ARNAVUTKÖY MUNICIPALITY

SUSTAINABLE ENERGY AND CLIMATE ACTION PLAN

2025 - 2030

CONTRIBUTORS TO THE STUDY

Arnavutköy Municipality Executive Team

Editor

Gökhan KURT / Deputy Mayor

Arnavutköy Municipality Executive Team

Mehmet Nuri ÖZTÜRK / Director of Climate Change and Zero Waste

Enes NAZIKOĞLU / Environmental Engineer (MSc)

Sabri ÖNER / Environmental Engineer (MSc)

Yunus Emre GÜNEŞ / Energy Systems Engineer

Tufan YILDIZ / Environmental Engineer

Meral DURSUN / Environmental Technician

Prepared by the Company

DE SÜRDÜRÜLEBİLİR ENERJİ VE İNŞAAT SANAYİ TİC. LTD. ŞTİ.
Koşuyolu mahallesi, Halili sokak, No:7, 34718, Kadıköy / İSTANBUL
Telefon: +90 (216) 428 76 69
E-mail: bilgi@demirenerji.com
Web adresi: www.demirenerji.com

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Climate change is the greatest global challenge of our time. The decisions taken today will shape not only the future of cities, but also the fate of our planet, societies, and future generations. In this process, local governments assume a historic role as the most powerful actors in implementation on the ground.

As Arnavutköy Municipality, we do not see this responsibility as a burden, but as an opportunity to shape the future. Cities are no longer merely expanding spaces; they are living environments being redefined through sustainability, resilience, and innovation. Arnavutköy demonstrates its determination to be a pioneer of this transformation.

With this understanding, we have prepared Arnavutköy's Sustainable Energy and Climate Action Plan (SECAP) through a scientific, data-driven approach aligned with international standards. This work represents a strong step toward implementing global climate objectives at the local level, in line with the goals of the Paris Agreement, the European Green Deal, and the Covenant of Mayors.

Our target to reduce greenhouse gas emissions by 55% by 2030 and 72% by 2034 is not merely a numerical commitment; it is a clear expression of Arnavutköy's vision to become a low-carbon and climate-resilient city. This target reflects a holistic urban development approach that addresses economic growth and environmental responsibility together.

The Sustainable Energy and Climate Action Plan (SECAP) we have finalized goes beyond being a conventional planning document; it is Arnavutköy's green transformation roadmap aligned with global climate goals. Focusing on energy efficiency, renewable energy investments, sustainable mobility, climate adaptation actions, and public participation, this plan provides a strategic framework that will shape the future of our city.

SECAP aims to ensure that Arnavutköy is prepared not only for the needs of today, but also for the world of tomorrow. The success of this process will be possible through the collective commitment of public institutions, the private sector, academia, civil society, and the residents of Arnavutköy. I would like to thank all stakeholders who have contributed to this visionary journey.

We believe that climate-compatible cities are the strong cities of the future. With its bold targets, determined actions, and strong sense of global responsibility, Arnavutköy will continue to be a powerful local representative of a sustainable future. Together, we are driving the transformation toward a greener, more resilient, and more livable Arnavutköy.

Mustafa CANDAROĞLU
Arnavutköy Belediye Başkanı

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Abbreviations

Abbreviation	Description
AR5	Fifth Assessment Report
BAU	Business-As-Usual Scenario
CO_2	Carbon dioxide
COP	Conference of the Parties
CoM	Covenant Of Mayors
C40	C40 Cities Climate Leadership Group
ÇŞİDB	Ministry of Environment, Urbanization and Climate Change
EPDK	Energy Market Regulatory Authority
EVEP	Energy Efficiency Action Plan
GWP	Global Warming Potential
GHG Protocol	Greenhouse Gas Protocol
ICLEI	Local Governments for Sustainability
IEAP	International Local Government Greenhouse Gas Emissions Analysis Protocol
IPCC	Intergovernmental Panel on Climate Change
İBB	Istanbul Metropolitan Municipality
İDEP	Climate Change Action Plan
İETT	Istanbul Electricity, Tramway and Tunnel Establishments
MCA	Multi-Criteria Assessment
MGM	Turkish State Meteorological Service
NASA	National Aeronautics and Space Administration
UNFCCC	United Nations Framework Convention on Climate Change
SG	Greenhouse Gas
SPI	Standardized Precipitation Index
SEİEP	The Sustainable Energy and Climate Action Plan
WMO	World Meteorological Organization

Executive Summary

With the increasing use of fossil fuels and the rise in emissions released into the atmosphere, the pressure on the climate system has intensified each year since the Industrial Revolution. The Intergovernmental Panel on Climate Change's (IPCC) 2021 report, The Physical Science Basis of Climate Change, clearly demonstrates that global warming is an undeniable reality, emphasizing that the changes observed after the 1950s have occurred much faster and more extensively than anything seen in the past millennium. Each decade over the last thirty years has surpassed all previously recorded decadal average global surface temperatures since 1850. It has been scientifically proven that human-induced carbon dioxide emissions intensified by the Industrial Revolution have risen at a pace that exceeds the natural absorption capacity of oceans and forests. If conventional production and consumption patterns continue, climate change is projected to lead to severe environmental losses, ecosystem degradation, widespread fatalities and serious humanitarian crises.

Sustainable Energy and Climate Action Plan (SECAP) Process

The preparation of the Sustainable Energy and Climate Action Plan (SECAP) was carried out in alignment with the methodology established under the Covenant of Mayors (CoM). Based on the SECAP reporting format and the related methodological documents of the Covenant of Mayors, the process progressed **under three main components**:

a) Preparation of the greenhouse gas emission inventory, analysis of the current situation and design of emission mitigation actions

b) Assessment of climate risks and vulnerabilities and development of adaptation actions for sectors that may be affected by climate change

c) Evaluation of energy poverty and identification of intervention areas related to this issue

Greenhouse Gas Calculation and Mitigation

For the year 2024, the total energy consumption of Arnavutköy district including industry, the airport, energy production and fugitive emissions was calculated as 9,857,001 MWh, while greenhouse gas emissions were calculated as 2,982,237 tCO_2e. When these sectors are excluded, the district's energy consumption amounts to 4,170,038 MWh and its greenhouse gas emissions to 1,353,247 tCO_2e.

When industry, the airport, energy production and fugitive emissions are excluded, the sectoral distribution of Arnavutköy's total greenhouse gas inventory is as follows:

- **Buildings:** 46.7%
- **Transport:** 37.8%
- **Solid waste and wastewater treatment:** 13.6%
- **Other emissions from agriculture, livestock and agricultural irrigation:** 1.9%

For 2024, the per capita emission level was calculated as **3.92 tCO_2e**. In the mitigation projection prepared by considering population growth trends, the baseline scenario for 2030 is estimated as **3.80 tCO_2e**. With the implementation of the mitigation actions defined within the

scope of the Plan, it is aimed to reduce the per capita emission level to **1.64 tCO_2e**. In this regard, various actions have been defined under the themes of buildings at urban and institutional scale, renewable energy, transport, waste, wastewater, agriculture and livestock.

Climate Change Adaptation and Climate Risks

In the climate risk assessment conducted for Arnavutköy, the main risks identified are:

- **Extreme heat**
- **Floods and inundations**
- **Forest fires**

In addition to these, other meteorological risks such as urban heat island effect, strong winds, hail, storms and tornadoes are also considered significant threats. The sectors found to be most vulnerable to these risks are **transportation**, **water resources** and **urban infrastructure**.

To enhance Arnavutköy's resilience against climatic risks, adaptation actions have been developed in the areas of **water management, green spaces, agriculture, public health** and **disaster management**.

Energy Poverty

Energy poverty is defined as the population that has limited or no access to energy and is therefore at risk of poverty. To assess this risk, specific indicators have been identified and various actions have been developed under the themes of **households**, **buildings** and **policies** to reduce energy poverty in Arnavutköy in the future.

1. INTRODUCTION

1.1. Purpose

The primary objective of the Sustainable Energy and Climate Action Plan (SECAP) is to enhance energy efficiency in urban areas, reduce greenhouse gas emissions, promote the use of renewable energy sources, build a climate-resilient urban structure and ensure social equity throughout these processes. The Plan is developed within the framework of the Covenant of Mayors for Climate and Energy commitments, setting targets to achieve at least a 55% reduction in greenhouse gas emissions by 2030, assess and mitigate energy poverty risks and strengthen climate change adaptation capacity.

1.2. Scope

The SECAP covers all settlement areas within the municipal boundaries and has been prepared with a holistic approach that encompasses mitigation, adaptation and energy poverty dimensions**.**

Under the mitigation component, the Plan addresses: Buildings and Urban Areas, Transportation, Renewable Energy and Waste Management.

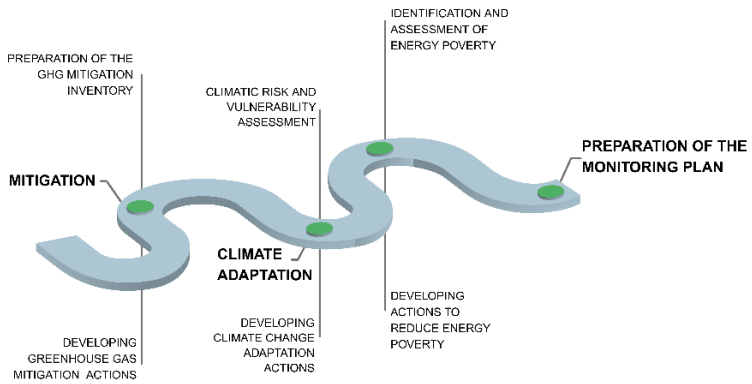
Under the adaptation component: Water Management, Agriculture, Green Areas, Disaster Management and Public Health are considered.

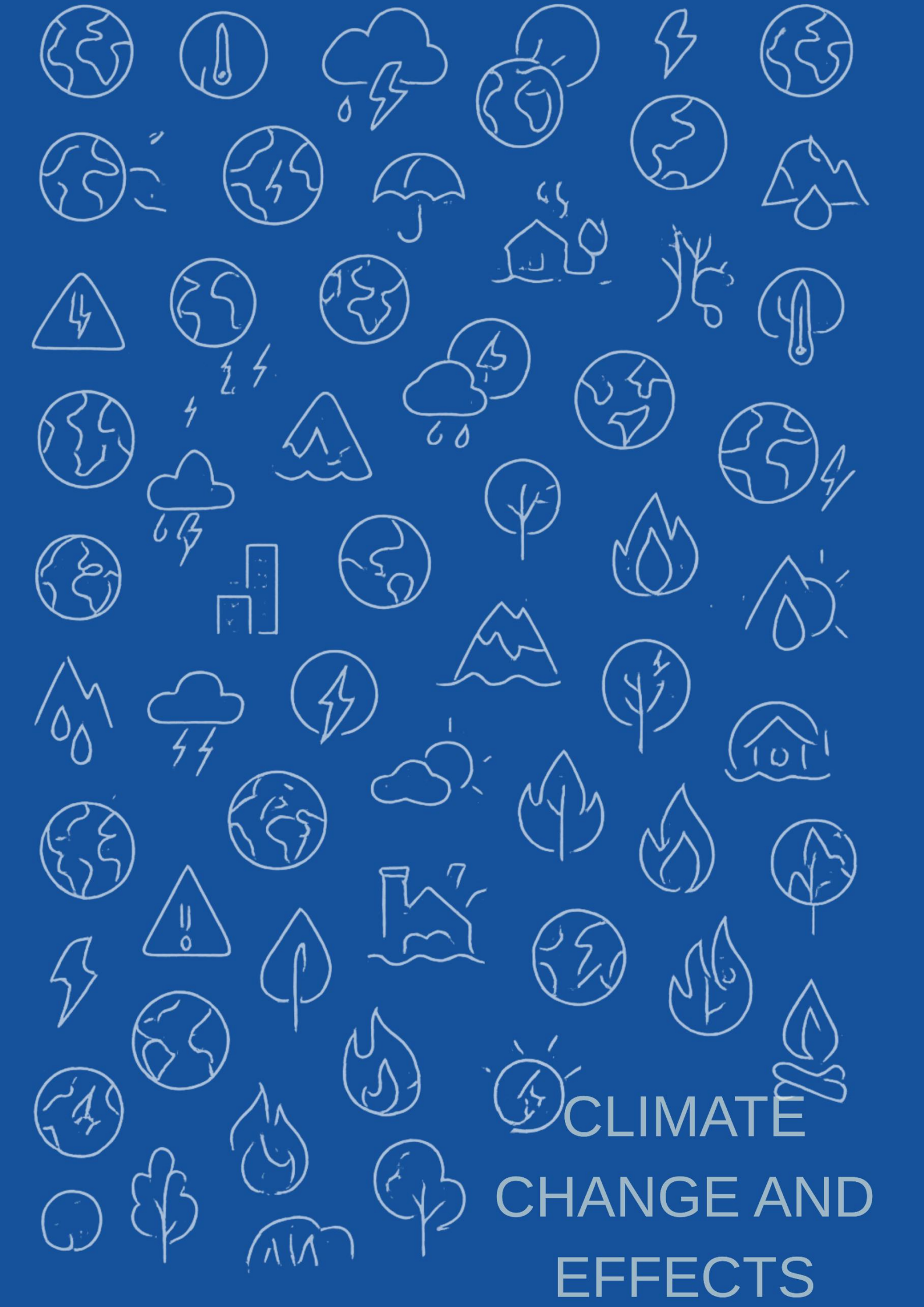
Under the energy poverty component: Buildings, Households and Policies are evaluated to develop the sustainability roadmap of the Arnavutköy Municipality.

Geographical Scope: The geographical scope of the Plan is limited to the administrative boundaries of the municipality. However, during the implementation phase, coordination with public institutions, private sector organizations, universities and nongovernmental organizations operating across the province is foreseen.

Time Frame: The Plan covers the 2025–2030 period, with strategic goals and action plans expected to be reviewed and updated in five-year intervals.

Social Dimension: The SECAP is not merely a technical energy and environmental plan but also a transformation document centered on social equity and inclusiveness. In this context, combating energy poverty, protecting vulnerable groups (such as the elderly, lowincome households, persons with disabilities and women) and strengthening the right to access energy are among the Plan's key social priorities.





CLIMATE CHANGE AND EFFECTS

2. CLIMATE CHANGE AND IMPACTS

2.1. Climate Change

Climate change refers to long term increases in temperature and alterations in weather patterns resulting from the disruption of the Earth's energy balance due to rising greenhouse gas emissions caused by human activities. Compared to the 1850–1900 period, the global average surface temperature increased by 1.1°C between 2011 and 2020 and 2023 was recorded as the hottest year on record. The intensive use of fossil fuels, unsustainable production and consumption patterns, urbanization forms and land use changes have accelerated this process, increasing the frequency and intensity of extreme events such as heatwaves, floods and water scarcity, particularly in cities.

Changes in the climate not only manifest as a rise in temperature but also affect every aspect of life by disrupting the balance of ecosystems. The consequences of climate change include severe droughts, water scarcity, intense wildfires, rising sea levels, floods, melting polar ice, catastrophic storms and declining biodiversity.[1] Moreover, climate related disasters have been occurring with increasing intensity, frequency, duration and in diverse locations in recent years.[2] Globally, between 1998 and 2017, approximately 1.3 million people lost their lives due to natural disasters, while 4.4 billion people were directly affected by them. It can be stated that 91% of the disasters that occurred during this period were caused by floods, storms, droughts, heatwaves and other extreme weather events.[3]

Climate change is not only an environmental issue but also a social and economic crisis. Its effects on food and water security, public health, ecosystem services and infrastructure are becoming increasingly evident across the world. Vulnerable communities those historically least responsible for this process are disproportionately affected, making climate justice and equity-based approaches imperative.

Cities are at the center of both the impacts and the solutions. Demand-side strategies for rapid emission mitigation, nature-based solutions, innovative technologies and just transition policies are coming to the forefront, while local knowledge, the wisdom of Indigenous peoples and multi-level governance mechanisms are of critical importance for the success of climate action.

In this context, the **Covenant of Mayors (CoM)** initiative stands out as a city-led movement that originated in Europe and later expanded globally. CoM aims to encourage local governments, on a voluntary basis, to reduce greenhouse gas emissions, improve energy efficiency and adapt to climate change. In 2016, it merged with the Compact of Mayors to form the **Global Covenant of Mayors for Climate and**

[1] https://www.un.org/en/climatechange/what-is-climate-change
[2] *Meteoroloji Genel Müdürlüğü, 2019 Yılı Meteorolojik Afet Değerlendirmesi Raporu, 2020.*
[3] *UNISDR&CRED, Economic Losses, Poverty & Disasters 1998-2017, 2018.*

Energy (GCoM), which today represents more than 7,000 cities and over 600 million people worldwide.

Under the GCoM framework, cities prepare greenhouse gas inventories, set targets, develop mitigation and adaptation plans and submit regular progress reports. This process not only strengthens cities' resilience to the climate crisis but also supports the creation of more just, healthy and livable urban environments. In short, initiatives such as CoM and GCoM make local governments active players in global climate solutions.

Climate Change Scenarios

Climate scenarios are critical tools used to understand and project future climate conditions, as well as the potential impacts of human activities and socio-economic developments. These scenarios help policymakers and researchers assess future risks and develop effective climate action strategies.

According to the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report published in 2023, due to human-induced greenhouse gas emissions, the global average surface temperature increased by approximately 1.1°C between 2011 and 2020 compared to the pre-industrial period. This increase has led to widespread and rapid changes across all components of the climate system; the observed impacts on the atmosphere, oceans, glaciers and ecosystems have exceeded the range of natural variability seen over the past few centuries. The IPCC warns that if current trends continue, it is very likely that global temperature rise will surpass the 1.5°C threshold in the coming years. This threshold, set under the Paris Agreement, represents a critical limit exceeding it would significantly increase both the scope and severity of climate-related risks.

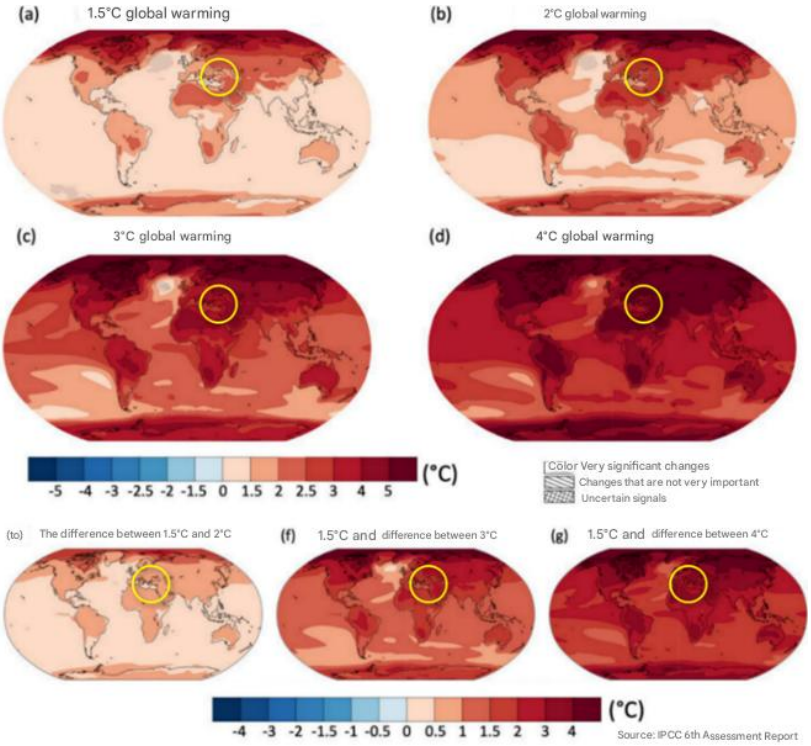


Figure 1 Map models showing global temperature increase

The scenario-based projections used in the **Sixth Assessment Report** are built upon five main development pathways that describe how climate change may evolve in the future. These scenarios model how greenhouse gas emissions might change under different socioeconomic, technological and political conditions and how these changes could affect the climate. The projected impacts of temperature rise under various scenarios are not limited to atmospheric variability but directly influence many sectors such as agriculture, water resources, health, ecosystems and infrastructure systems. Even in a 1.5°C warming scenario, a noticeable increase in the frequency of tropical storms, a mitigation in snowfall and striking changes in drought and extreme precipitation events

are projected. In this scenario, for instance, drought risk could increase by 2 to 2.5 times, while the intensity of heatwaves could rise by about 1.9°C. If the temperature increase exceeds this threshold, the impacts become even more severe and destructive. If the temperature rise exceeds this threshold, the impacts become even more devastating. According to the IPCC, if global warming reaches 2°C or higher, the frequency of tropical cyclones could increase by up to 30%, snow cover could decrease by as much as 25%, rainfall intensity on wet days could rise by 2.8 times and sea level rise could reach up to five times the global average. This situation would cause severe and irreversible damage, particularly to low-lying coastal areas, agriculture-based economies and water resources.

These projections make it essential to shape local and regional climate policies through a scenario-based approach. Climate change is not merely an issue of rising average temperatures; it has the potential to trigger simultaneous crises across multiple sectors from food production to infrastructure security, from biodiversity to public health. Therefore, in locally developed Sustainable Energy and Climate Action Plans, the scientific scenarios presented by the IPCC should be taken as a foundation. Vulnerable areas should be prioritized and resilient urbanization and adaptation strategies should be developed to address climate risks.

Türkiye's Climate Change Scenarios

In Türkiye, evaluations conducted by the Turkish State Meteorological Service indicate that the frequency of disasters has increased dramatically, particularly since the 2000s. The year 2022, with a total of 1,030 extreme events, was recorded as the year with the highest number of extreme weather occurrences. Meteorological disasters such as floods, storms, hail, frost, snow and drought frequently affect the country. An analysis of the 2022 events shows that storms, floods and hailstorms were the most common types of disasters experienced that year.[4]

Climate change projections for Türkiye have been developed by the Turkish State Meteorological Service using scenarios and global climate models formulated within the framework of the IPCC's Fifth Assessment Report (AR5). These projections reveal the spatial and temporal variations of Türkiye's climate, assessing both temperature and precipitation trends and providing a scientific basis for regional risk analyses and adaptation strategies. Under the RCP4.5 scenario, a decrease in annual average precipitation across Türkiye is projected, with mitigations reaching 20–40% particularly in the summer and autumn seasons. In the RCP8.5 scenario, this decrease becomes even more pronounced, with summer precipitation expected to decline by more than 50%. The models also indicate irregularities in precipitation patterns an increase in some regions, but an overall decreasing trend. The Southeastern Anatolia, Central Anatolia and Mediterranean regions are identified as areas where significant mitigations in summer and autumn rainfall are expected from the mid-century onward.

[4] 2022 Yılı İklim Değerlendirmesi MGM, 2023.

