actions and services. Higher efficiencies can be achieved by sharing tasks and responsibilities in implementing relevant

strategies. It is important to establish a coordination committee consisting of experts and decision makers in order to carry out the necessary studies in a coordinated manner.[76]

[76]Adapted from Nilüfer Sustainable Energy and Climate Adaptation Strategies Report.

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ANNEXES

CoM SECAP TEMPLATE FOR BAĞCILAR