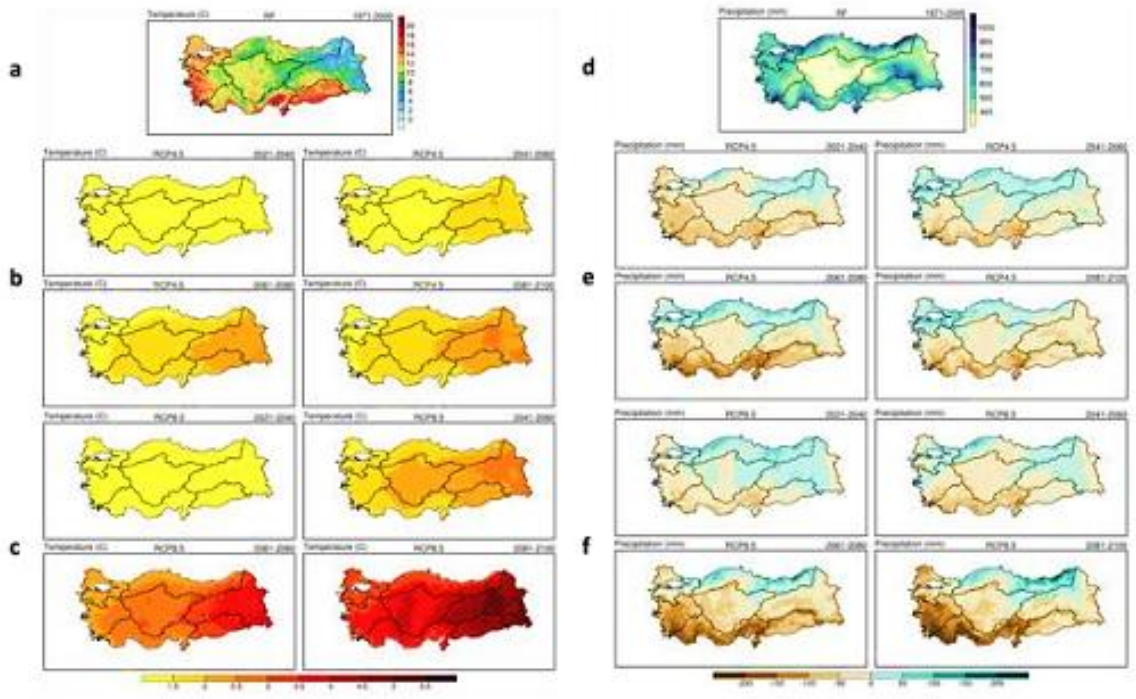


Figure 2 Changes in average temperature and total precipitation during the reference period according to RCP4.5 and RCP8.5

Projections related to extreme weather events are also noteworthy. In recent years, Türkiye has experienced an increase in both the frequency and intensity of extreme events such as heatwaves, droughts and sudden heavy rainfall. Climate models indicate that this trend will continue, with an expected rise in the number of hot days, hot nights and tropical nights during the summer months and a decrease in the number of frost days and cool nights. Additionally, an upward trend in short-duration intense rainfall is particularly evident in parts of the Black Sea, Marmara and Eastern Anatolia regions. These changes are expected to heighten the risks of disasters such as floods, droughts and wildfires.

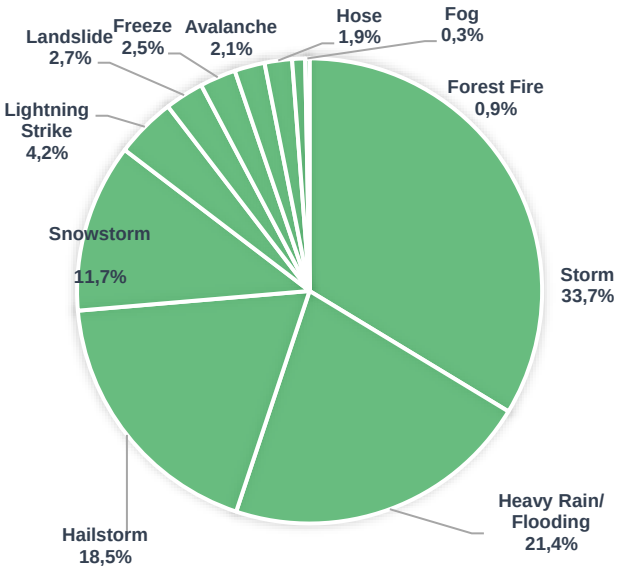


Figure 3 Distribution of meteorological disasters occurring in 2022

In conclusion, Türkiye's climate projections, in line with global trends, indicate that temperature increases are inevitable, while changes in precipitation will have varying regional impacts. These scientific findings underscore the urgent need to develop timely measures at both national and local levels. They also highlight the necessity of integrated policies that take climate risks into account across multiple sectors, particularly energy, water, agriculture, transportation and disaster management.

2.2. International and National Negotiations

The global threat posed by climate change began to draw the attention of scientists in the mid-20th century, but it was the 1972 Stockholm Conference that marked the first serious consideration of the issue by the international community. This conference highlighted, for the first time on a global scale, the link between environmental degradation and development; however, concrete scientific evidence on climate change was still limited at the time. The subsequent 1979 World Climate Conference emphasized the need for systematic monitoring of atmospheric changes, laying the groundwork for the establishment of the Intergovernmental Panel on Climate Change (IPCC) in 1988.[5]

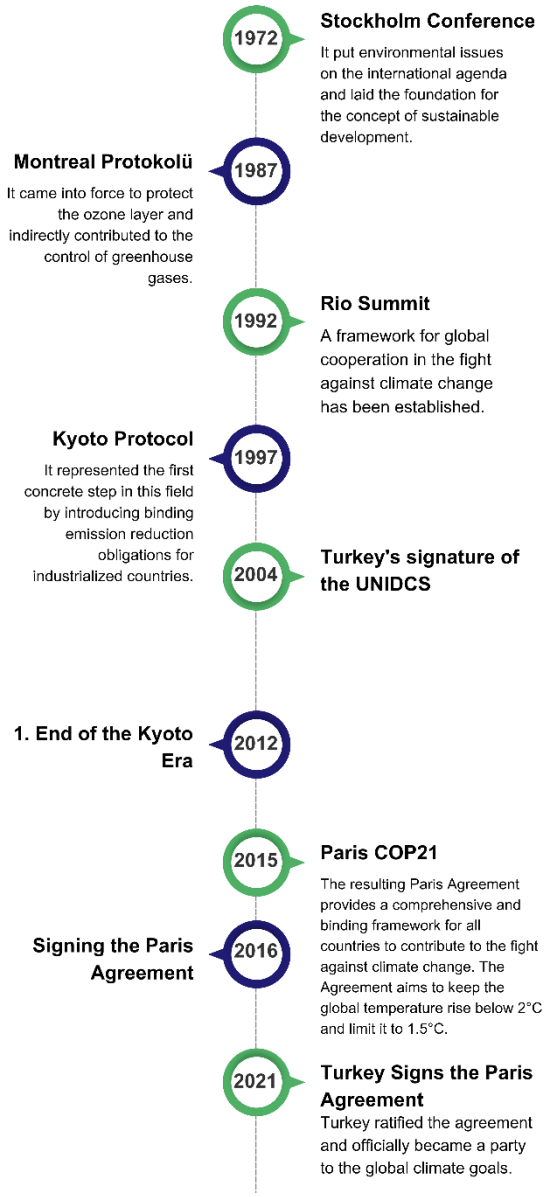


Figure 4 The international climate negotiations process

The First Assessment Report published by the IPCC in 1990 clearly demonstrated that human-induced greenhouse gas emissions were altering the climate system. This scientific evidence formed the foundation for the United Nations Framework Convention on Climate Change (UNFCCC), adopted at the 1992 Rio Summit. [6] The Convention obligated countries to limit greenhouse gas emissions based on the principle of common but differentiated responsibilities, while also recognizing the historical responsibility of developed nations.

With the first Conference of the Parties (COP1) held in Berlin in 1995, concrete targets began to be discussed and two years later, at COP3, the Kyoto Protocol was adopted as the first agreement imposing binding emission mitigation commitments on developed countries. However, the withdrawal of the United States and the exclusion of emerging economies such as China limited the effectiveness of the protocol, paving the way for a new search for a more inclusive climate regime. This search culminated in COP21, held in Paris in 2015, where the Paris Agreement was adopted marking a new turning point in the global fight against climate change.[7] The Paris Agreement aims to keep the increase in global average temperature well below 2°C above pre-industrial levels while pursuing efforts to limit it to 1.5°C. It involves all countries in the process through their nationally determined contributions (NDCs) for emission mitigations. In this sense, the Paris Agreement replaced Kyoto's

[5] *UNFCCC. History of the Convention.*
[6] *IPCC. (1990). First Assessment Report*
[7] *UNFCCC. (2015). Paris Agreement.*

approach which imposed obligations only on developed countries with a framework that shares responsibility among all nations

Following the Paris Agreement, climate negotiations have expanded their focus beyond emission mitigation to include adaptation, climate finance, technology transfer and loss and damage. Developing countries, in particular, have emphasized that nations with historical responsibility must commit to providing financial support to enhance their resilience against the impacts of climate change.

At this stage, international climate negotiations have evolved from a purely science-based technical process into a multidimensional diplomatic platform encompassing issues of development, justice, vulnerability and global cooperation. The COP30 conference, to be held in 2025 in Belém, Brazil, will mark a critical milestone, as countries are expected to submit their updated nationally determined contributions (NDCs) under the Paris Agreement and define the direction of climate goals beyond 2030.

Before becoming a Party to the United Nations Framework Convention on Climate Change (UNFCCC), Türkiye took its first institutional step in this field by establishing the Climate Change Coordination Board in 2001. By 2009, the Department of Climate Change was established under the General Directorate of Environmental Management within the Ministry of Environment and Urbanization and administrative coordination of climate-related efforts began to be carried out through this unit.

Taking into account its national circumstances and level of development, Türkiye published the “National Climate Change Strategy” document in May 2010. This document outlined the goals and policies to be pursued in sectors such as transportation, industry, buildings, waste management and agriculture.

In terms of legal responsibilities, the Energy Efficiency Law, which came into force in 2007, introduced regulations that encompass not only the energy sector but also all institutions and individuals nationwide. Within this framework, new action plans, support mechanisms and obligations were defined for the industrial, building and transportation sectors. With the implementation of the Building Energy Performance Regulation in 2008, it became mandatory for all new buildings to obtain an Energy Performance Certificate starting from 2011.

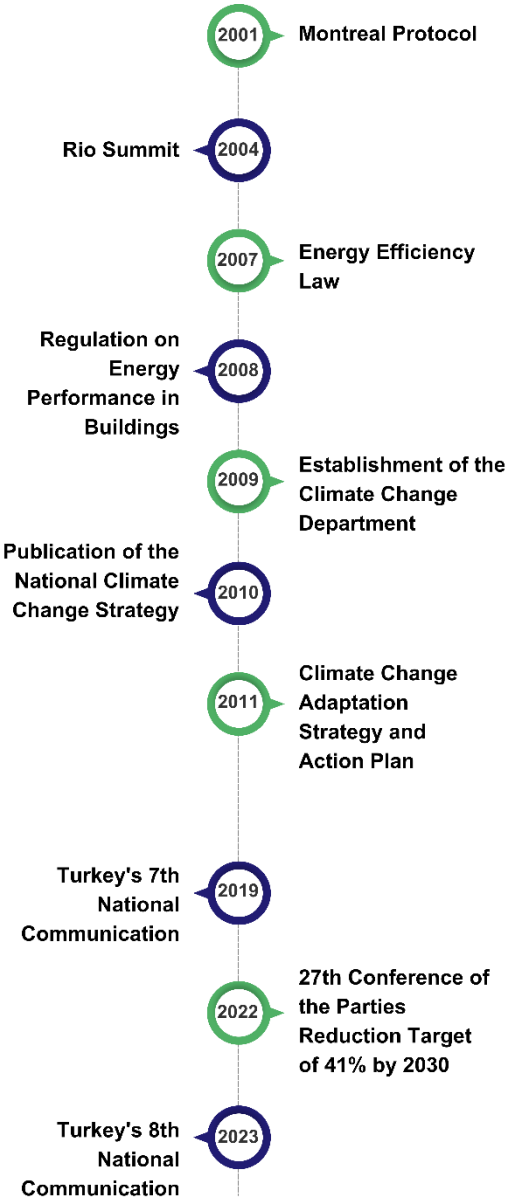


Figure 5 National efforts

The Regulation on Increasing Efficiency in the Use of Energy Resources and Energy (No. 28097), published in 2011, provides various incentives for those who voluntarily participate in projects aimed at reducing energy intensity. At the same time, the legal framework for the use of local renewable energy sources was strengthened, leading to a significant increase in solar and wind power plants. The 'Climate Change Adaptation Strategy and Action Plan,' prepared by the Ministry of Environment and Urbanization in 2011 through a broad participatory process, focused on five main areas: water resource management; agriculture and food security; protection of biodiversity and forest ecosystems; disaster risk management and public health.

At COP27, held in 2022, Türkiye's then Minister of Environment, Urbanization and Climate Change announced the country's updated greenhouse gas mitigation targets. According to the first Nationally Determined Contribution (NDC), greenhouse gas emissions were projected to reach 1,175 million tons of CO_2 by 2030. Under the new commitment, this target was revised to 695 million tons of CO_2e. Thus, the original mitigation target of 21% was updated and increased to 41%.

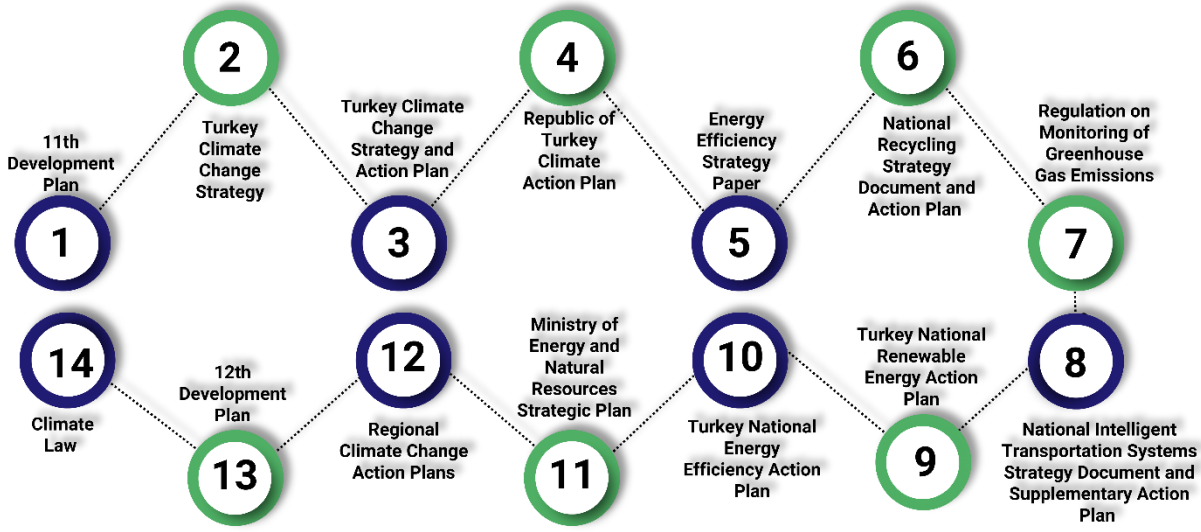


Figure 6 Türkiye's national climate change policy documents

In Türkiye, significant policy documents have been developed at both national and regional levels to address climate change. In this context, the Regional Climate Change Action Plans, published in March 2021 under the leadership of the Ministry of Environment, Urbanization and Climate Change, were prepared through a holistic approach that incorporates both mitigation and adaptation components. These actions are categorized sectorally under thematic areas such as disaster management, energy, transportation, coastal management, urban infrastructure, air quality, water resources, agriculture and livestock, forestry, ecosystems and biodiversity, public health, socio-cultural structure and economy. Beyond these plans, Türkiye is currently in the process of developing roadmaps aimed at achieving low-carbon development and net-zero emission targets for 2030 and 2053. In particular, long-term strategic visions are being advanced to strengthen the country's alignment with its international commitments and the Paris Agreement.

The 12th Development Plan, published at the end of 2023, as in previous plans, includes policy frameworks aimed at combating climate change. It envisions new steps toward regulatory reforms, strengthening governance mechanisms and enhancing inter-institutional coordination.

The plan also emphasizes the preparation of sectoral roadmaps and the promotion of green transformation processes at the national level. In parallel with this, Türkiye's first Climate Law Proposal was submitted to the Grand National Assembly of Türkiye (TBMM) on February 21 2025 and was approved by the TBMM Environment Commission on February 27, 2025. However, after the first four articles were adopted in the General Assembly, the proposal was withdrawn and sent back to the commission on April 15, 2025, due to public pressure and opposition objections. Although it has not yet been enacted, this draft law assigns significant responsibilities to local governments in addressing climate change. It includes various provisions aimed at enabling cities and municipalities to adapt to climate change and reduce greenhouse gas emissions. The main local responsibilities and support mechanisms outlined in the draft are summarized below:

Local Climate Action Plans (YIDEP)

Under the proposed climate law, it is planned to make it mandatory for each province to develop a comprehensive climate action plan under the leadership of the governor's office through the cooperation of metropolitan municipalities in metropolitan areas and provincial municipalities and special provincial administrations in other regions. These plans are expected to include both targets for reducing greenhouse gas emissions and strategies for adapting to climate change.

Provincial-Level Coordination Mechanisms

To guide climate-related decision-making processes at the provincial level, a *Provincial Climate Change Coordination Board* will be established in each province under the chairmanship of the governor. This board will consist of representatives from relevant public institutions and local governments and will ensure the coordinated approval and implementation of the Provincial Climate Action Plans (YIDEP).

Sustainable Urban Development

Cities account for 60–80% of national energy consumption and approximately 75% of carbon emissions. This highlights the critical importance of sustainable urbanization and low-carbon urban infrastructure planning. However, while the draft law identifies priorities in this area, it does not include comprehensive regulations regarding urban planning.

Financial and Capacity Development Support

Within the framework of the *Climate and Disaster-Resilient Cities* initiative, implemented in cooperation between Ilbank and the World Bank, technical and financial support will be provided to local governments. The program will prioritize projects aimed at enhancing preparedness for climate-related disasters and strengthening the resilience capacity of cities.[8]

2.3. Türkiye's 2053 Net-Zero Roadmap

Countries that are parties to the Paris Climate Agreement are developing strategies to transition toward a net-zero emission economy in line with global climate goals and are updating these strategies in parallel with international developments. In this context, Türkiye has been taking significant steps based on its Net Zero Emission vision, aligned with its goals of sustainable

[8] *https://iklim.gov.tr/Türkiyenin-ilk-iklim-kanunu-geliyor-haber-4431*

environmental policies and enhancing social welfare. Accordingly, Türkiye ratified the Paris Agreement in 2021 and declared its commitment to achieving net-zero emissions by 2053.[9]

Türkiye's climate target envisions greenhouse gas emissions peaking no later than 2038, followed by a gradual mitigation to reach net-zero levels by 2053.[10] This goal represents not only an environmental necessity but also a strategic transformation vision at the core of Türkiye's long-term development perspective. The *Long-Term Development Strategy (2024–2053)*, prepared within the framework of the Twelfth Development Plan, provides the main roadmap for this transformation.[11] The strategy aims to position Türkiye as a globally leading country in areas such as science, technology, production and trade by 2053, while also becoming a strong actor that contributes to international peace and prosperity through the preservation of its national values. Within this framework, comprehensive and structural transformations are planned to be implemented across the agriculture, industry, energy, transportation and service sectors to achieve net-zero emissions.

The key pillars of the transition to a carbon-neutral economy include energy supply security, expansion of renewable energy capacity, investments in green hydrogen and energy storage, digitalization, circular economy practices and diversification of green financing instruments. In this process, the private sector is expected to contribute an amount equivalent to 1% of the annual GDP, while total investment needs supported by public investments are projected to reach approximately 1.7% of the national income.[12]

[9] *T.C. Çevre, Şehircilik ve İklim Değişikliği Bakanlığı (2021). Paris Anlaşması Onayı ve Türkiye'nin 2053 Net Sıfır Emisyon Taahhüdü.*
[10] *Türkiye Cumhuriyeti İklim Değişikliği Başkanlığı (2023). Türkiye'nin İklim Değişikliği Stratejisi ve Hedefleri.*
[11] *T.C. Strateji ve Bütçe Başkanlığı (2023). On İkinci Kalkınma Planı (2024–2028) ve Uzun Vadeli Gelişmenin Stratejisi (2024–2053).*
[12] *ÇŞİDB. (2023). Türkiye 2053 Uzun Vadeli İklim Stratejisi*

ARNAVUTKOY OVERVIEW

3. OVERVIEW OF ARNAVUTKÖY

Located on the European side of Istanbul, Arnavutköy is the city's fourth-largest district with a land area of 506.52 km². Positioned at 41°12′ north latitude and 28°44′ east longitude, the district is bordered by the Black Sea to the north, Eyüpsultan to the east, Sazlıdere Dam, Başakşehir, Esenyurt and Büyükçekmece to the south and Çatalca to the west. With an average elevation of 119 meters, Arnavutköy stands out as the host of major transportation projects such as Istanbul Airport.

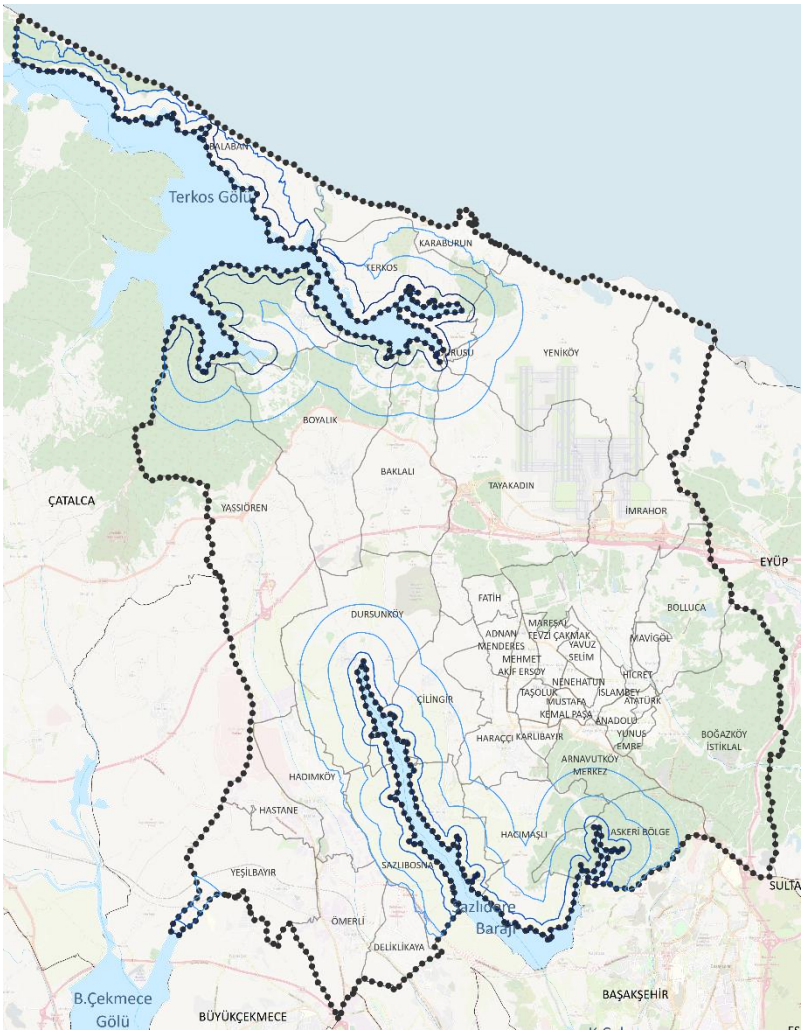


Figure 7 Arnavutköy district and neighborhood boundaries

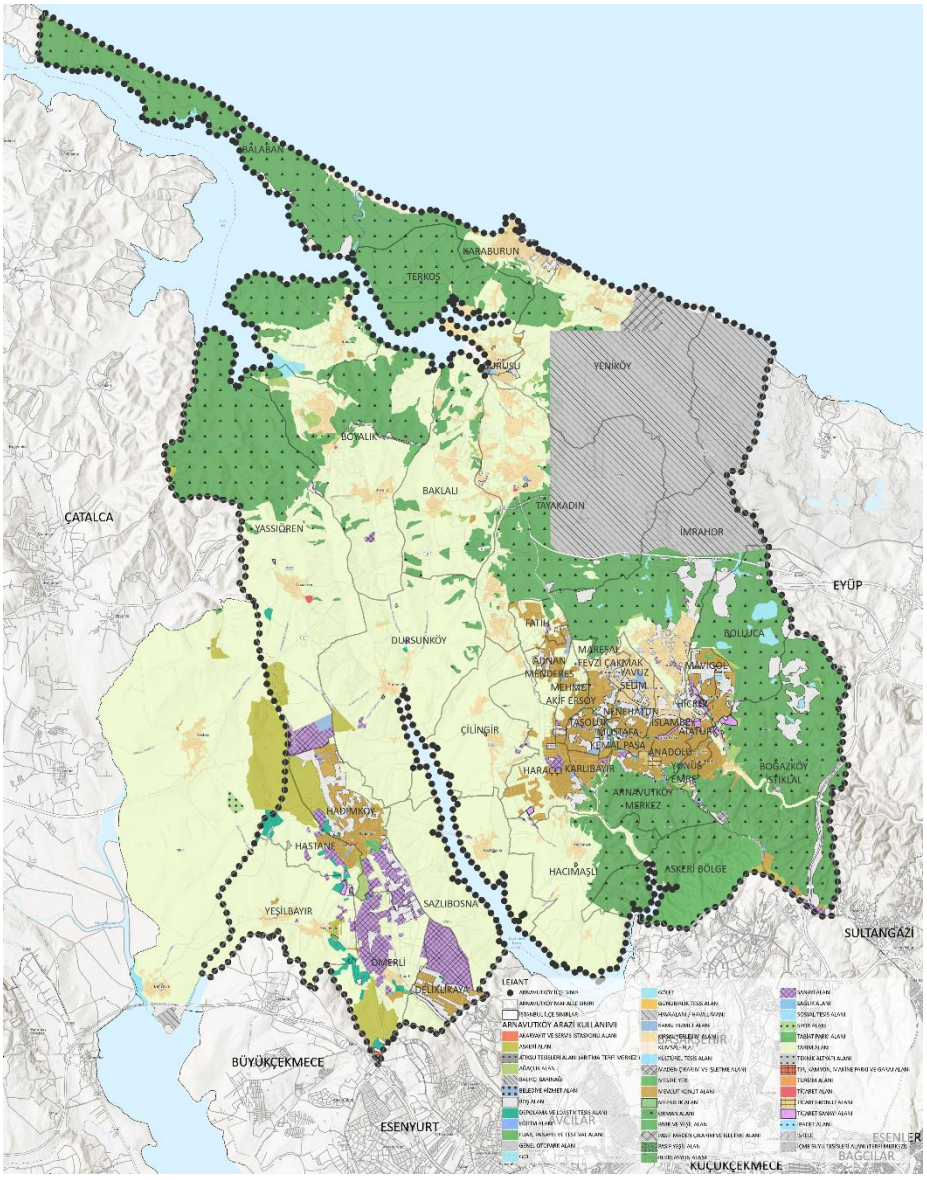
Arnavutköy is administratively composed of 38 neighborhoods, each exhibiting diverse demographic and physical characteristics, encompassing both rural and urban settlement patterns. Among these, neighborhoods such as Anadolu, Arnavutköy Merkez, Hadımköy, Boğazköy İstiklal, Hicret, İslambey and Taşoluk stand out as more developed residential areas, while Durusu, Karaburun and Sazlıbosna, as well as Tayakadın, retain a more rural and natural character.

The neighborhoods vary in size. For example, Anadolu Neighborhood covers approximately 1.536 km² and had a population of 38,263 as of 2023. İslambey Neighborhood has a similar land area but hosts around 21,425 residents. Arnavutköy Merkez Neighborhood serves as the administrative and commercial hub of the district, covering about 6,7 km² with a population exceeding 20,000.

The geographical locations and land areas of the neighborhoods lead to variations in the planning and provision of social services, transportation and infrastructure across the district. Settlements such as Tayakadın Neighborhood are among the areas with high development potential due to new transportation corridors and logistics investments, holding strategic importance thanks to their proximity to Istanbul Airport. On the other hand, northern coastal neighborhoods like Karaburun stand out for their natural landscapes and ecological characteristics.

Figure 8 General view of Arnavutköy

Land Use



Arnavutköy District, with its large surface area and diverse land uses, is one of Istanbul's key regions where both urban and rural characteristics coexist. Within the district boundaries, forested areas, agricultural lands, industrial zones, residential areas, logistics facilities and infrastructure uses are distributed in a balanced manner. The northern parts are characterized by dense forests and water basins, while the southern and eastern sections host a higher concentration of industrial and residential areas.

Figure 9 Land use in Arnavutköy

The largest land use type in Arnavutköy is agricultural land, which accounts for 34.62% of the district's total area. This is followed by forest areas, which cover 30.61% of the total land. In addition, Istanbul Airport occupies 21.19% of the

district's total area. Residential areas account for 5.31%, while industrial zones represent 1.74%, corresponding to approximately 958.3 hectares.

In the north, dense forest areas and the airport zone dominate the landscape, while the eastern and southern parts feature urban development areas, as well as commercial and industrial zones. Agricultural lands are mainly concentrated in the western and southwestern parts of the district. This diversity highlights Arnavutköy's strategic position in terms of both ecological value and economic activity.

Land Use Functions	Area (ha)	Land Use Functions	Area (ha)
Agriculture Area	192.329	Fuel and Service Station Area	275
Forest Area	168.946	Pond	230
Airport Area	116.880	Lake	230
Housing Area	29.296	Lakes and Ponds	230
Industrial Area	9.583	Wooded Area	211
Waterway Area	3.010	Administrative Facility Area	104
Park Area	1.550	Wastewater Facilities Area (Treatment-Pumping Center)	62
Trade Area	1.546	Municipality Service Area	62
Storage and Logistics Facility Area	1.170	Trade+Industrial Area	50
Education Area	1.108	Fair, Fair and Festival Area	32
Recreation Area	898	Police Station Service Area	16
Trade+Residential Area	660	General Parking Area	14
Military Area	614	Fishing Shelter	10
Technical Infrastructure Area	574	Kindergarten Area	10
Sports Facility Area	458	Cultural Facility Area	10
Worship Space	412	Market Area	10
Vacant Area	370	Commercial+Residential+Parking and Garage Area	10
Cemetery Area	361	**Total**	**555.120**
Health Facility Area	310		

Table 1 Spatial distribution of land use in Arnavutköy

Demographic Structure

As of 2024, Arnavutköy District has a population of 344,868, making it one of the fastest-growing districts in Istanbul. The male population accounts for 51.4% (177,241 people), while females make up 48.6% (167,627 people), a distribution similar to Istanbul's overall demographic structure. In 2024, Istanbul's total population was recorded at approximately 15.9 million, with males representing 50.2% and females 49.8%. Compared to these averages, Arnavutköy has a slightly more male-dominated population, which is associated with the high proportion of young, male labor migrants settling in the district.[13]

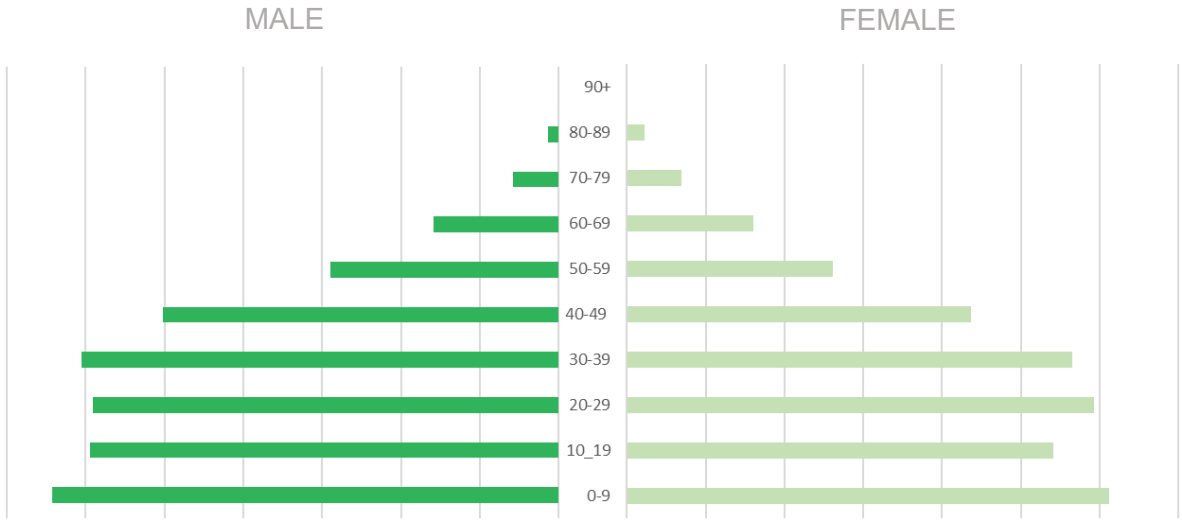


Figure 10 Arnavutköy population pyramid

[13] *TÜİK ADNKS (Adrese Dayalı Nüfus Kayıt Sistemi), 2024*

The median age in Arnavutköy is around 29–30, which is significantly lower than Istanbul's average of 35.4. This indicates that Arnavutköy is among the districts with the highest concentration of young people in Istanbul. The proportion of the population aged 15–64 is approximately 66%, compared to around 70% for Istanbul as a whole. This shows that Arnavutköy has a strong working-age population and due to its younger demographic structure, possesses a more dynamic labor force potential than the city average. In terms of household size, Arnavutköy also differs from the general pattern in Istanbul. The average household size in the district is 3.7 persons, compared to 3.1 across the city.

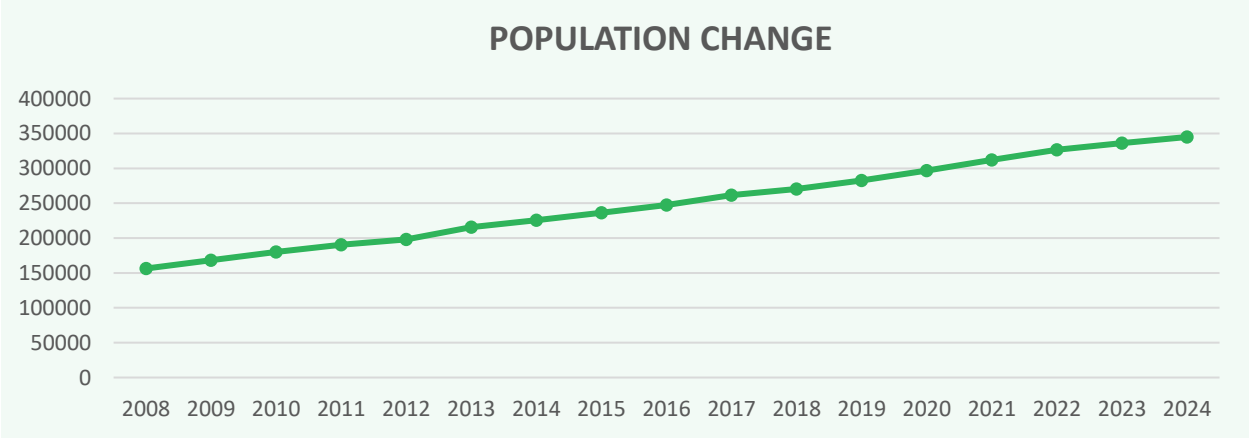


Figure 11 Arnavutköy population growth chart

The population of Arnavutköy has shown a steady upward trend over the past decade. This growth is directly linked to the implementation of large-scale infrastructure projects such as Istanbul Airport and the Northern Marmara Motorway as well as the development of new residential areas. In 2009, the district's population was around 175,000 and by 2024 it had reached 344,868, marking an increase of approximately 97%. During the same period, Istanbul's total population grew by about 22.7%. This comparison clearly indicates that Arnavutköy's population growth rate is far above the Istanbul average.

The population is not evenly distributed across the neighbourhoods of the district. The most densely populated neighbourhoods are Arnavutköy Merkez, Anadolu, and İslambey. These areas have become attraction centres due to their proximity to social amenities and transportation corridors. This demographic density necessitates strategic interventions at various scales in the planning of many urban services, particularly transportation, social services, and energy consumption. While the central districts of Istanbul have reached saturation in terms of development, Arnavutköy continues to maintain its potential as a still developing area.

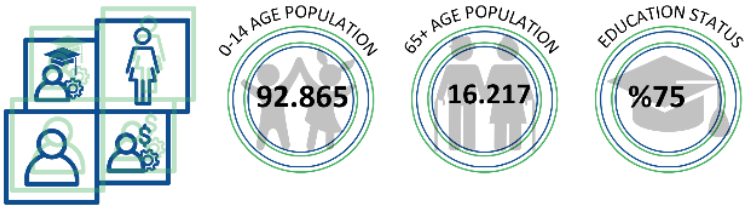


Figure 12 Socioeconomic indicators

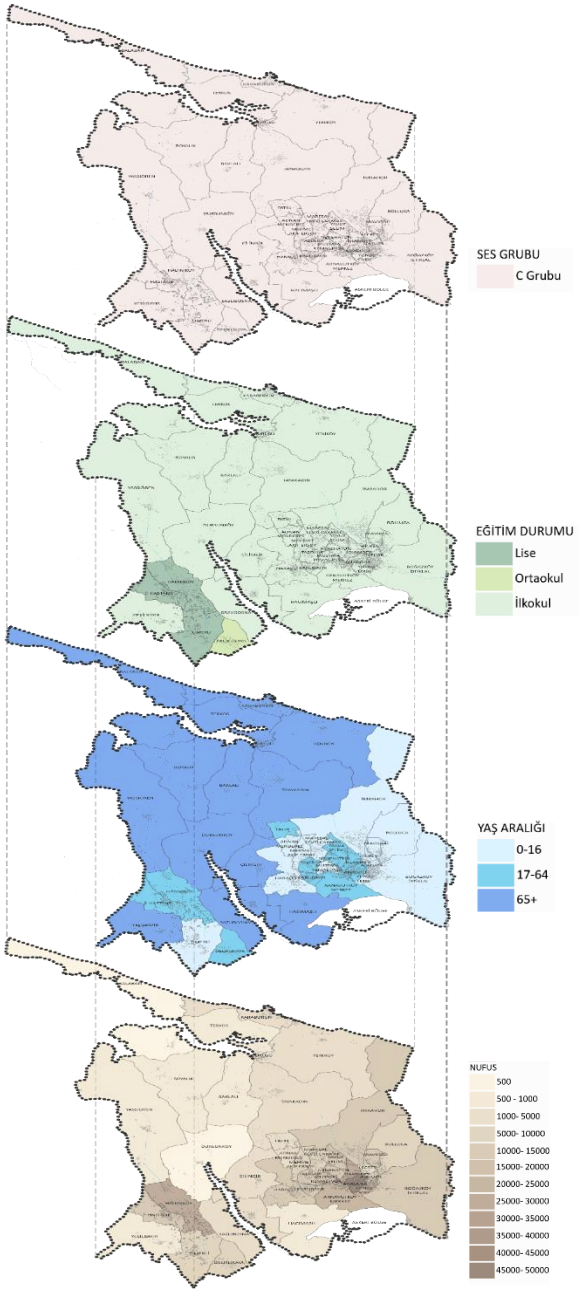


Figure 13 Socioeconomic indicators

In terms of education level, Arnavutköy falls below the Istanbul average. In the district, the proportion of individuals with only primary school education is as high as 76%, while the share of those with university or higher education is just 8%. The remaining 17% consists of individuals who have completed secondary or high school education. In contrast, across Istanbul, 23.7% of the population holds a university degree or higher. This gap can be attributed to the relatively limited educational opportunities in the district, lower socioeconomic conditions and the fact that a significant portion of the young population enters the workforce at an early age.

Within the boundaries of Arnavutköy District, there are 38 neighborhoods and the distribution of the population among them shows significant variation. The most densely populated neighborhoods include Arnavutköy Merkez, Hadımköy, Anadolu, Taşoluk, Boğazköy İstiklal, Deliklikaya and İslambey. These neighborhoods are located at the center of residential areas as well as transportation and commercial corridors, which explains their high population density.

According to the Socioeconomic Development Index (SEGE-2022) data updated in 2022 by the Ministry of Industry and Technology, Arnavutköy ranks within the top 17.2% among 973 districts. An examination of the socioeconomic status of the neighbourhoods in the district shows that all neighbourhoods fall into Group C.

Sectoral Structure

The economic structure of Arnavutköy exhibits a mixed character in which industry, agriculture and services are intertwined. While commercial and service activities are concentrated in areas close to the district center, agricultural production, livestock farming and tourism activities are more prominent in rural neighborhoods. In particular, Balaban and Yeniköy neighborhoods have coastal

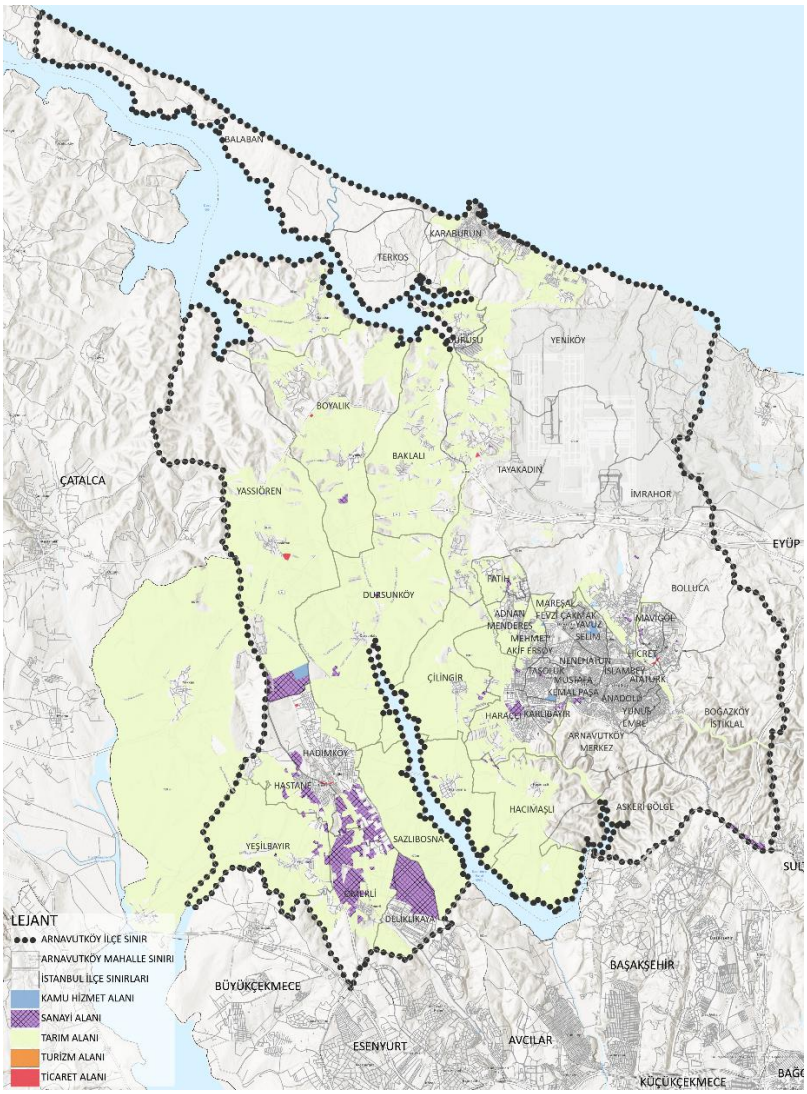


Figure 14 Arnavutköy work areas

tourism potential, whereas agricultural activities continue in areas such as Dursunköy, Yassıören and Hacımaşlı.

With the continuous expansion of industrial and service areas, agricultural production in Istanbul has become increasingly concentrated in the city's peripheral districts. On the European side, Çatalca, Silivri, Arnavutköy and Büyükçekmece are among the main districts where agricultural activities are most prevalent, while on the Asian side, Beykoz and Şile play a similar role. According to the Farmer Registration System (ÇKS) data from 2019, 8.7% of Istanbul's 3,475 registered farmers are located in Arnavutköy, underscoring the district's significance in agricultural production. Rural production remains active even in sparsely populated neighborhoods such as Baklalı, Boyalık, Sazlıbosna and Yeşilbayır.[14]

In terms of the industrial sector, Arnavutköy stands out as one of Istanbul's key districts, with 886 industrial facilities and an employment capacity of 45,757 people. Industrial establishments are largely clustered in and around Hadımköy. Although the district lags behind some of the larger industrialized areas in terms of the number of facilities, it exhibits a notable concentration in terms of employment. While districts such as Başakşehir, Esenyurt, Tuzla, Bağcılar and Umraniye are prominent in industrial development, Arnavutköy represents a significant component of this structure, particularly from an employment perspective. Furthermore, one of Türkiye's 15 private industrial zones Baykar Makina Sanayi ve Ticaret A.S. Private Industrial Zone is located on the border between Arnavutköy and Esenyurt, covering an area of 18.2 hectares. This private industrial zone, specializing in advanced technology production for the defense and aviation industries, not only enhances local employment but also contributes to the transformation of Arnavutköy's economic profile.15

[14] *Kadir Bulut (Mart 2023). Büyük Ölçekli Projelerin Sosyal Hasar Görebilirlik Bağlamında Değerlendirilmesi: İstanbul Arnavutköy İlçesi Örneği.*
[15] *İstanbul Kalkınma Ajansı (2022). 2024–2028 İstanbul Bölge Planı, Ek 1: Mevcut Durum Analizi*

ARNAVUTKOY GREENHOUSE GAS INVENTORY

4. ARNAVUTKÖY DISTRICT GREENHOUSE GAS INVENTORY

4.1. Methodology

Başkanlar Municipalities that are members of the Covenant of Mayors are required to quantify greenhouse gas emissions resulting both from their own operations and from activities within their geographic boundaries. To support this process, the International Council for Local Environmental Initiatives (ICLEI) developed the International Local Government Greenhouse Gas Emissions Analysis Protocol (IEAP) a practical guideline that provides common rules and standardized approaches for local governments to accurately identify and compare their greenhouse gas emissions and implement measurable mitigations.

Through the IEAP, greenhouse gas monitoring processes have been simplified, enabling the compilation and reporting of outcomes from various communities' activities and the creation of a reliable data system. ICLEI assists local governments in their efforts to reduce greenhouse gases that contribute to both climate change and declining air quality. To date, it has provided analytical tools and methodologies to help local authorities measure their emissions, set mitigation targets and achieve those targets.

Each area of activity within the jurisdiction of a local authority requires the preparation of its own greenhouse gas management program. Local government greenhouse gas emission inventories can be divided into two categories: emissions from the local authority's own operations and emissions arising from activities of the community within the administrative area for which the authority is responsible.

For the preparation of a corporate greenhouse gas inventory, the most commonly used international standard is the GHG Protocol. In contrast, the preparation of a city-scale greenhouse gas emission inventory is based on the 2014 IPCC Guidelines for National Greenhouse Gas Inventories developed by the Intergovernmental Panel on Climate Change (IPCC) Working Group on National Greenhouse Gas Inventories.

Base Year

The baseline year is the reference year against which the emission mitigation target will be compared in order to monitor the results of the proposed actions. When determining this year, it is recommended to choose a year with the most reliable data available and without extraordinary events (such as a pandemic). In this context, the baseline year for Arnavutköy has been selected as 2024.

Scope

Within the boundaries of Arnavutköy Municipality, the selected sectors include buildings, energy, transportation, waste and wastewater, agriculture and livestock and greenhouse gas emissions from the industrial sector have also been calculated. However, Arnavutköy Municipality does not have any regulatory authority over the industrial sector, which is largely classified as part of the private sector. Therefore, greenhouse gas emissions from industry have been excluded from the scope of mitigation targets.

Method

In preparing the current greenhouse gas inventory, the activity-based approach most commonly used by cities has been applied. This approach includes all CO_2e (or greenhouse gas) emissions resulting from both direct (through fuel combustion) and indirect (through electricity consumption) energy use within Arnavutköy. While most greenhouse gas emissions consist of CO_2, CH_4 and N_2O emissions are of secondary importance in relation to combustion processes in the residential and transport sectors. All CO_2, CH_4 and N_2O emissions are calculated for each fuel type using the emission factors and global warming potentials (GWP) provided in the IPCC Sixth Assessment Report (AR6).

- **Scope 1 – Direct greenhouse gas emissions*:*** These are emissions from all stationary and mobile greenhouse gas sources owned or directly controlled by the organization. Assets that are owned, leased, or acquired through financial leasing are included in these sources. The scope boundary covers all emission sources under the organization's control. This scope should also include refrigerant gases used in air conditioning systems employed for operational purposes.
- **Scope 2 – indirect energy greenhouse gas emissions:** These are greenhouse gas emissions resulting from the energy purchased for the organization's operations. This scope includes grid electricity as well as other forms of energy used for heating or cooling purposes.
- **Scope 3 – other indirect greenhouse gas emissions:** These are greenhouse gas emissions that are not under the organization's direct control and exclude indirect emissions arising from its activities. Such emissions may result from activities that occur before or after the organization's core operations, from employee travel, or from the activities of institutions not under the authority of Arnavutköy Municipality but serving the residents of Arnavutköy.

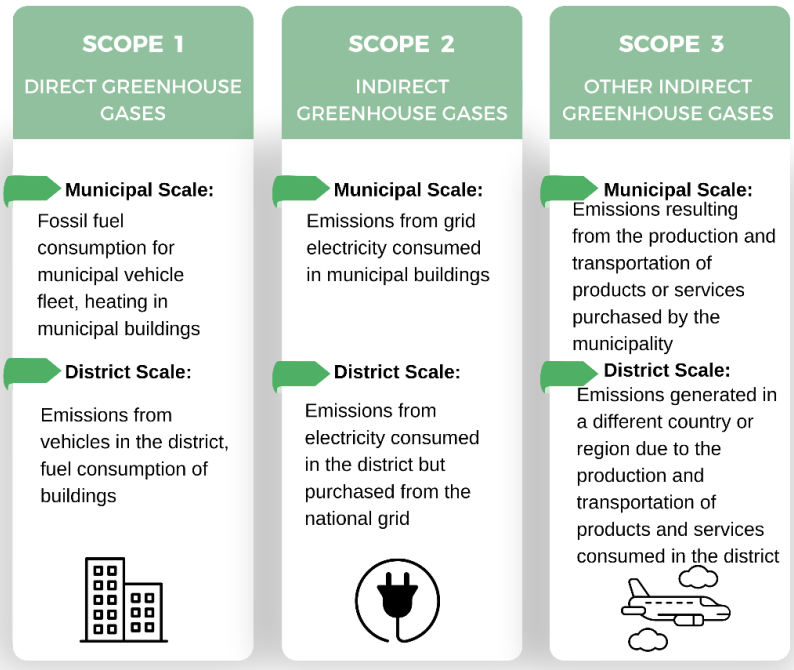


Figure 15 Greenhouse Gases by Scope

The global warming potentials of greenhouse gases specified in the Kyoto Protocol and the greenhouse gases that must be included in greenhouse gas inventories have been used. These are;

- *KIP (Global Warming Potential):* The factor defining the radiative forcing effect based on the mass equivalent of carbon dioxide for a specific greenhouse gas within a specific time interval (GWP).
- *CO_2e (Carbon dioxide equivalent):* A unit used to compare the radiative forcing of a greenhouse gas with that of carbon dioxide.

Table 2 Greenhouse gases and GWP values according to the IPCC and the Kyoto Protocol

Greenhouse Gases	Chemical Formula	Atmospheric lifetime (Year)	Global Warming Effect* (CO_2e) [16]
Carbon dioxide	CO_2	5-200	1
Methane	CH_4	12	27,9
Diazot monoxide	N_2O	114	273
Perfluorocarbons	PFCs	50.000**	7.380-10.000
Hydrofluorocarbons	HFCs	226**	160-14.600
Sulfur hexafluoride	SF_6	3.200	24.300
Trifluoride nitrogen	NF_3	740	17.400
*: Time is dependent. **: This group shows the highest values for greenhouse gases.			

The direct and indirect greenhouse gas emissions of each energy carrier were calculated by multiplying the final energy consumption by the corresponding emission factor. In addition, CH_4 and N_2O emissions from waste and wastewater treatment were calculated and converted to CO_2e.

Data Collection: For the development of this data inventory, an effective division of tasks was established at the institutional level among the administrative units of the local government and at the city scale with other organizations that could influence or provide information on both institutional and urban activities (such as other public institutions, organized industrial zones, various associations and chambers and energy suppliers).

Calculation: Within the boundaries of Arnavutköy Municipality, the following formulas and variables have been used in the calculations of greenhouse gas emissions for Scope 1, Scope 2 and Scope 3 sources according to their respective types.

[16] *https://ghgprotocol.org/sites/default/files/2024-08/Global-Warming-Potential-Values%20%28August%202024%29.pdf*

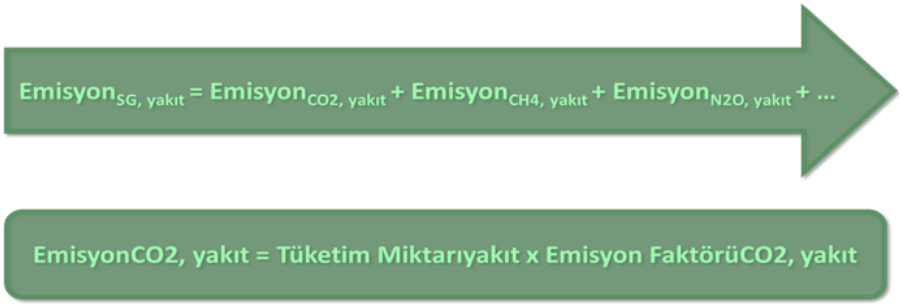


Figure 16 Greenhouse Gas Calculation Formulas

4.2. Greenhouse Gas Inventory

Based on data collected from Arnavutköy Municipality and external stakeholders (such as electricity and gas distribution companies, EPDK and İETT), the 2024 greenhouse gas inventory for Arnavutköy District has been prepared. The inventory covers the sectors selected within the boundaries of Arnavutköy Municipality, namely buildings, energy, transportation, waste and wastewater, agriculture and livestock. Since Arnavutköy Municipality has no regulatory authority over **industry, airports, energy production, or fugitive emissions**, two separate inventories have been prepared one including and one excluding these sources.

As shown in Table 3, for the year 2024, the total energy consumption of Arnavutköy District including industry, airport, energy production and fugitive emissions was calculated as 9,857,001 MWh and the total greenhouse gas emissions as 2,982,237 tCO_2e. According to the table, emissions from fuel and electricity consumption in buildings account for 37.5% of total emissions, while transportation-related greenhouse gas emissions make up 55.2%. Other greenhouse gas emissions from solid waste, wastewater treatment, fugitive emissions, agriculture, livestock and agricultural irrigation constitute 7.3% of total emissions. Emissions from energy production represent a 0.1% share.

Assumptions Made in the Calculation

- The CO_2 emissions from the LTO (Landing and Take-Off) cycle of Istanbul Airport have been included in the inventory based on calculated data provided by İGA. The LTO cycle up to an altitude of 3,000 feet (approximately 914 meters) covers the ascent from take-off up to this altitude and the descent down to this altitude during landing. This boundary has been defined to represent the emissions occurring around the airport that affect local air quality.
  Under the ACA (Airport Carbon Accreditation) program, it is required to assess emissions occurring during this LTO cycle. According to the ACA definition, this process includes emissions from the **approach**, **taxi and ground idle – in**, **taxi and ground idle – out**, **take-off** and **climb** phases. The airport has performed its calculations in accordance with this approach.
  In this context, the LTO emissions for each aircraft landing or taking off from Istanbul Airport are calculated based on their engine types and ground movements using the document published by the European Environment Agency (EEA), titled *"1.A.3.a Aviation - Annex X - LTO Emissions Calculator - 2023 - Protected."* This calculation method enables the estimation of pollutant amounts such as CO_2, NO_x and PM for each aircraft

type using ICAO-certified engine data and the four LTO phases (taxi-out, take-off, climb-out and approach).
These emissions have been evaluated as Scope 1 emissions, in line with the GPC (Global Protocol for Community-Scale GHG Inventories) and similar international standards, as they result from fuel combustion occurring within the district boundaries. However, similar to emissions from industrial facilities, since these are not emissions over which the municipality has direct control, they will not be included in the greenhouse gas mitigation targets to be set under the SECAP. Instead, they will be reported solely for the purpose of presenting the current situation.

- In calculating greenhouse gas emissions from solid waste, it has been taken into account that the waste collected in the district is sent to İSTAÇ's disposal site in Silivri. It is assumed that approximately 75% of the waste at this site is used for energy production at the energy recovery facility, while the remaining 25% is disposed of in the landfill area. Based on this assumption, only 25% of the total solid waste emissions have been included in the district's greenhouse gas inventory.

- The coal consumption amount for Arnavutköy has been calculated based on the total coal consumption data provided in the Istanbul Provincial Environmental Status Report, taking into account the district's population ratio within Istanbul.

Table 3 Arnavutköy district greenhouse gas inventory (including industry, airport, energy production and fugitive emissions), 2024

Arnavutköy Municipality Greenhouse Gas Inventory (Including industry, airports, energy production and fugitive emissions)	Energy Consumption	Greenhouse Gas Emissions	Share in Inventory
	MWh	Ton CO_2e	%
Buildings	**3.571.042**	**1.117.583**	**37,5**
Municipal Buildings and Facilities	11.498	3.908	0,1
Other Buildings and Facilities Outside Municipal Buildings	1.046.485	315.689	10,6
Housing	1.191.836	304.383	10,2
Municipal and Other Street Lighting	16.721	7.746	0,3
Industry	1.304.503	485.857	16,3
Transportation	**6.272.499**	**1.645.353**	**55,2**
Municipal Vehicle Fleet	9.859	2.663	0,1
Public Transportation Municipal Buses	84.124	22.796	0,8
Public Transportation Electric Systems	17.400	8.061	0,3
City Vehicles	1.792.041	478.426	16,0
Civil Airport	4.369.076	1.133.407	38,0
Other Emissions	**75**	**216.596**	**6,7**
Solid Waste Disposal	-	9.006	0,3
Wastewater Treatment	-	175.121	5,9
Fugitive Emissions	-	7.021	0,2
Agriculture, Livestock and Land Use	-	25.413	0,9
Agricultural Irrigation	75	35	0,001
Energy Production	**13.384**	**2.706**	**0,1**

Fuel Consumption for Electricity Generation	13.384	2.706	0,1
Grand Total	**9.857.001**	**2.982.237**	**100,00**

The table below shows that the total energy consumption of Arnavutköy District excluding industry, airport, energy production and fugitive emissions is **4,170,038 MWh**, with a total greenhouse gas emission amount of **1,353,247 tCO_2e**.

Table 4 Arnavutköy district greenhouse gas inventory (excluding industry, airport, energy production and fugitive emissions), 2024

Arnavutköy Municipality Greenhouse Gas Inventory (Excluding industry, airports, energy production and fugitive emissions)	**Enerji Tüketimi**	**Sera Gazı Salımı**	**Envanterdeki Payı**
	MWh	**Ton CO_2e**	**%**
Buildings	**2.266.539**	**631.727**	**46,7**
Municipal Buildings and Facilities	11.498	3.908	0,3
Other Buildings and Facilities Outside Municipal Buildings	1.046.485	315.689	23,3
Housing	1.191.836	304.383	22,5
Municipal and Other Street Lighting	16.721	7.746	0,6
Transportation	**1.903.423**	**511.945**	**37,8**
Municipal Vehicle Fleet	9.859	2.663	0,2
Public Transportation Municipal Buses	84.124	22.796	1,7
Public Transportation Electric Systems	17.400	8.061	0,6
City Vehicles	1.792.041	478.426	35,4
Other Emissions	**75**	**209.575**	**15,5**
Solid Waste Disposal	-	9.006	0,7
Wastewater Treatment	-	175.121	12,9
Agriculture, Livestock and Land Use	-	25.413	1,9
Agricultural Irrigation	75	35	0,003
Grand Total	**4.170.038**	**1.353.247**	**100,00**

As indicated in Figure 17, within the total greenhouse gas inventory of Arnavutköy District excluding industry, airport, energy production and fugitive emissions buildings account for 46.7%, transportation for 37.8%, solid waste and wastewater treatment emissions for 13.6% and other greenhouse gas emissions from agriculture, livestock and agricultural irrigation for 1.9%.

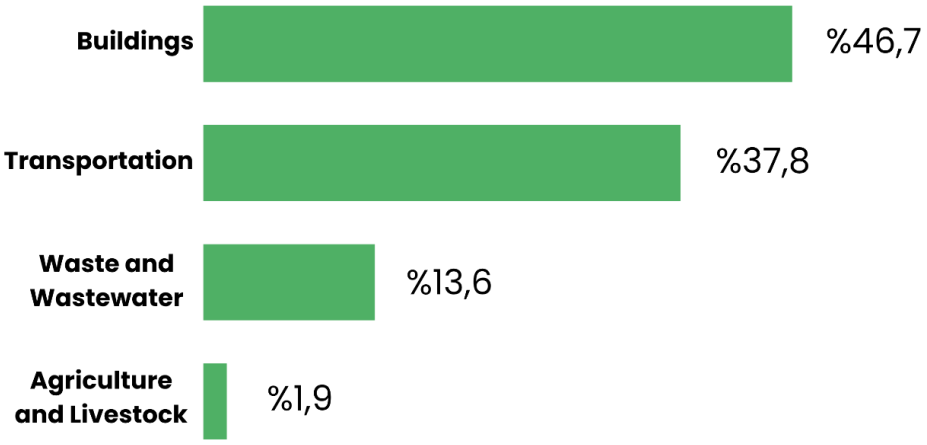


Figure 17 Greenhouse gas distribution by sector, 2024

4.2.1. Buildings and Renewable Energy

The buildings and renewable energy sectors play a critical role in achieving the sustainability goals of Arnavutköy District. To ensure the more effective and efficient delivery of municipal services, modern, functional and accessible service buildings are being constructed due to the inadequacy of existing buildings and the emergence of new service areas. Throughout this process, planning, design and construction activities are carried out in line with user needs and sustainability principles.

Energy audit studies have been successfully completed in the municipality's main service building and annexes with the aim of increasing energy efficiency and creating a sustainable environment. Within the scope of this project, the annual energy consumption data of the buildings were collected and the current energy use levels were thoroughly analyzed. As a result of the energy audit studies carried out to improve energy efficiency in existing municipal buildings, improvements were made in heating, cooling, lighting and insulation systems, leading to a significant reduction in energy consumption.

In addition, within the scope of renewable energy investments, the 500 kW rooftop Solar Power Plant (SPP) project at the Bolluca Market Building has reached the completion stage. Furthermore, construction works are ongoing for two separate rooftop SPP projects: one with a capacity of 400 KWe / 475.2 KWp at the Arnavutköy Sports Facility and another with a capacity of 250 KWe / 348.7 KWp at the Hadımköy Covered Market.

The district's location along the Black Sea coast offers an opportunity to harness wave energy potential and related research is being conducted in Karaburun in this regard. In addition, hybrid renewable energy systems integrating solar, wind and wave energy are being developed to strengthen energy independence. These efforts hold significant potential for reducing greenhouse gas emissions in the buildings and energy sectors, increasing energy efficiency and raising the share of renewable energy use.

In the greenhouse gas inventory of Arnavutköy District excluding industry, airport, energy production and fugitive emissions, the buildings sector has the largest share at 46.7% Figure 17). Since buildings represent a major portion of total emissions, interventions in this sector are crucial to achieving the mitigation target. When the buildings are broken down by use, commercial and

public buildings (tertiary buildings) hold the highest share at 23.3%, followed by residential buildings at 22.5%, park and street lighting at 0.6% and municipal buildings and facilities at 0.3% (Figure 18).

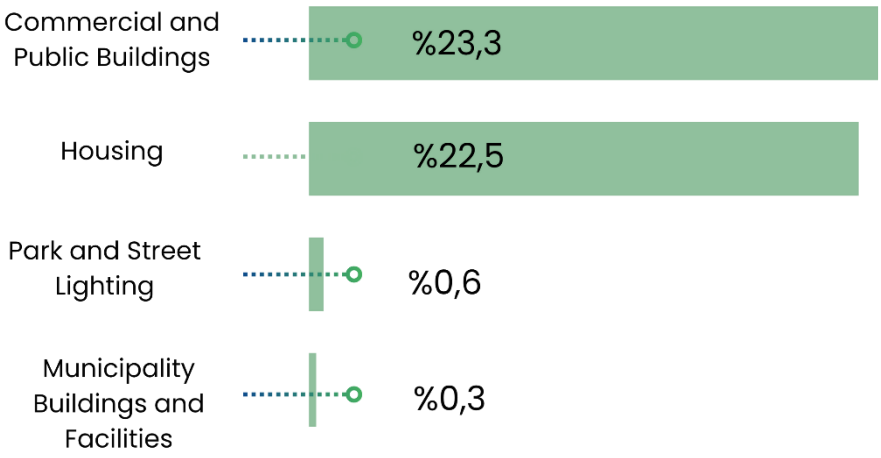


Figure 18 Greenhouse gas emissions from buildings, 2024

Figure 19 illustrates the breakdown of residential emissions by type of energy source. Accordingly, greenhouse gas emissions from residential energy consumption consist of 62.3% natural gas, 36.3% electricity, 0.8% LPG and 0.6% coal.

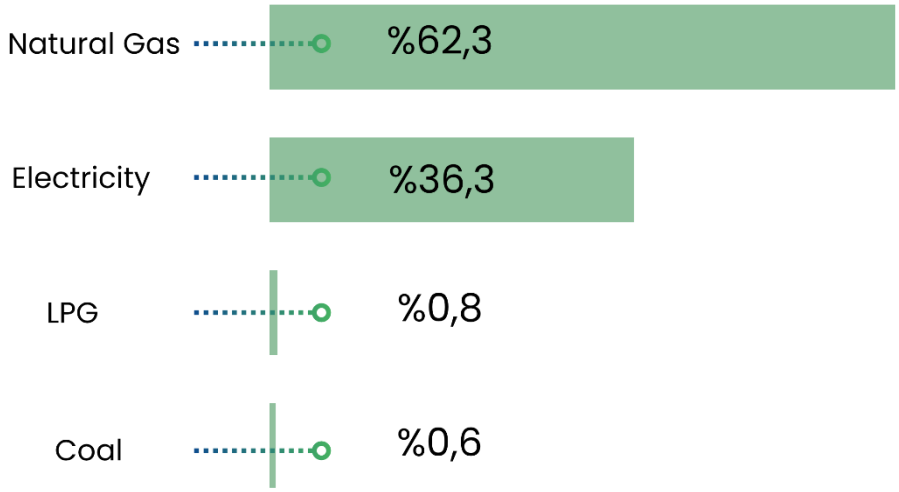


Figure 19 Breakdown of greenhouse gas emissions from residential buildings, 2024

4.2.2. Transportation

Arnavutköy District is one of the rapidly developing areas of Istanbul and serves as an important transportation corridor both within the city and on a regional scale. The increasing population and number of motor vehicles in the district are contributing to higher greenhouse gas emissions resulting from traffic congestion and dependence on fossil fuels.

In this context, the municipality is implementing comprehensive transportation planning and infrastructure projects to improve traffic flow, promote the use of public transportation and enhance pedestrian and vehicle safety.

In line with its sustainable transportation and environmentally friendly urban development goals, Arnavutköy Municipality has made free shuttle (ring) bus services available to residents, operated by 15 electric buses. Thanks to this transportation system, which consists entirely of electric vehicles, the aim is to reduce carbon emissions in the district, improve air quality, and promote accessible and affordable public transportation. The initiative contributes to environmental sustainability while also enabling residents to meet their daily mobility needs free of charge and in a comfortable manner.

In the 2024 greenhouse gas inventory of Arnavutköy District, the transportation sector is the second-largest source of emissions, accounting for 37.7% of total emissions (excluding industry, airport, energy production and fugitive emissions).

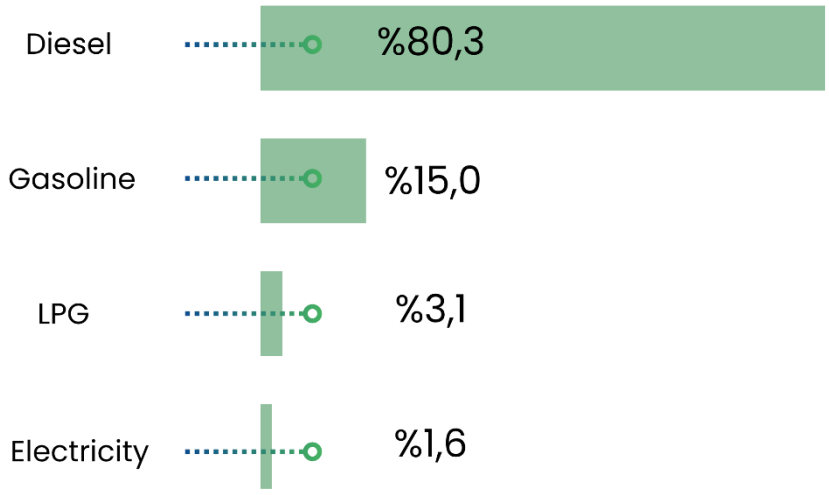


Figure 20 Breakdown of greenhouse gas emissions in transportation, 2024

In transportation-related greenhouse gas emissions, the largest share 80.3% comes from diesel consumption. This is followed by gasoline consumption with 15.0%, LPG consumption with 3.1% and electricity consumption with 1.6%.

4.2.3. Waste and Wastewater

With population growth, the development of new residential areas and the expansion of commercial activities and industry, the amount of waste in Arnavutköy District has been increasing each year. The municipality carries out waste management activities not only focused on disposal but also aimed at waste recovery and reintegration into the economy.

The solid waste collected in the district is sent to İSTAÇ's disposal site in Silivri. Paper and cardboard, plastic, metal, glass, waste vegetable oil, electronic waste, clothing and textile waste, and expired medicines are separated at the source, collected regularly and sent to recycling and sorting facilities.

To promote the Zero Waste System in waste management, waste bins and indoor office bins have been placed throughout the district. Furthermore, through educational activities conducted in public institutions, schools and workplaces, 1,838 people were trained on zero waste, recycling and environmental awareness in 2024. The aim is to increase volunteer participation through projects such as the Recycling Volunteer Project and 'Arnavutköy Life is Here' to promote sustainable living practices.

Bulky waste and construction and demolition waste generated in the district are collected from designated points and transported to licensed transport and disposal sites.

In Arnavutköy, water and wastewater management is carried out on an integrated basin basis rather than at the district level. Most of the district's wastewater is treated at the Ambarlı Advanced Biological Wastewater Treatment Plant, while the remaining portions are treated at the Terkos, Büyükçekmece, Karaburun, Boyalık, Baklalı, Yassıören and Dursunköy Biological Wastewater Treatment Plants. A separate sewerage system is applied in most parts of the district and in newly developed residential areas, stormwater and wastewater networks are separated to reduce potential environmental pollution risks.

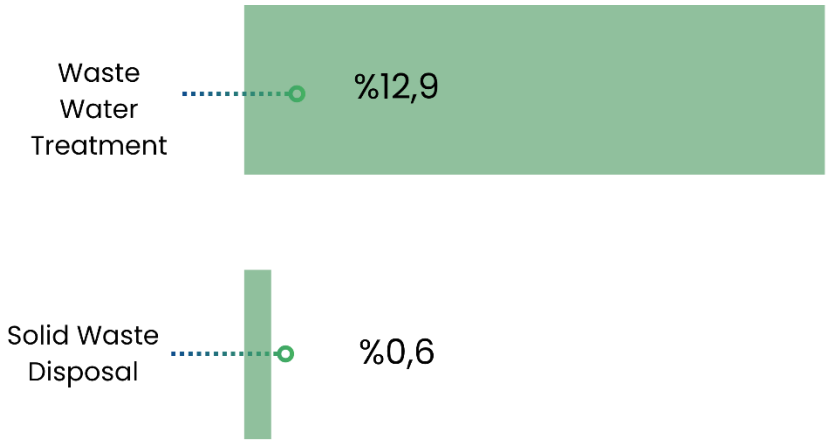


Figure 21 Greenhouse gas emissions from solid waste disposal and wastewater treatment, 2024

In the 2024 greenhouse gas inventory of Arnavutköy District, the waste and wastewater sector accounts for 13.6% of total emissions (excluding industry, airport, energy production and fugitive emissions). Emissions from wastewater treatment represent 12.9%, while emissions from solid waste disposal account for 0.6%. The main reason for the relatively high share of wastewater-related emissions is the lack of separate data on industrial wastewater consumption; therefore, the total wastewater consumption of the entire district has been included in the assessment.

4.2.4. Agriculture and Livestock

In the 2024 greenhouse gas inventory of Arnavutköy District (excluding industry, airport, energy production and fugitive emissions), the agriculture and livestock sector accounts for 1.9% of total emissions. Emissions from chemical fertilizer use and agricultural irrigation in the agriculture sector, as well as emissions from enteric fermentation and manure management in the livestock sector, have been included in the calculations.

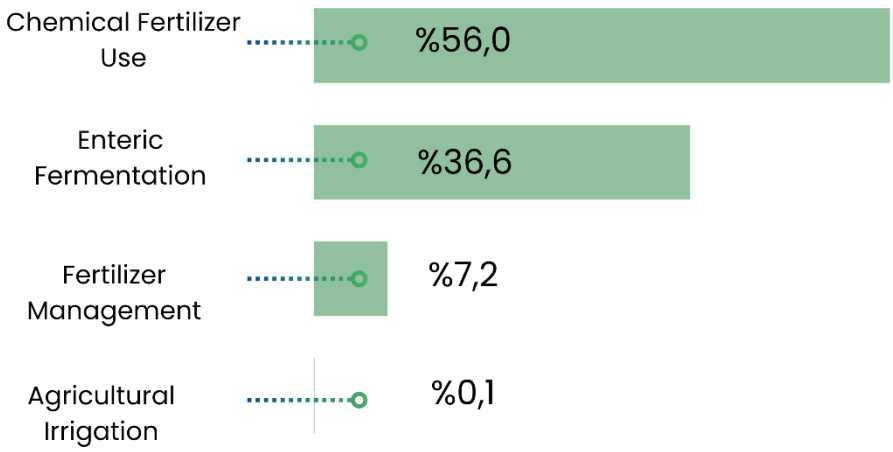


Figure 22 Tarım ve hayvancılık sera gazı dağılımları, 2024

In the 2024 greenhouse gas inventory of Arnavutköy District, under the “other emissions” category, the agriculture and livestock sector consists of 56.0% emissions from chemical fertilizer use, 36.6% from enteric fermentation, 7.2% from manure management and 0.1% from energy use in agricultural irrigation.

GREENHOUSE GAS MITIGATION ACTIONS

5. GREENHOUSE GAS MITIGATION ACTIONS

This section outlines the studies conducted to estimate the 2030 greenhouse gas emission inventory under a business-as-usual scenario, considering projected increases in population and other sectors, as well as the potential emission reduction amounts achievable through the implementation of mitigation measures.

5.1. Business-As-Usual (BAU) and Mitigation Assumptions

The greenhouse gas emission assumptions for the target year 2030 have been made by taking into account the population growth rate, the growth rate of the building and service sectors, energy consumption trends over the past decade and regulatory changes within the jurisdiction of Arnavutköy Municipality. The assumptions used to estimate the city's greenhouse gas trajectory under a business-as-usual scenario, based on sectoral continuity, are listed below.

Table 5 Arnavutköy district BAU and mitigation assumptions

	BAU Assumptions	Mitigation Assumptions-2030
Population Projection		
Population	Based on the increase over the last 10 years, it has been calculated using a 4% increase rate. Based on the average population growth rate between 2014 and 2024.	According to projections for 2030, the population is expected to reach 436,368 by 2030.
Buildings		
Housing	Electricity consumption is estimated to be - 20% for cooling, - 10% for heating, - 70% for other electrical appliances, - 20% for lighting purposes. A change proportional to population growth is anticipated.	- - 50% mitigation in 90% of existing homes, - - 50% mitigation in all new homes, - - A 15% mitigation in all homes through awareness-raising activities, - - An 85% mitigation by ensuring energy efficiency in the lighting of all homes, - - A 100% mitigation is anticipated by converting all existing buildings that use coal to natural gas. - - It is anticipated that 35% of electricity consumption in residential and commercial buildings will be met by renewable energy from solar sources.
Tertiary (commercial) buildings	Natural gas: An annual increase of 2% is projected. LPG: An annual increase of 2% is projected. Energy consumption increases are determined by taking into account trends over the past five years and the development status of the service sector.	- A 50% mitigation is projected in 90% of commercial buildings and awareness-raising activities are expected to result in a 15% mitigation in 80% of commercial buildings.

	BAU Assumptions	Mitigation Assumptions-2030
Municipal buildings	Natural gas: An annual increase of 3% is projected. Electricity: An annual increase of 3% is projected.	- An 80% mitigation is envisaged across all municipal buildings. - It is anticipated that 46% of electricity consumption in municipal buildings will be met by solar-powered renewable energy.
Transportation		
Municipal vehicle fleet	Diesel: An annual increase of 4% is projected. Gasoline: An annual increase of 4% is projected.	- A 80% mitigation is projected by replacing all municipal vehicles with low-emission vehicles and a 15% mitigation is projected for all municipal vehicles through economic driving training.
Private vehicles	Diesel: An annual increase of 4% is projected. Gasoline: An annual increase of 4% is projected. LPG: An annual increase of 4% is projected.	- It is anticipated that the preference for electric vehicles in the district will result in a 24% mitigation in the total number of vehicles.
Public transportation, bicycles and pedestrian access	The increase in fuel consumption for public transportation vehicles is projected to be 4% annually.	- An 80% mitigation is projected through the use of electric vehicles in all public transportation vehicles and a 20% mitigation is projected through the integration of rail systems and public transportation vehicles. - A 5% mitigation in bicycle transportation and a 5% mitigation in pedestrian transportation are anticipated.
Signaling systems		- A 15% mitigation is anticipated in 50% of signaling systems.
Waste and Wastewater		
Waste	An annual increase of 4% is projected. Waste-related emissions projections for 2030 have been developed based on anticipated population growth, as these emissions are directly linked to public activities.	- A 55% mitigation is projected for the disposal of solid waste.
Wastewater	An annual increase of 4% is projected. Wastewater discharges have been projected for 2030 based on the anticipated population growth, as they are directly linked to public activities.	- A 55% mitigation is projected for the entire wastewater treatment process.
Agriculture and Livestock		
Animal population	No increase is anticipated.	- A 55% mitigation in the total livestock population is projected.
Fertilizer management	No increase is anticipated.	- A 55% mitigation is anticipated through the complete utilization of animal waste as fertilizer.

	BAU Assumptions	Mitigation Assumptions-2030
Chemical fertilizer	No increase is anticipated.	- By using organic fertilizer instead of chemical fertilizer, a 55% mitigation in all current emissions is anticipated.
Agricultural irrigation	An annual increase of 2% is projected.	- A 55% mitigation is projected for all agricultural irrigation.

5.2. 2030 Greenhouse Gas Projection

As a result of the assumptions made, the greenhouse gas emissions of Arnavutköy District (excluding industry, airport, energy production and fugitive emissions) are estimated to reach 1,659,145 tCO_2e in 2030 under the business-as-usual (BAU) scenario. Accordingly, the per capita emission, which was 3.92 tCO_2e in 2024, is projected to be 3.80 tCO_2e in 2030 under the BAU scenario. With the implementation of the mitigation actions defined in the plan, the per capita emission is targeted to decrease to 1.64 tCO_2e. Figure 23 presents the effects of the defined targets, showing the current situation, the business-as-usual scenario and the mitigation scenarios.

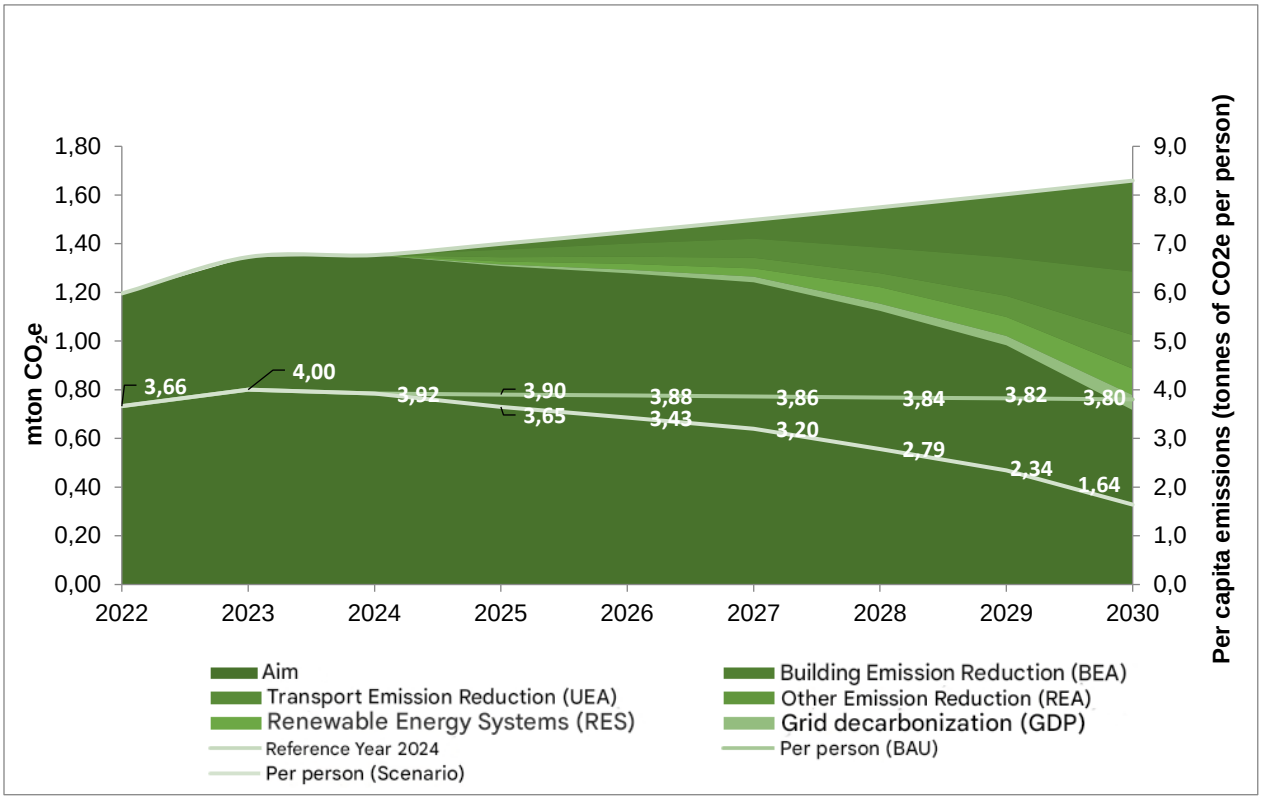


Figure 23 Arnavutköy greenhouse gas reduction projection

When the greenhouse gas inventory (excluding industry, airport, energy production and fugitive emissions) is examined, it is seen that buildings have the highest share in Arnavutköy's inventory, accounting for 46.7%. Through the identified mitigation actions, a total reduction of 482,613 tCO_2e is targeted in the buildings and energy sectors by the year 2030.

The transportation sector is the second most significant contributor, accounting for 37.8% of total emissions. Through the identified mitigation actions, a reduction of 261,114 tCO_2e is targeted in the transportation sector by 2030.

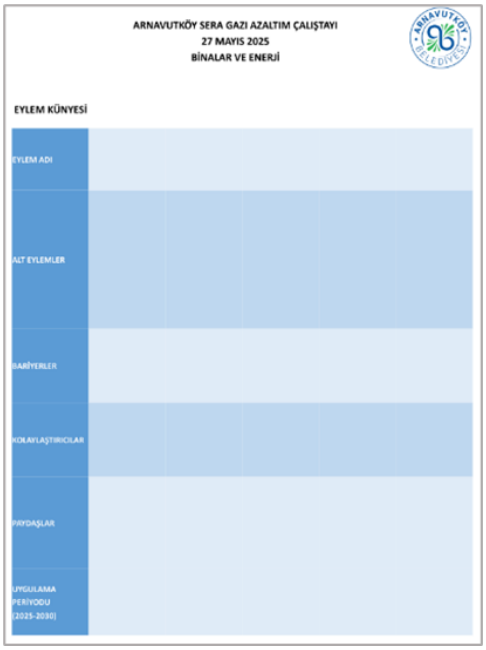
For the remaining 15.5% of Arnavutköy's greenhouse gas inventory (excluding industry, airport, energy production and fugitive emissions) comprising (13.6% from waste and wastewater and 1.9% from agriculture and livestock) mitigation actions have also been proposed. With these measures, a total reduction of 137,825 tCO_2e is targeted by the year 2030.

In addition to all these mitigation efforts, studies aimed at reducing emissions from the electricity grid are gaining momentum through the integration of emerging technologies in line with Türkiye's national targets. Considering the ongoing objectives to reduce coal use in electricity generation and to increase the share of renewable energy over the years, the impact on Arnavutköy's greenhouse gas emissions has been analyzed. Within this context, an emission reduction of 61,278 tCO_2e is projected by the year 2030. Table 6'te provides a summary of the mitigation targets for all sectors.

Table 6 Arnavutköy district 2030 mitigation

Industry	MWh Mitigation, 2030	Ton CO_2e Mitigation, 2030
Buildings	1.524.561	373.426
Renewable Energy	266.075	109.187
Transportation	1.163.414	261.114
Other (Waste and wastewater - agriculture and livestock)	17	137.825
Grid decarbonization	-	61.278
Total Mitigation	**2.954.067**	**942.830**

5.3. Mitigation Workshop



The preparation process of the Sustainable Energy and Climate Action Plan (SECAP) involves a series of activities that bring together different stakeholders and are carried out through an interdisciplinary approach. In determining greenhouse gas mitigation priorities, the priority actions were identified and detailed through collaborative work conducted with the participation of all stakeholders during the mitigation workshop.

During the workshop, actions that could be prioritized in the fields of buildings, energy, transportation, waste and wastewater management, industry, as well as agriculture and livestock were discussed and prioritized, following the format illustrated in the accompanying visual. The subactions of these measures, potential barriers and

Figure 24 Mitigation Conflict Resolution Method

enabling factors during implementation, relevant internal units and stakeholders, and the timeframes within which they could be implemented during the 2025–2030 period were examined in detail. These discussions formed the basis of the identified greenhouse gas mitigation actions.

Figure 25 Mitigation Workshop Images

5.4. Actions

5.4.1. Buildings and Renewable Energy

The buildings sector in Arnavutköy accounts for a significant share of the district's total energy consumption and represents 46.7% of greenhouse gas emissions when industry, airport, energy production and fugitive emissions are excluded. This makes buildings one of the key priority areas for intervention under the district's energy efficiency and sustainability goals. In this context, Arnavutköy Municipality has planned a series of comprehensive actions to improve energy performance in buildings and reduce greenhouse gas emissions.

Firstly, awareness-raising initiatives, training programs and communication campaigns targeting municipal staff and residents are planned to promote energy-saving behaviors. Detailed energy audits will be conducted in municipal buildings, with investments in thermal insulation, window replacement, energy-efficient lighting and automation systems to enhance energy performance. In addition, the installation of renewable energy technologies such as solar energy systems and heat pumps is planned for these buildings.

In new buildings, it is planned to integrate the Nearly Zero Energy Building (NZEB) standards into the permitting processes, make energy performance simulations mandatory and develop guidance and support activities in this field. In existing buildings, the aim is to reduce emissions through energy audits, insulation applications, efficient heating and cooling systems and the establishment of energy monitoring infrastructures.

To increase the use of renewable energy, the installation of solar power systems (SPP) in municipal buildings and common-use areas is planned, along with the integration of such systems on the roofs of marketplaces and parking structures, as well as the utilization of local biomass potential. Although various challenges exist in this process such as financial constraints, lack of

technical infrastructure and bureaucratic permit procedures national and international grant programs, regulatory support, the guiding role of the municipality and collaboration with stakeholders stand out as key enabling factors.

All these efforts aim not only to enhance energy efficiency and reduce emissions but also to improve the quality of life for Arnavutköy residents, lower energy costs and implement a sustainable model of urban development.

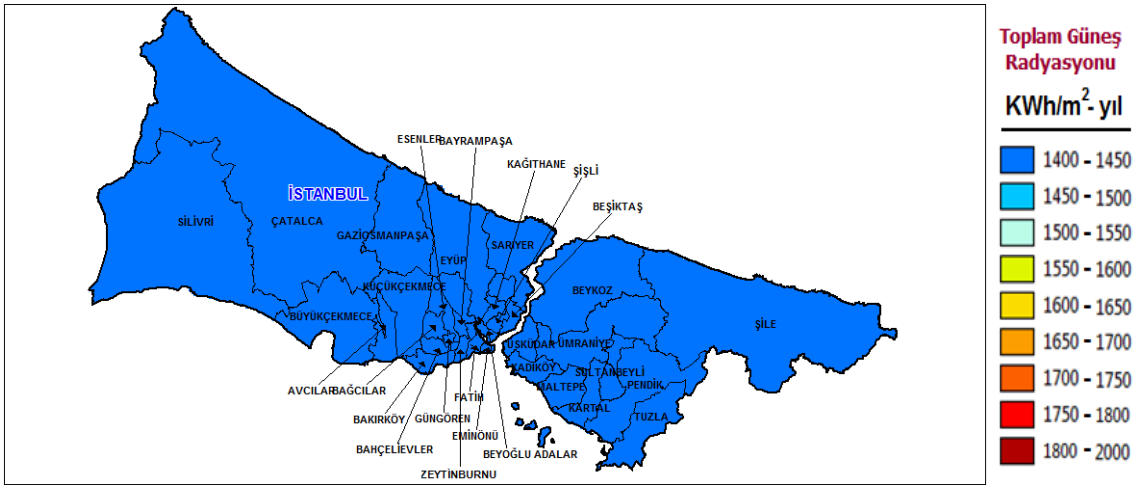


Figure 26 Atlas of Solar Energy Potential in Istanbul[17]

According to the Solar Energy Potential Atlas, which was developed to identify the most suitable locations for solar energy applications in Türkiye and to determine the potential for electricity or heat generation based on solar energy in these areas, the solar radiation values of all districts in Istanbul are shown in the figure above. The solar radiation value for the city of Istanbul has been mapped at 1,400–1,450 kWh/m² per year. Although the potential for renewable energy use from solar power in municipal buildings and residential energy consumption in Istanbul is relatively low, this potential can be enhanced through technological advancements and supportive policies.

[17] *https://gepa.enerji.gov.tr/MyCalculator/pages/34.aspx*

ACTION B1

BUILDINGS

ACTION *Carrying out awareness-raising activities on energy efficiency in buildings*

TYPE OF ACTION Plan/Strategy

B.1.1	Providing training for public personnel on energy efficiency in public buildings
B.1.2	Providing information through posters, digital visuals, and print media in common areas such as associations, foundations, public buildings, and shopping malls
B.1.3	Organizing energy awareness programs for primary and secondary school students
B.1.4	Raising awareness about the transition to time-of-use energy billing and conducting communication activities to encourage reduced consumption between 16:00 and 22:00 hours
B.1.5	Establishment of online solution centers on energy efficiency and provision of environmental sustainability and awareness trainings

THE CONTRIBUTION OF THE MUNICIPALITY
Informative, guiding, and supervisory

RESPONSIBLE
Arnavutkoy Municipality

STAKEHOLDERS
Ministry of National Education, Project designers, Neighborhood headships, Private sector

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2025-2030

INDICATORS

- *Number of schools/institutions where awareness activities were conducted*
- *Number of people trained*
- *Number of distributed/reached communication materials*

ACTION B2

BUILDINGS

ACTION *Ensuring energy efficiency in public buildings and promoting the widespread adoption of nearly zero-energy buildings*

TYPE OF ACTION Investment (private)

B.2.1	Conducting energy audits, monitoring, and renovation works in municipal buildings
B.2.2	Installation of renewable energy systems (such as PV systems, rooftop solar panels, and heat pumps) in public buildings
B.2.3	Investments in energy efficiency measures in public buildings, such as lighting, insulation, and window systems
B.2.4	Integration of advanced building automation systems in public buildings

THE CONTRIBUTION OF THE MUNICIPALITY
Implementer, technical controller, and resource provider

RESPONSIBLE
Arnavutkoy Municipality

STAKEHOLDERS
Provincial Directorate of the Ministry of Environment, Urbanization and Climate Change (ÇŞİDB), Istanbul Metropolitan Municipality (IBB), NGOs, Private sector

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2025-2028

INDICATORS

- *Annual reduction in energy consumption (kWh)*
- *Number of implemented energy efficiency measures*
- *Installed PV capacity (kW)*

ACTION B3

BUILDINGS

ACTION *Implementation of nZEB (Nearly Zero Energy Building) standards in new buildings*

TYPE OF ACTION Regulatory / Awareness-raising

B.3.1	Updating and/or mandating nZEB standards in new building permit applications
B.3.2	Requiring building energy performance simulations prior to construction
B.3.3	Preparation of a guideline on nZEB standards for project designers
B.3.4	Development of inspection and monitoring mechanisms to manage the implementation process of nZEB standards

THE CONTRIBUTION OF THE MUNICIPALITY
Planning, inspection, licensing

RESPONSIBLE
Arnavutkoy Municipality, Ministry of Environment, Urbanization and Climate Change

STAKEHOLDERS
Provincial Directorate of the Ministry of Environment, Urbanization and Climate Change (ÇŞİDB), Project designers, Private sector

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2026-2030

INDICATORS

- *Number of buildings approved according to nZEB criteria*
- *Energy performance class of buildings (based on BEP-TR data)*

ACTION B4

BUILDINGS

ACTION *Establishment of energy efficiency and energy monitoring systems in existing buildings*

TYPE OF ACTION Investment (public/private)

B.4.1	Inspection of structural integrity in existing buildings and assessment of their suitability for energy efficiency improvements
B.4.2	Conducting energy audits to identify building-level consumption profiles and energy-saving potentials
B.4.3	Implementation of passive efficiency measures such as thermal insulation and window replacement
B.4.4	Integration of energy-efficient systems such as heat pumps
B.4.5	Establishment of energy monitoring and reporting systems to regularly track building energy performance

THE CONTRIBUTION OF THE MUNICIPALITY
Guidance, information, inspection, direction

RESPONSIBLE
Citizens, Arnavutköy Municipality, Ministry of Environment, Urbanization and Climate Change

STAKEHOLDERS
Property owners, Energy efficiency consulting firms, Energy Service Companies (ESCOs), Banks and financial institutions

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2026-2030

INDICATORS

- *Number of renovated buildings*
- *Number of installed energy monitoring systems*
- *Change in energy consumption after implementation (kWh/m²)*

ACTION B5

BUILDINGS

ACTION *Expansion of Renewable Energy Systems*

TYPE OF ACTION Investment (public/private)

B.5.1	Use of hybrid energy systems in street lighting systems
B.5.2	Expansion of rooftop PV systems and their use in municipal buildings
B.5.3	Conducting studies on energy generation from wave energy in coastal areas
B.5.4	Supporting common areas in existing buildings with PV systems
B.5.5	Implementation of passive efficiency measures such as thermal insulation and window replacement
B.5.6	Installation of PV systems on the roofs of marketplaces, parking areas, and public buildings
B.5.7	Analysis of biomass potential and initiation of pilot applications

THE CONTRIBUTION OF THE MUNICIPALITY
Guidance, information, inspection, direction

RESPONSIBLE
Arnavutkoy Municipality, Çevre, Şehircilik ve İklim Değişikliği Bakanlığı

STAKEHOLDERS
Property owners, Energy efficiency consulting firms, Energy Service Companies (ESCOs), Banks and financial institutions

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2026-2030

INDICATORS

- *Installed PV capacity (kWp)*
- *Amount of energy generated (kWh)*
- *Emission reduction (tons CO_2e)*
- *Number of benefiting buildings*

5.4.2. Transportation

In Arnavutköy, the transportation sector accounts for 37.8% of the city's total greenhouse gas emissions when industry, airport, energy production and fugitive emissions are excluded, making it a critical area in terms of environmental impact. Therefore, making transportation more sustainable and reducing its carbon footprint are among the primary goals of Arnavutköy Municipality. To this end, comprehensive actions have been planned both to transform the municipal vehicle fleet and to encourage residents to adopt low-emission transportation alternatives.

Within this scope, it is aimed to gradually replace both the municipal vehicle fleet and vehicles used in the city with electric vehicles, while also strengthening and expanding the charging station infrastructure. Alongside awareness campaigns targeting citizens and drivers, the goal is to promote and encourage the adoption of electric vehicle use. Identifying suitable locations for the installation of electric vehicle charging stations, conducting feasibility studies and completing the necessary permitting processes are also key steps in this transformation.

In addition, a Sustainable Urban Mobility Plan (SUMP) will be prepared and integrated with the main transportation plan to ensure coordination among different transport modes such as public transport, walking and cycling and to develop scenarios aligned with greenhouse gas mitigation targets. Under micromobility solutions, encouraging the use of bicycles and scooters, expanding pedestrianized areas and integrating bike paths with public transport are also important steps.

Moreover, eco-driving training programs will be organized for municipal staff and residents to help reduce fuel consumption and emissions. According to sector experts, such training can achieve fuel savings of up to 15–20%.

All these efforts including the expansion of electric vehicles and charging infrastructure, integration of public transport and micromobility systems will contribute to reducing transportation-related greenhouse gas emissions in Arnavutköy. However, challenges such as high investment costs, lack of technical infrastructure, difficulties in changing user habits and lengthy permitting processes may be encountered. Despite these challenges, national and international incentives, growing public demand, rail system investments across Istanbul and the municipality's ongoing infrastructure efforts stand out as facilitating factors in this transition.

The actions identified for Arnavutköy's transportation sector are presented below.

ACTION U1

TRANSPORTATION

ACTION *Transition of the municipal vehicle fleet, as well as urban vehicles, to electric vehicles*

TYPE OF ACTION Awareness-Raising, Infrastructure Development, Capacity Building

U.1.1	Providing awareness-raising activities/trainings for decision-makers, starting from top management, on the transition to electric vehicles
U.1.2	Inventorying and assessing the existing vehicle fleet
U.1.3	Gradual replacement of fossil-fuel vehicles with electric vehicles
U.1.4	Establishment of the infrastructure required for electric vehicles (such as charging stations) (related to Action U2)
U.1.5	Conducting awareness activities for drivers about the advantages of electric vehicles (e.g., informational posters, billboards, etc.)

THE CONTRIBUTION OF THE MUNICIPALITY
Implementing

RESPONSIBLE
Arnavutkoy Municipality

STAKEHOLDERS
Istanbul Metropolitan Municipality, Istanbul Electric Vehicles Association, Ministry of Energy and Natural Resources, TOGG, private car rental companies, non-governmental organizations, universities

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2026-2027

INDICATORS

- *Annual increase in the number of electric vehicles*
- *Number of fossil-fuel vehicles converted*
- *Number of charging stations installed*
- *Number of trainings/awareness events organized on electric vehicle use*

ACTION U2

TRANSPORTATION

ACTION *Expansion of electric vehicle charging infrastructure*

TYPE OF ACTION Awareness-Raising, Infrastructure Development, Capacity Building

U.2.1	Conducting feasibility studies to determine parking needs and to establish electric vehicle charging infrastructure in suitable areas
U.2.2	Assigning relevant sub-units for the maintenance, operation, and risk management of electric vehicle charging infrastructure
U.2.3	Carrying out awareness-raising activities among citizens and vehicle users regarding electric vehicle charging infrastructure
U.2.4	Establishing the operational processes of electric vehicle charging infrastructure and monitoring the infrastructure

THE CONTRIBUTION OF THE MUNICIPALITY
Implementer, Coordinator, Permitting and Supervisory

RESPONSIBLE
Arnavutkoy Municipality , Directorate of Transportation and Infrastructure

STAKEHOLDERS
Istanbul Metropolitan Municipality, Ministry of Energy and Natural Resources, Electricity Distribution Companies, Private Sector (charging infrastructure providers), Non-Governmental Organizations, Local Community

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2026-2027

INDICATORS

- *Number of electric vehicle charging stations installed*
- *Utilization rate of the charging infrastructure*
- *Completion rate of feasibility studies*
- *Number of awareness-raising events held for citizens*

ACTION U3

TRANSPORTATION

ACTION *Promoting micro-mobility applications (bicycles, scooters, etc.)*

TYPE OF ACTION Awareness-Raising, Infrastructure Development, Governance

U.3.1	Creating safe and accessible micro-mobility routes by increasing pedestrianized prestige street projects closed to vehicle traffic
U.3.2	Strengthening intermodal connectivity by integrating micro-mobility vehicles with public transport transfer points
U.3.3	Identification of micro-mobility routes across the district, installation of directional signage, and marking of the routes
U.3.4	Organizing awareness-raising events such as bicycle races and bicycle days to promote a micro-mobility culture in the community
U.3.5	Collaborating with the private sector for scooter and bicycle sharing systems and expanding these services across the city

THE CONTRIBUTION OF THE MUNICIPALITY
Coordinator, data provider, implementer, and planning partner

RESPONSIBLE
Arnavutkoy Municipality (Transportation Unit / Directorate of Strategy Development)

STAKEHOLDERS
Istanbul Metropolitan Municipality (IBB), Ministry of Transport and Infrastructure, General Directorate of Highways, Ministry of Environment, Urbanization and Climate Change, NGOs, academic institutions

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2025-2030

INDICATORS

- *Length of bicycle lanes (km)*
- *Number of micro-mobility hubs integrated with public transport*
- *Number of bicycle/scooter users*
- *Number of awareness-raising events organized*

ACTION U4

TRANSPORTATION

ACTION *Providing eco-driving trainings for municipal staff and citizens*

TYPE OF ACTION Training, Awareness-Raising

U.4.1	Adding an "Economic Driving" module to the Transportation Academy program within the municipality and preparing training materials for personnel and citizens
U.4.2	Announcing the trainings to citizens through communication channels such as SMS, social media, and public notices, and ensuring broad participation
U.4.3	Issuing certificates at the end of the trainings and increasing motivation through small incentive practices (gifts, discounts, etc.) for participants
U.4.4	Repeating the trainings at regular intervals and monitoring the outcomes achieved

THE CONTRIBUTION OF THE MUNICIPALITY
Implementer, training organizer

RESPONSIBLE
Arnavutkoy Municipality (Transportation Unit / Directorate of Strategy Development)

STAKEHOLDERS
Driving schools, NGOs working in the field of energy efficiency, Istanbul Metropolitan Municipality, professional chambers

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2025-2026

INDICATORS

- *Number of people trained (staff citizens)*
- *Number of completed trainings*
- *Post-training evaluation survey results*

5.4.3. Waste and Wastewater

When industry, airport, energy production and fugitive emissions are excluded, waste and wastewater-related greenhouse gas emissions account for 13.6% of Arnavutköy's total emission inventory. Although this share appears relatively low, waste and wastewater management play a crucial role in sustainable environmental management.

To reduce waste generation, increase recycling and ensure resource efficiency, integrated practices based on a circular economy approach have been planned. Within this scope, the installation of waste separation systems in restaurants, shopping malls and local markets is envisaged, along with the utilization of food waste as animal feed, the promotion of household composting practices and the establishment of a central composting facility owned by the municipality. In addition, educational programs, awareness-raising activities and faith-based environmental campaigns to be organized in schools and public spaces aim to increase community participation.

On the wastewater management side, strengthening infrastructure and introducing modern technologies are among the primary steps. Projects tailored to local needs will be developed to access funding sources, improve treatment processes and establish sensor-based digital monitoring systems. To ensure the active participation of households, businesses and farms in wastewater management, it is planned to develop mobile applications with reward mechanisms, implement educational programs for children and launch pilot projects promoting wastewater reuse. Notably, the treatment and reuse of wastewater from livestock activities for agricultural irrigation and the separate collection and recycling of gray and black water from the airport, are among the prominent practices in this process.

With the successful implementation of these efforts, Arnavutköy aims to both reduce waste generation and improve efficiency in wastewater management. This will contribute to lowering greenhouse gas emissions, conserving natural resources and establishing a sustainable urban model based on the circular economy concept. However, challenges such as high costs, insufficient technical infrastructure, lack of oversight and low public awareness may arise. Despite these barriers, national incentive mechanisms, funding opportunities, the guiding role of the municipality and growing environmental awareness stand out as key facilitators in this transformation process.

The actions identified for Arnavutköy's Waste and Wastewater sector are presented below.

ACTION A1

WASTE AND WASTEWATER

ACTION *Expansion of Integrated Waste Management Practices Focused on Circular Economy and Source Separation*

TYPE OF ACTION Behavioral

A.1.1	Restoran zincirlerinde atık ayrıştırma sistemlerinin kurulması ve etkin şekilde uygulanması
A.1.2	AVM'ler ve semt pazarlarında organik ve geri dönüştürülebilir atıklar için ayrı toplama ekipmanlarının yerleştirilmesi
A.1.3	Döngüsel ekonomi ve kaynakta ayrıştırma odaklı entegre uygulamalar konusunda işletmelere yönelik teknik destek ve bilgilendirme faaliyetlerinin düzenlenmesi
A.1.4	Restoran ve ev kaynaklı gıda atıklarının uygun şekilde toplanarak hayvan yemi olarak değerlendirilmesi
A.1.5	Hanelerde evsel organik atıkların kompostlanması için eğitimler ve yönlendirmelerin yapılması
A.1.6	Belediyeye ait merkezi kompost tesisinin kurulması ve mahallelerden toplanan organik atıkların burada işlenmesi
A.1.7	Anket çalışmaları yoluyla halkın mevcut atık yönetimi davranışlarının değerlendirilmesi ve bilinçlendirme kampanyalarının bu sonuçlara göre şekillendirilmesi
A.1.8	İsrafın önlenmesi ve sorumlu tüketim temalarının, camilerde verilecek vaaz ve sohbetlerle topluma aktarılması
A.1.9	Okullarda, semt merkezlerinde ve kamu alanlarında sıfır atık, kompost ve kaynakta ayrıştırma temalı atölye ve eğitimlerin düzenlenmesi, Geri Dönüşüm Şantiye ve Atölye Kurulumu

THE CONTRIBUTION OF THE MUNICIPALITY
Implementing and guiding

RESPONSIBLE
Private sector, Arnavutkoy Municipality

STAKEHOLDERS
Associations, NGOs, Neighborhood headships (Muhtars), Private sector, Other public institutions

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2025-2030

INDICATORS

- *Number of restaurants/shopping malls/marketplaces implementing circular economy practices*
- *Number of separate collection equipment installed and number of areas covered*
- *Amount of organic waste directed to animals (tons/year)*
- *Number of household composting systems implemented or number of trainings/workshops conducted on this topic*
- *Number of municipal compost/recovery facilities established*
- *Number of surveys conducted and number of people reached (awareness-raising activities)*

ACTION A2

WASTE AND WASTEWATER

ACTION *Improvement of Wastewater Management and Treatment Infrastructure*

TYPE OF ACTION Investment (public)

A.2.1	Developing new projects tailored to local needs for strengthening wastewater management and treatment infrastructure, and applying for funding sources
A.2.2	Development of reward mechanisms operating through a mobile application and granting points to users to encourage the active participation of households, businesses, and farms in wastewater management
A.2.3	Development and implementation of interactive educational programs for preschool and primary school children on topics such as the wastewater cycle, conservation, and reuse
A.2.4	Implementation of reward and incentive mechanisms for individuals, institutions, or businesses that support wastewater reduction and efficient use
A.2.5	Initiation of local pilot projects for treating wastewater generated from livestock activities and reusing it in agricultural irrigation
A.2.6	Assignment and training of technical personnel within local governments to monitor, track, and inspect wastewater management processes
A.2.7	Installation of sensor-based or digital monitoring systems that can detect issues such as odor, leakage, or overflow before they occur

THE CONTRIBUTION OF THE MUNICIPALITY
Implementing and guiding

RESPONSIBLE
Arnavutkoy Municipality

STAKEHOLDERS
NGOs, neighborhood headships (muhtars), villages, women's branches of political parties

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2025-2030

INDICATORS

- *Number of newly developed and implemented wastewater projects*
- *Number of students and personnel trained on wastewater management*
- *Number of individuals/institutions benefiting from incentive and reward systems*
- *Amount of livestock wastewater reused in agriculture (m^3/year)*
- *Number of outreach activities conducted for firms and participation rate*
- *Number of wastewater violations detected before complaints are filed*
- *Number of newly installed monitoring, control, or automation systems*
- *Total amount of treated wastewater and reuse rate (%)*
- *Amount of separately collected special-quality wastewater (e.g., airport-generated)*

5.4.4. Agriculture and Livestock

In Arnavutköy, the agriculture and livestock sector in Arnavutköy plays a critical role in greenhouse gas mitigation due to the high concentration of rural areas and the prevalence of livestock activities. In this regard, the promotion of organic fertilizer use and composting practices is among the key priorities. It is aimed to collect animal waste for use as fertilizer, establish a municipal composting facility and contribute to the circular economy by making the produced compost available for sale. In addition, on-site organic fertilizer production will be encouraged in areas with high livestock density to ensure more active participation of farmers in this process.

Furthermore, soilless agriculture practices are emerging as an innovative solution for Arnavutköy. The plan includes identifying suitable crops such as vegetables specific to the district, organizing training workshops for farmers and establishing local markets for the sale of produced goods. This approach aims to support local production while reducing the carbon footprint.

The transformation process in this sector may face challenges such as lack of awareness, insufficient monitoring and limited availability of suitable land. However, the development of incentive and reward systems, the relatively low cost of soilless agriculture and the economic return potential of composting practices stand out as facilitating factors in this field.

All these initiatives will contribute to reducing greenhouse gas emissions from agriculture and livestock in Arnavutköy, while also strengthening the circular economy, enhancing the economic sustainability of farmers and promoting environmentally friendly production models.

The actions identified for Arnavutköy's Agriculture and Livestock sector are presented below.

ACTION TH1

AGRICULTURE AND LIVESTOCK

ACTION *Expansion of Organic Fertilizer Use and Composting Activities*

TYPE OF ACTION Implementation

TH.1.1	Collection of animal waste and its use as organic fertilizer
TH.1.2	Establishment of a composting facility and contribution to the local circular economy by offering the produced compost for sale
TH.1.3	Encouraging on-site production and use of organic fertilizer in areas with high numbers of livestock

THE CONTRIBUTION OF THE MUNICIPALITY
Guiding

RESPONSIBLE
Arnavutkoy Municipality

STAKEHOLDERS
Farmers, Istanbul Provincial Directorate of Agriculture and Forestry, Arnavutkoy District Governorate, Chamber of Agriculture, Professional Chambers, neighboring district municipalities

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2026-2030

INDICATORS

- *Amount of organic fertilizer produced (kg/year)*
- *Number of composting facilities established (units/year)*

ACTION TH2

AGRICULTURE AND LIVESTOCK

ACTION *Expansion of Soilless Agriculture Practices*

TYPE OF ACTION Implementation

TH.2.1	Identification of products suitable for soilless agriculture (such as vegetables) specific to the district
TH.2.2	Organizing training workshops and practical sessions on soilless agriculture for producers
TH.2.3	Direct delivery of local products to consumers through the establishment of local markets

THE CONTRIBUTION OF THE MUNICIPALITY
Guiding

RESPONSIBLE
Arnavutkoy Municipality

STAKEHOLDERS
Farmers, Public Education Centers, neighboring district municipalities

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2026-2028

INDICATORS

- *Number of training workshops organized (units/year)*
- *Number of local markets established (units/year)*

5.4.5. Industry

The industrial sector is both a significant driver of climate change and a critical intervention area for the transition to a low-carbon economy. Since the Industrial Revolution, the increasing use of fossil fuels has led to a rise in greenhouse gas emissions across all stages of industrial activity from production processes to logistics. This has made the adoption of clean energy, environmentally friendly technologies, and energy efficiency measures not a choice, but a necessity. [18]

The mitigation practices developed for the industrial sector in Türkiye include increasing the use of renewable energy, promoting efficient production techniques, improving water and raw material efficiency, recovering waste heat, and strengthening sustainable supply chain management.

In the context of Arnavutköy, the presence of extensive industrial zones, logistics activities, and rapidly growing production capacity makes it essential to plan this transformation effectively at the local level. Therefore, the industrial actions defined within the scope of the plan aim to support greenhouse gas emission reductions across the district.

The actions identified for Arnavutköy's industrial sector are presented below.

[18] *https://iklimportal.gov.tr/page/industry*

ACTION S1

INDUSTRY

ACTION *Increasing the Use of Renewable Energy in the Manufacturing Industry*

TYPE OF ACTION Investment

S.1.1	Researching renewable energy applications suitable for Arnavutköy district that can be used in industry (e.g., solar, wind, etc.)
S.1.2	Considering renewable energy-related requirements during the licensing process
S.1.3	Development of incentive mechanisms

THE CONTRIBUTION OF THE MUNICIPALITY
Incentivizing

RESPONSIBLE
Industrial Enterprises

STAKEHOLDERS
Arnavutkoy Municipality, Ministry of Industry and Technology, Ministry of Environment, Urbanization and Climate Change, Istanbul Chamber of Industry, Istanbul Chamber of Commerce, MÜSİAD (Independent Industrialists' and Businessmen's Association)

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2026-2030

INDICATORS

- *Number of manufacturing industries using renewable energy (units/year)*
- *Renewable energy production in industry (MWh/year)*

ADAPTATION TO CLIMATE CHANGE

6. CLIMATE CHANGE ADAPTATION

Cities have become highly vulnerable to climate change due to increasing population density, pressure on infrastructure and socioeconomic fragilities. The frequency and intensity of climate-related disasters such as droughts, extreme rainfall, floods, hailstorms, heatwaves and sea level rise have significantly increased in recent years. Therefore, developing climate change adaptation strategies is vital not only for reducing disaster risks but also for ensuring the continuity of urban sustainability and social well-being.[19]

Scientific data reveal that even if greenhouse gas emissions were completely halted today, the impacts of past emissions released into the atmosphere would persist for many years. This situation demonstrates that mitigation policies alone are not sufficient and must be complemented by adaptation policies. The adaptation process aims to reduce the vulnerabilities and enhance the resilience of natural, social and economic systems to the current and future impacts of climate change.

Within the framework of climate change adaptation efforts, it is essential for local governments to conduct risk analyses to identify existing vulnerabilities, determine sensitive areas and prepare integrated plans accordingly. Adaptation actions include various measures such as green infrastructure practices, nature-based solutions, early warning systems, disaster management integration, protection of water resources and climate-resilient urban development against extreme weather events. Adaptation planning not only involves interventions in the physical environment affected by climate change but also paves the way for investments that bring long-term socioeconomic benefits. In this context, enhancing the resilience of cities to climate change requires strengthening not only environmental but also governance, technological and financial capacities.

6.1. Climate Change Scenarios

According to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), the Mediterranean Basin, which includes Turkey, is among the regions expected to be most affected by climate change. This region is facing impacts such as increasing temperatures, decreasing precipitation, prolonged droughts, water stress and a significant rise in the frequency of extreme weather events.[20]

According to climate modeling studies conducted specifically for Turkey:

- An increase of 1.5°C to 4.8°C in average temperatures is projected by the end of the century.
- The duration and intensity of heatwaves, particularly in summer months, are expected to increase.
- While annual total precipitation is projected to decrease, intense short-term rainfall events are expected to become more frequent, raising the risks of flash floods and inundations.

[19] *UN-Habitat (2021). Cities and Climate Change Initiative: Promoting Climate Resilient Urban Development.*
[20] *IPCC (2022). Sixth Assessment Report: Climate Change 2022 – Impacts, Adaptation and Vulnerability*

- Agricultural productivity will decline, pressure on water resources will intensify and heat-related health problems will increase across various segments of society.

With a population exceeding 16 million, a high level of urbanization and increasing pressure on infrastructure, Istanbul is considered one of the most vulnerable cities in Turkey to climate change. The global climate crisis has multidimensional impacts on Istanbul, as the frequency and intensity of extreme weather events increasingly threaten urban life. The city is under significant stress in both its natural and built environments.

One of the most evident impacts of climate change in Istanbul is the rise in temperature. According to scenarios based on the IPCC's Sixth Assessment Report, temperatures in Istanbul are expected to increase by approximately 2.85°C compared to historical averages during the 2041–2060 period. In the 2061–2080 period, this increase is projected to exceed 4°C. This situation will lead to prolonged heatwaves during summer months, persistently high nighttime temperatures and associated health risks. Rising temperatures will pose serious health threats, particularly for the elderly, children and individuals with chronic illnesses.

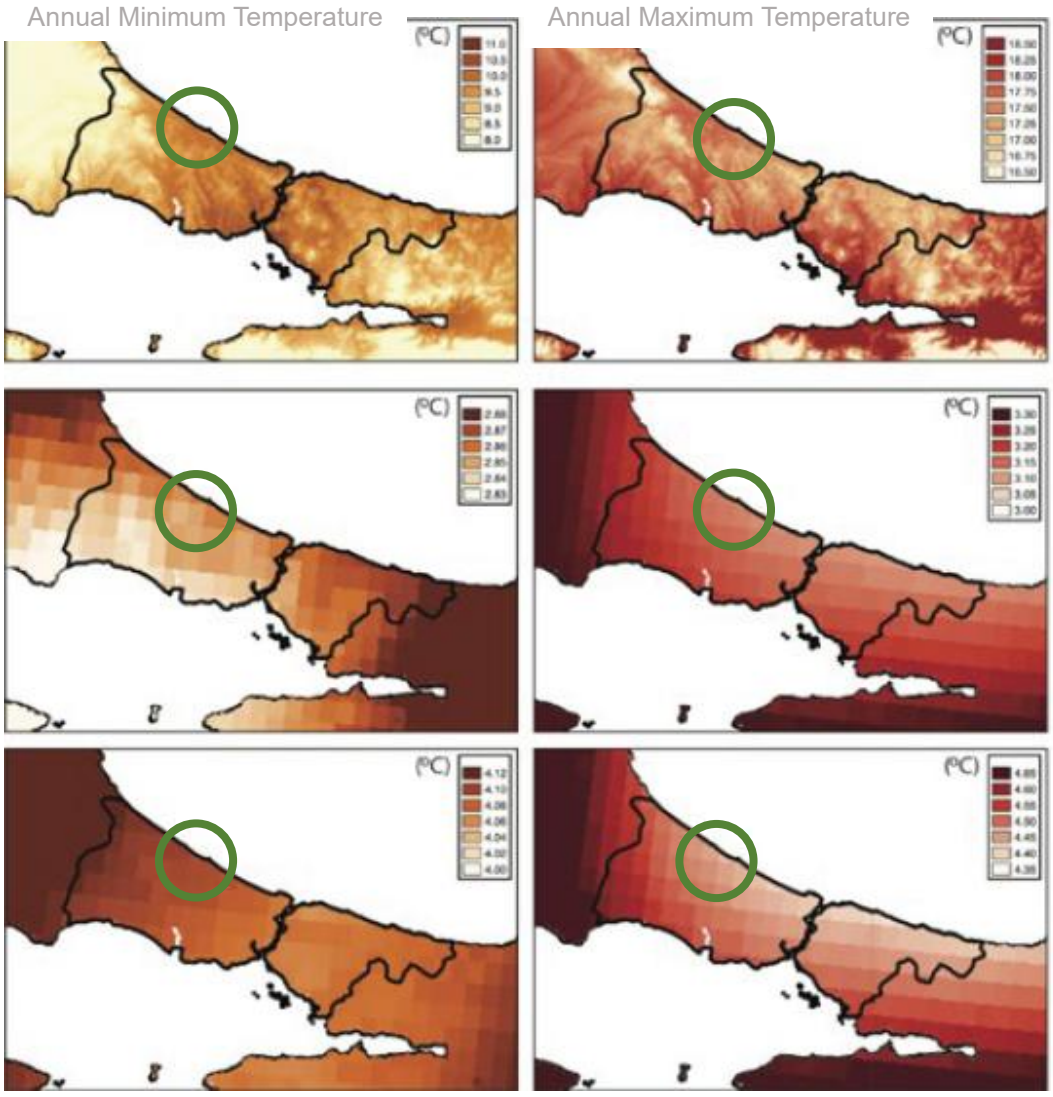


Figure 27 According to Worldclim data, the annual minimum and maximum temperature distributions for Istanbul during the 1960-1990 period and the changes in these parameters according to the RCP8.5 scenario up to the 2041-2060 and 2061-2080 periods.

Across Istanbul, the impacts of climate change such as rising temperatures, irregular precipitation patterns, increasing risks of floods and inundations and the urban heat island effect are becoming increasingly evident. Although these impacts affect all components of the city, certain districts experience higher levels of vulnerability. Located in the northwestern part of Istanbul, Arnavutköy stands out among these vulnerable areas due to both its natural ecosystem assets and its rapidly transforming urban structure.

In recent years, Arnavutköy has drawn attention with its growing population and large-scale infrastructure projects. However, this development process has affected the district's natural water cycle, soil structure and microclimate, making it more vulnerable to floods, droughts and rising temperatures. Analyses conducted within the Istanbul SECAP report identified areas with high flood risk, particularly in regions close to stream beds. In addition, the increasing rate of urban construction has led to a rise in impermeable surface areas, preventing water from being absorbed by the soil and consequently increasing surface runoff and flooding events.

The impacts of rising temperatures in Arnavutköy manifest differently across rural and urban areas. In agricultural zones, declines in crop productivity and difficulties in accessing water resources are anticipated, while in urbanized areas, the heat island effect is expected to increase health risks, particularly for vulnerable groups. Furthermore, the district is experiencing a deterioration in habitat quality, with forested areas and coastal ecosystems showing signs of fragmentation.

All these indicators reveal that the impacts of climate change in Arnavutköy will intensify both ecologically and socioeconomically. Therefore, it is crucial to develop adaptation policies that take into account the district's specific vulnerabilities, are supported by nature-based solutions and focus on strengthening local capacity.

Climate Overview

The climate of Arnavutköy has a complex structure that reflects the transitional characteristics between the Black Sea and Marmara climate types. The presence of the Black Sea along the northern coast brings more dominant maritime influences, while in the southern areas closer to the Sea of Marmara, the effects of the Mediterranean climate are observed. This climatic diversity is shaped by a combination of the district's topography, water resources and geographical location.[21]

[21] *Kübra Çiçek (2022). Arnavutköy İlçesinde Nüfusun Gelişimi: Sosyo-Kültürel ve Mekânsal Analiz, İstanbul Üniversitesi Sosyal Bilimler Enstitüsü, Yüksek Lisans Tezi*

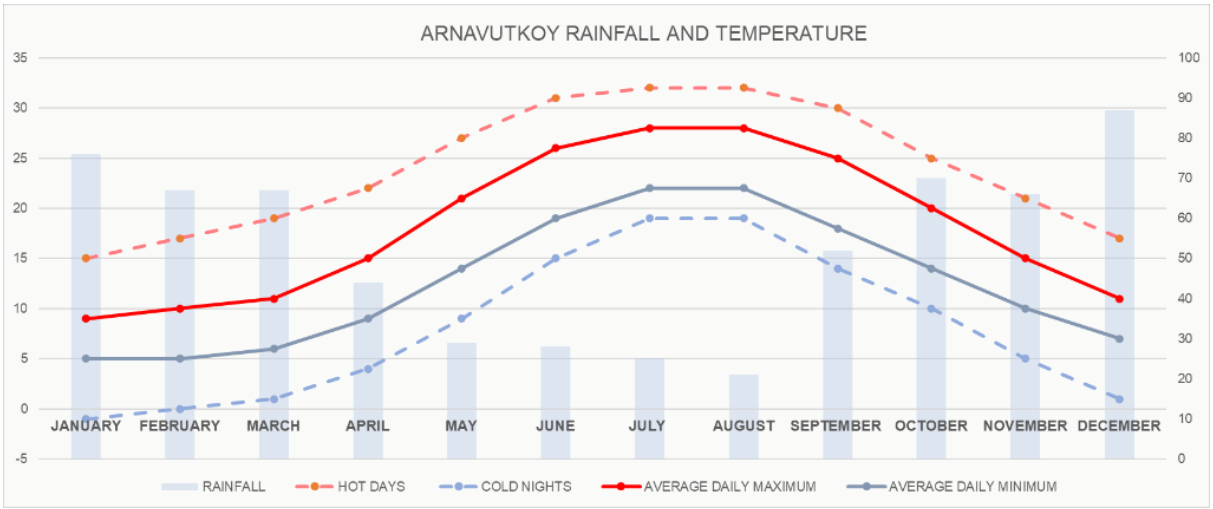


Figure 28 Arnavutköy rainfall and temperature graph

The temperature and precipitation patterns in the district clearly reflect its transitional climatic characteristics. According to data from the Turkish State Meteorological Service, the annual average temperature is 14,6 °C. The highest average temperature, 24,3 °C, is recorded in August, while the lowest, 4,9 °C, occurs in January. These figures indicate that summers in the district are warm but short, whereas winters are cooler and wetter. In areas closer to the Black Sea coast, summers tend to be milder, while winters are more humid and rainy. Precipitation is also an important climatic factor in Arnavutköy. Based on 2020 measurements, the district's annual average precipitation is 640.7 mm. The highest rainfall occurs during the winter and autumn months, while the summer period particularly July and August tends to be relatively dry.[22]

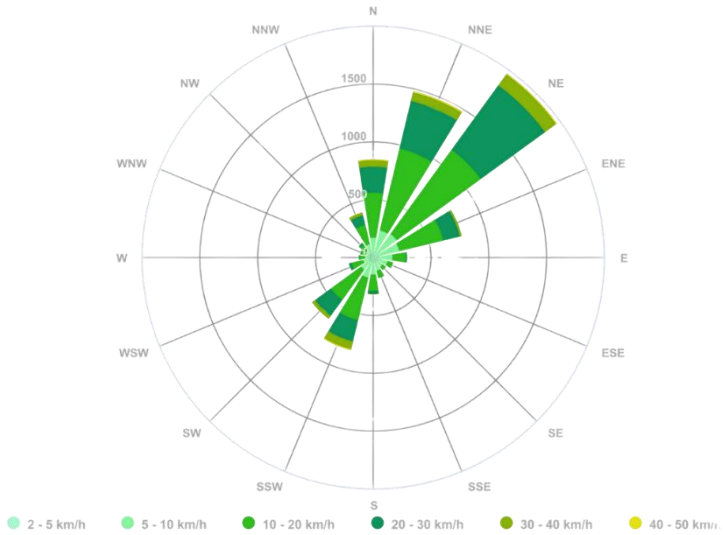


Figure 29 Arnavutköy wind direction and speed

One of the defining climatic elements in Arnavutköy is wind. The district is predominantly influenced by northern and northeastern winds, with the effects of the "poyraz" (a strong northeasterly wind) being particularly evident along the Black Sea coast. According to 2020 data, the annual average wind speed in the district is 4.6 m/s. The highest average speed, 5.5 m/s, was recorded in April, while the lowest, 3.3 m/s, occurred in May. This wind pattern provides a cooling effect during the summer months but causes cold air masses to be felt more intensely in winter. Moreover, in terms of agricultural production, both the direction and intensity of the wind play a significant role in determining crop productivity.

[22] *Meteoroloji Genel Müdürlüğü (MGM) Verileri, Arnavutköy ve Terkos İstasyonları (2015-2020).*

6.2. Disaster Risks According to Climate Change Scenarios

Urban Heat Island Effect Scenarios

The urban heat island effect refers to the climatic changes that occur as a result of reduced evaporative surfaces and a decrease in green spaces within urban areas due to rising temperatures. This phenomenon is characterized by a distinct heat and water cycle in urbanized regions compared to surrounding rural areas, particularly in zones experiencing intense urbanization pressure.[23]

Istanbul is in a high-risk position regarding the urban heat island effect due to changes in land use. The reduction of forested areas and the growing pressure of urbanization further exacerbate this risk. Academic studies examining the relationship between land use and thermal environmental characteristics have shown that higher temperatures are typically observed in densely populated residential zones, commercial areas and regions with heavy traffic, while lower temperatures are recorded in green spaces, low-density settlements and open areas. In this context, changes in surface cover, the increase in concrete surfaces and the high level of exhaust gas emissions have been identified as key factors contributing to rising temperatures.

According to the urban heat island projection study conducted within the scope of the Istanbul Climate Change Action Plan, the current urban-induced temperature increase is approximately 1.2°C. Scenario projections suggest that this increase could exceed 1.5°C by 2030 and 1.7°C by 2050. It has also been determined that urbanization-related warming is more pronounced during the summer months compared to other seasons.[24]

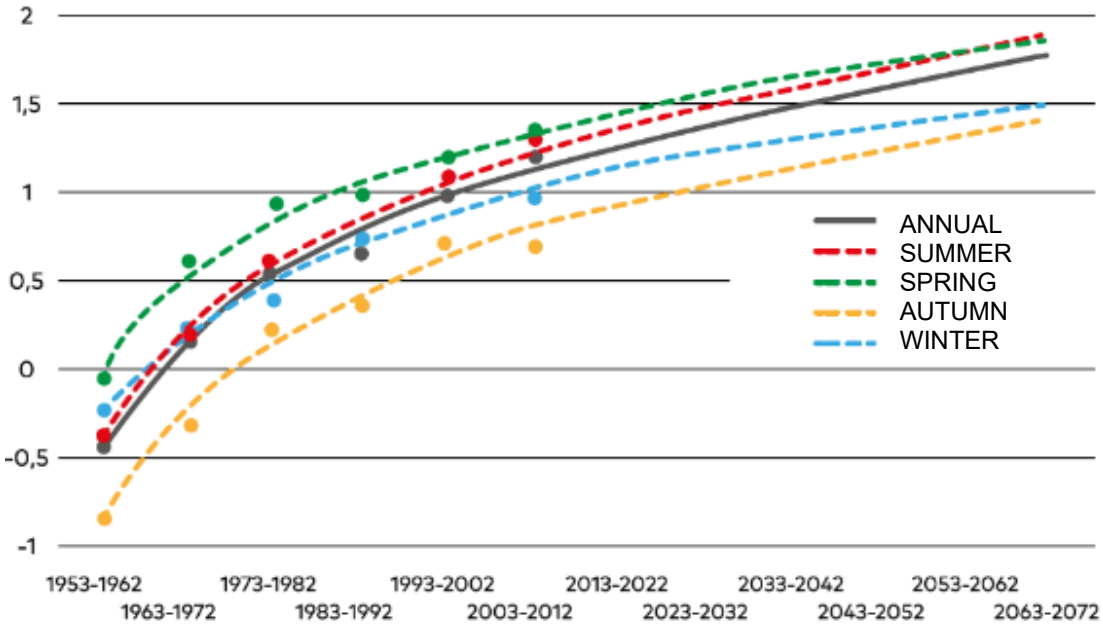


Figure 30 Future projection of the urban heat island in Istanbul (°C) [25]

[23] *Tabanoğlu, O., Antalya için İklim Değişikliğine Uyum Stratejileri Önerisi, İstanbul Teknik Üniversitesi, Yüksek Lisans Tezi, 2018, sf:77.*
[24] İstanbul İklim Değişikliği Eylem Planı, Final Raporu, 2018, sf:10.
[25] İBB, İstanbul İklim Değişikliği Eylem Planı, 2021, sf:51.

Arnavutköy District Surface Temperature Analysis

Surface temperature refers to the temperature value determined through ground measurements and generally represents the temperature of the land surface. Land cover and land use patterns in urban areas are the primary factors that directly influence surface temperatures. The main elements that contribute to the rise in surface temperatures within urban environments are:

- Building masses
- Concrete pavements
- Road networks
- Metal and other impermeable surfaces

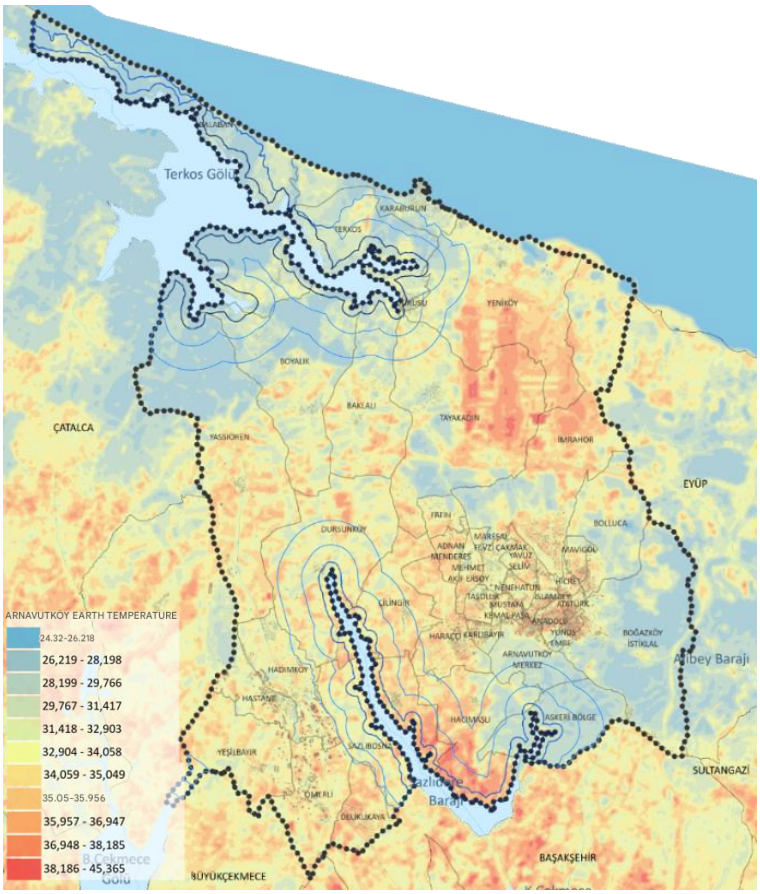


Figure 31 Analysis of the urban heat island effect in Arnavutköy

With the acceleration of urbanization, increasing surface temperatures have intensified the urban heat island effect, particularly in areas with dense construction and built-up environments.[26]

In recent years, remote sensing methods have been widely used to determine land surface temperatures. Using regional data from Landsat, one of NASA's longest-running satellite programs, a surface temperature analysis of Arnavutköy was conducted in a GIS environment based on data from July 22, 2024. According to the data, the maximum air temperature recorded around Arnavutköy on that date was 32°C. However, in areas containing buildings, concrete surfaces and various land use functions, surface temperatures were observed to reach between 36°C and 42°C.

In Arnavutköy District, land surface temperatures range between 24.32°C and 45.36°C. When the analysis is evaluated together with land use characteristics, it reveals the presence of a distinct Urban Heat Island (UHI) effect within the district.

[26] Çilek Ünal, M. (2022). Kentsel Yüzey Isı Adalarının Belirlenmesinde Yer Yüzey Sıcaklık Verilerinin Kullanımı. European Journal of Science and Technology, 213-222.

- **Low temperature zones (24.32–29.76 °C):** Measurements were taken in areas such as Terkos Lake, Karaburun, Boyalık, Baklalı and the northern parts of Yeniköy, where water surfaces, forested zones and agricultural lands are concentrated. In these areas, the extensive green cover and open soil surfaces provide a cooling effect through evapotranspiration and shading.

Forest area around Lake Terkos

- **Temperate zones (31.14–35.95 °C)**: These patterns were observed in rural–peri-urban transition areas such as Dursunköy, Tayakadın, Çilingir and Hadımköy. In these zones, low-density settlements coexist with agricultural activities; however, the presence of infrastructure and transportation networks partially contributes to higher surface temperatures.

Hadımkoy neighborhood is a low-density residential area

- **High temperature zones (36.93–45.36 °C)**: The urban heat island effect is concentrated in settlement areas such as Arnavutköy Center, Nenehatun, Mehmet Akif, Yavuz Selim, Yunus Emre, İslambey, Haraccı, Hacımuslu, Sazlıbosna and around the Azizli Dam. In these regions, high population density, industrial and commercial land uses, extensive asphalt and concrete surfaces and limited green space contribute to the intensification of the urban heat island effect. Particularly around the Sazlıdere Dam and Istanbul Airport, surface temperatures have been identified as being above the regional average, coinciding with patterns of urban expansion.

İstanbul Airport

Green Area Analysis

Green areas play a critical role in mitigating the impacts of climate change and enhancing adaptation capacity in urban environments. Vegetation and green spaces help reduce surface temperatures, thereby alleviating the urban heat island effect, while also contributing to improved air quality, noise reduction and the creation of ecological corridors. In particular, their permeable surface characteristics help to mitigate the effects of extreme weather events such as floods and inundations by facilitating groundwater infiltration and reducing pressure on urban infrastructure. However, green areas should be evaluated not only in quantitative terms but also in terms of their qualitative characteristics and spatial distribution within settlement areas.

Table 7 Green space information for Arnavutköy

Green Area Information	m²
Active green areas (parks, sports fields, recreation areas, forest areas, etc.)	750600
Passive green area (roadside, median, cemetery, etc.)	886233
Total green area	1636833
Total population	344868
Active green area per capita	2,18
Total green area per capita	4,75

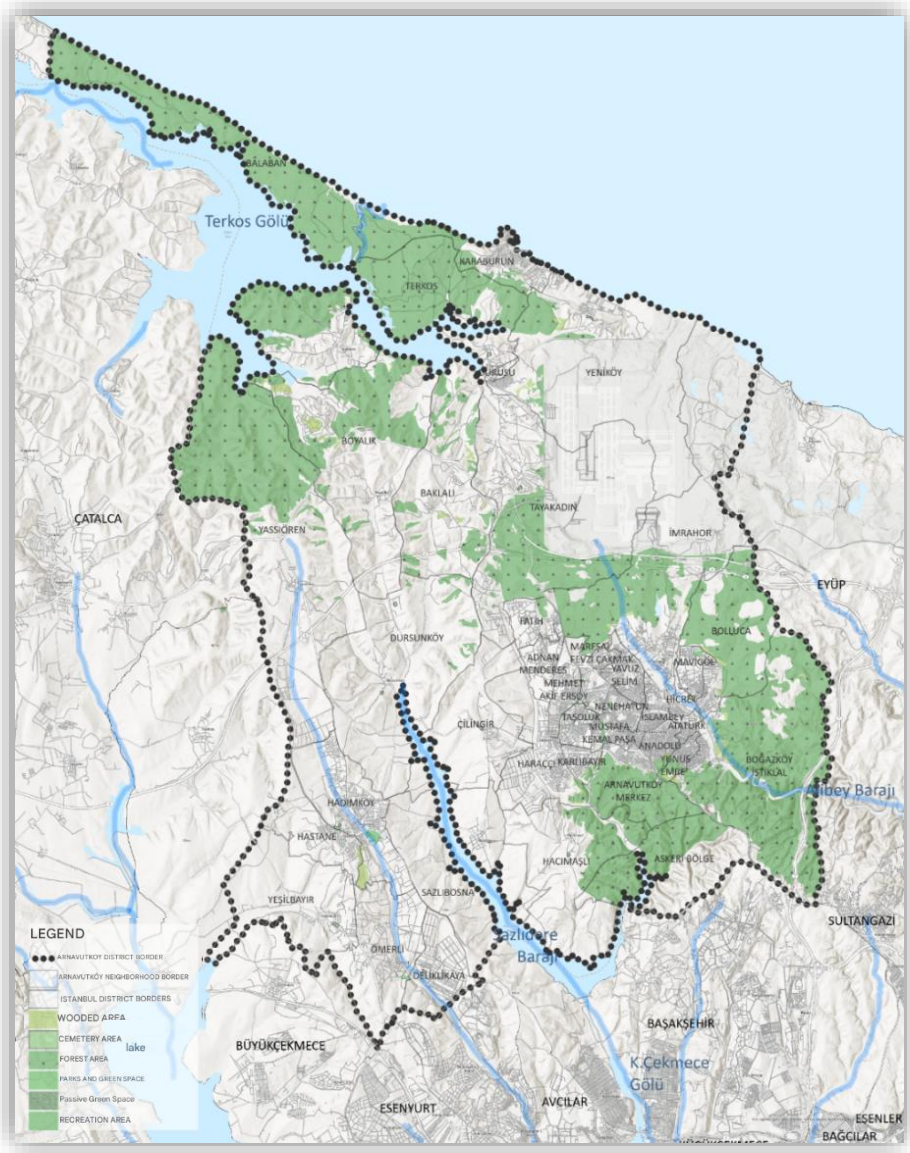


Figure 32 Green space distribution in Arnavutköy

Arnavutköy is one of the leading districts in Istanbul in terms of total open and green space area, with approximately 60% of its territory consisting of agricultural and forest lands. The amount of open and green space per capita across the district is estimated to range between **6- 8 m²**, which is above the Istanbul average. However, since only **2.82%** of the green areas designated in the current zoning plans have been physically implemented, most of these areas remain at the planning stage and are not reflected in daily life. While the extensive forest and watershed areas in the northern part of the district increase the total green space, the amount of active green space per capita drops below **3 m²** in neighborhoods such as Arnavutköy Center, Bolluca, Hacımaşlı, İslambey and Taşoluk. This indicates that the spatial distribution of existing green areas across the district is uneven and that access to active green spaces remains limited.

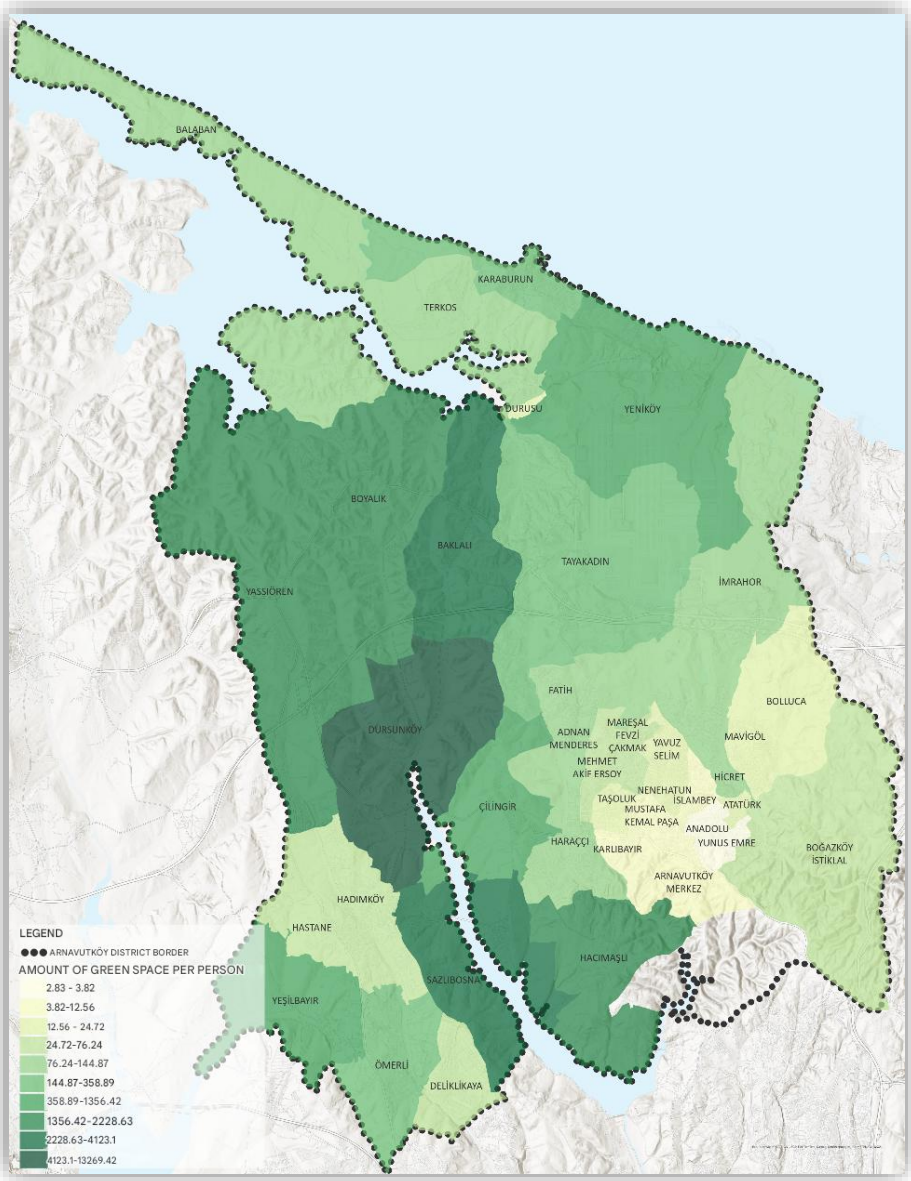


Figure 33 Distribution of green space per person in the neighborhood

As of 2025, excluding the areas of Kanal Istanbul and Istanbul Airport, the amount of active green space in Arnavutköy District has been calculated as 750,600 m², while passive green space

amounts to 886,233 m². Active green spaces refer to parks, sports fields, recreation areas and forest zones that can be directly used by residents, whereas passive green spaces include roadside areas, medians, cemeteries and forested zones adjacent to water basins. Although the district possesses a strong presence of forests and watershed areas, the quantity and distribution of active green spaces are insufficient. In particular, the amount of active green space per capita in central neighborhoods remains below the 10 m² minimum threshold set by the Spatial Plans Construction Regulation. This indicates that despite Arnavutköy's high potential in passive green spaces, there is an ongoing need to enhance accessible urban green infrastructure. Accordingly, green space planning should not only focus on conservation but also be supported by high-quality, accessible and continuous active green infrastructures that strengthen urban climate resilience.

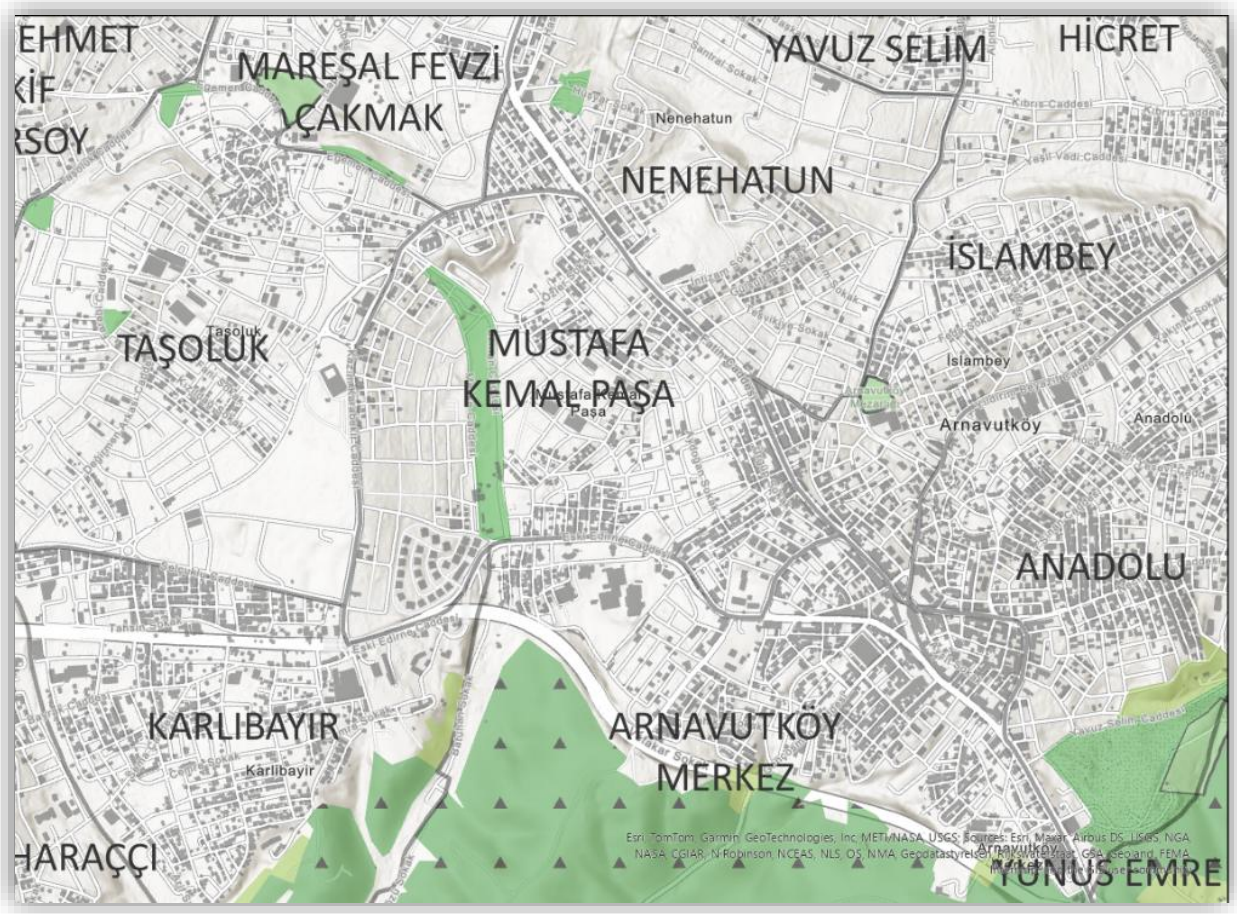


Figure 34 Green areas in the central district of Arnavutköy

Arnavutköy District is one of the areas in Istanbul with the highest forest cover, particularly distinguished by its extensive forested and wooded zones concentrated in the northern part of the district, around Terkos Lake and along the Balaban–Boyalık–Terkos–Karaburun–İmrahor corridor. These areas not only serve as ecological corridors but also enhance the district's carbon sink capacity, contributing to the reduction of greenhouse gas emissions. However, when assessed in terms of spatial distribution, it becomes evident that green areas are predominantly located in the northern part of the district, while active and accessible green spaces remain limited in settlement areas such as Arnavutköy Center, Adnan Menderes, Mustafa Kemal Paşa, Hacımaşlı, İslambey, Taşoluk and Bolluca. In the southern parts particularly around Hadımköy, Deliklikaya and

Yassıören increasing development pressure is fragmenting the green fabric, leading to the degradation of forest areas and the northward expansion of the urban heat island effect. The forest cover surrounding Terkos, Sazlıdere and other water basins provides significant adaptation potential by supporting water resource protection and reducing the risks of drought and flooding. Therefore, while Arnavutköy possesses a strong potential as a carbon sink area, the sustainable preservation of this natural asset requires preventing the conversion of forest areas for development, mandating ecological impact analyses in new settlement pressures and advancing spatial planning approaches that ensure the continuity of green spaces.

Precipitation Change Scenarios

According to projections extending to the year 2100, under the optimistic scenario (RCP2.6), no significant change is expected in the amount of precipitation for Istanbul, whereas the pessimistic scenario (RCP6.0) indicates a substantial decrease in rainfall (Figure 28). Along with declining precipitation and rising temperatures, the current drought period approximately 45 days is projected to extend to between 50 and 57 days by the 2050s and to between 49 and 68 days by the end of the century. These developments are expected to considerably increase the risk of drought in the region.

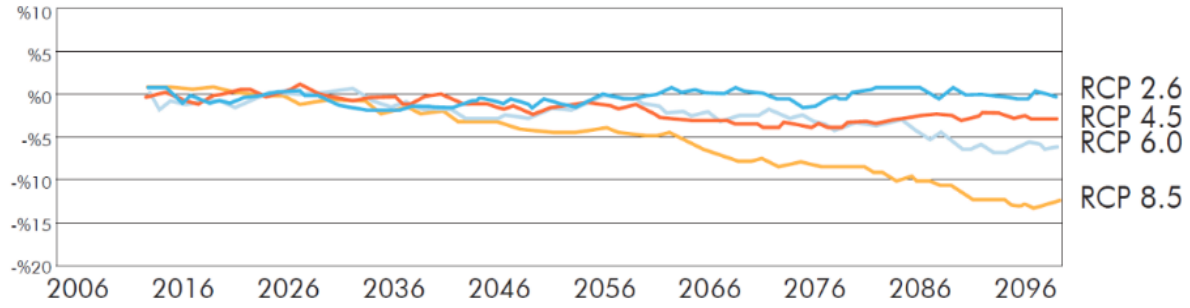


Figure 35 2006-2069 precipitation scenario[27]

The current situation across Turkiye and particularly in Istanbul, demonstrates the extent to which the threat of drought can reach critical levels. According to the Istanbul Precipitation and Drought in Turkey report published by the Water Policies Association in December 2020, rainfall in Istanbul during September and November 2020 was 30% and 54% below the long-term average, respectively. This finding supports assessments indicating that meteorological drought has evolved into hydrological drought.[28]

Another striking aspect, alongside the decrease in total precipitation, is the change in rainfall patterns. Projections indicate an increase in sudden and intense rainfall events. These extreme precipitation episodes, which elevate flood risks, are projected under the worst-case scenario (RCP8.5) to rise by up to 20% on sunny days and by as much as 59% on rainy days. Such increases are expected to lead to more frequent occurrences of disasters such as floods and inundations across many regions of Turkey, including Istanbul.

According to Istanbul's climate projections based on the IPCC's RCP2.6, RCP4.5, RCP6.0 and RCP8.5 scenarios, an increase is expected in the number of very rainy and extreme rainfall days,

[27] İstanbul İklim Değişikliği Eylem Planı, Final Raporu, 2018, sf:11.
[28] *https://supolitikalaridernegi.org/2020/12/19/spd-istanbul-yagislari-ve-Türkiyede-kuraklik-raporu-yayinladi-2021-kurak-gecebilir/ Erişim Tarihi: Ağustos, 2025*

as well as in daily maximum precipitation amounts. In summary, the projections for extreme and sudden rainfall in Istanbul are as follows:

- A significant increase in precipitation on very rainy days (up to 20%),
- A substantial increase in precipitation on extremely rainy days (up to 59%),
- An increase in the maximum daily precipitation amount (up to 13%),
- A rise in rainfall intensity (up to 9%),
- A notable extension in the duration of the longest dry periods.[29]

At the same time, for the Terkos Basin, which includes the Arnavutköy District, it is projected that extreme rainfall and flow events will occur at much shorter intervals in the future. Climate change assessments conducted for the basin indicate that the increase in disasters such as floods and inundations combined with the expansion of impervious surfaces due to urbanization and the influence of pollution sources such as industrial, transportation and domestic waste will significantly contaminate both groundwater and surface water resources.

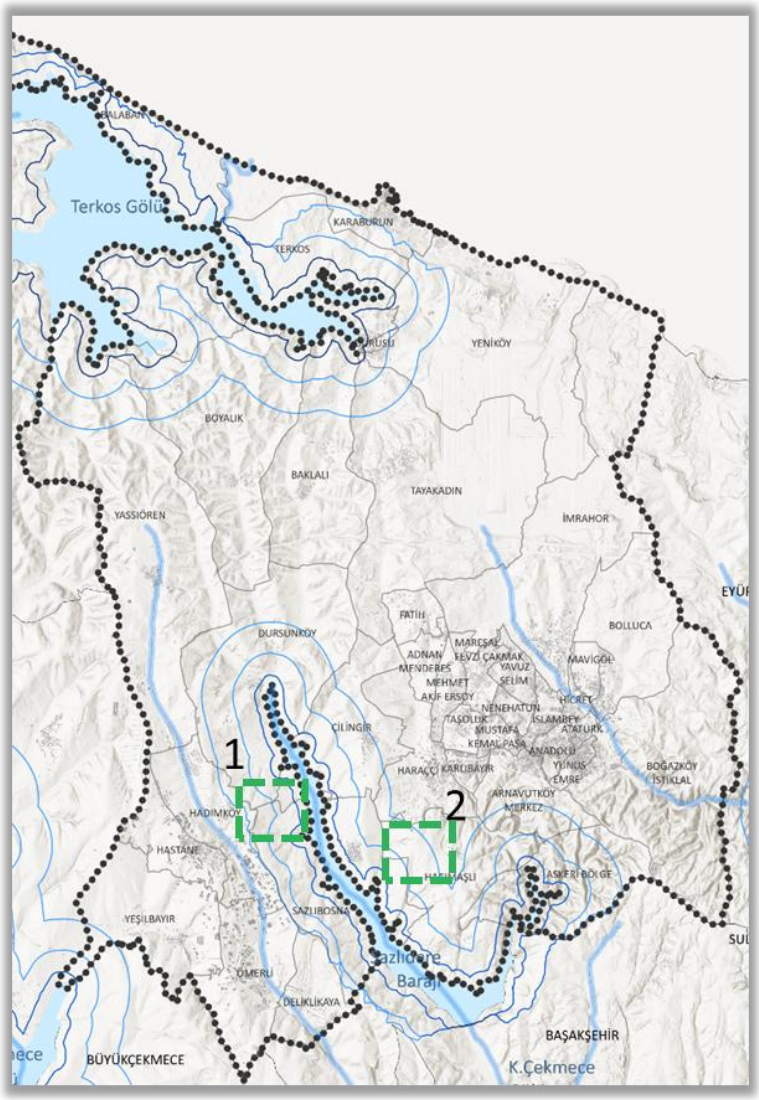


Figure 36 Arnavutköy water resources

Arnavutköy District lies within the influence area of four major basins that play a critical role in meeting Istanbul's drinking water needs. These basins are the Alibey Basin, Terkos Lake Basin, Büyükçekmece Lake Basin and Sazlıdere Dam Lake Basin. The contribution of these basins to Istanbul's water supply is highly significant: 33.5% of the city's water demand is met by the Terkos Basin, 18.5% by the Büyükçekmece Basin, 15% by the Alibey Basin and 2% by the Sazlıdere Basin. Collectively, these sources account for 69% of Istanbul's total water supply.

The significance of the basins located within Arnavutköy extends beyond their role in providing drinking water. These areas also function as ecological corridors that form the city's natural ventilation pathways. For instance, the water

[29] İstanbul İklim Değişikliği Eylem Planı, Final Raporu, 2018

corridor within the Sazlıbosna Basin connects the Sazlıbosna Dam to the Black Sea, thereby facilitating natural air circulation. Similarly, the Alibeyköy Dam Lake is part of the ecological corridor that links Terkos Lake to the Golden Horn, extending through Bolluca and İmrahor toward the northern forests.[30]

Considering the land use patterns and land cover characteristics across the basin, as well as the rapid pace of urbanization, it is anticipated that the rate of climate-related impacts will continue to increase in the coming years. In this context, it is crucial to ensure that settlement areas particularly those located along stream beds and floodplains are prepared for the risks of floods and inundations caused by extreme and sudden rainfall. Within the boundaries of Arnavutköy District, watershed protection zones and stream buffer areas have been designated to safeguard drinking and utility water resources. These zones hold strategic importance for maintaining water quality, reducing flood risks and preserving natural habitats. The watershed protection zones are defined at varying distances around lakes and rivers to prevent pollution within their catchments. However, these areas face ongoing pressure from agricultural activities, industrial operations and urban expansion, all of which pose potential threats to local water resources.

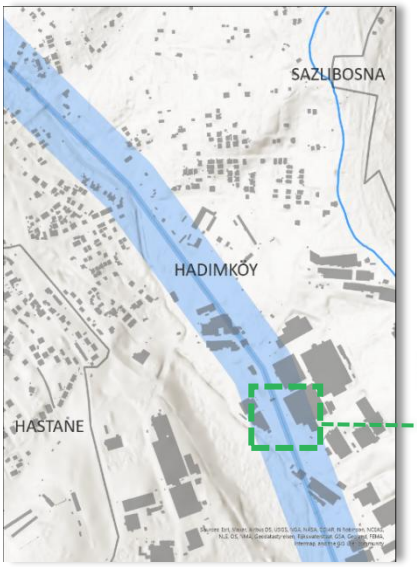


Figure 37 Hadımkoy industrial facilities and watercourse

Figure 38 100m stream protection zone

Stream corridors are not only areas where surface runoff accumulates but also integral components of the regional precipitation regime and groundwater cycle. Within the 100-meter-wide stream protection zone extending between Hadımkoy and Sazlıbosna, residential and industrial areas are located. This situation is noteworthy in terms of both flood risk and water quality. Significant urban development pressure is evident along the stream axis, with new housing areas positioned in close proximity to the stream. This poses potential threats to both the hydrological balance and ecological continuity in the coming years. Additionally, the narrowing of the stream bed combined with increasing construction activities, when coupled with changes in precipitation patterns, further amplifies the risk of flooding.

[30] *https://www.Arnavutköy.bel.tr/Arnavutköy-icerik/su-havzalari Erişim Tarihi: Ağustos,2025*

Figure 39 Sazlıdere absolute protection zones and structures

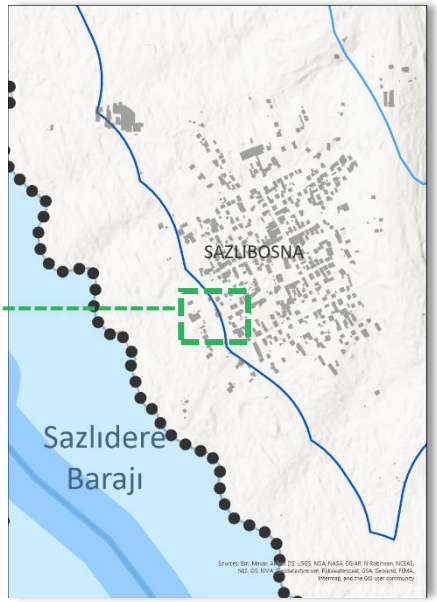


Figure 40 Sazlıbosna Sazlıdere Dam absolute and short-term protection areas and structures

The absolute protection zone of the Sazlıdere Dam encompasses the lake area in direct contact with the water and a designated buffer area surrounding it. The primary function of this zone is to preserve the physical and chemical quality of the water. The short-distance protection zone, which encircles the absolute protection zone, is an area where human activities that could potentially impact water resources are restricted. However, the presence of construction and settlement activities within these zones currently poses a serious threat to the long-term water quality of the dam. From an ecological and hydrological perspective, these sensitive areas of the Sazlıdere Dam are significant not only for ensuring drinking water security but also for maintaining microclimatic balance, habitat continuity and natural air corridors. The ongoing development within the protection boundaries has the potential to disrupt the integrity of the watershed, increase surface pollution loads and degrade the dam's overall water quality.

In conclusion, the preservation of the absolute and short-distance protection zones surrounding the Sazlıbosna and Sazlıdere Dams is of critical importance for Istanbul's drinking water security and ecological continuity. Limiting existing and potential construction activities within these areas is essential to ensure long-term environmental sustainability.

Sea Level Rise

As a result of global climate change, the rise in sea levels poses a significant risk for coastal cities. According to IPCC reports, the global average sea level has risen by 10–20 cm over the past century and an additional rise of 40–60 cm is expected by the end of this century.[31]

[31] *IPCC,* Sixth Assessment Report (AR6) – Climate Change 2021: The Physical Science Basis, *Intergovernmental Panel on Climate Change, 2021.*

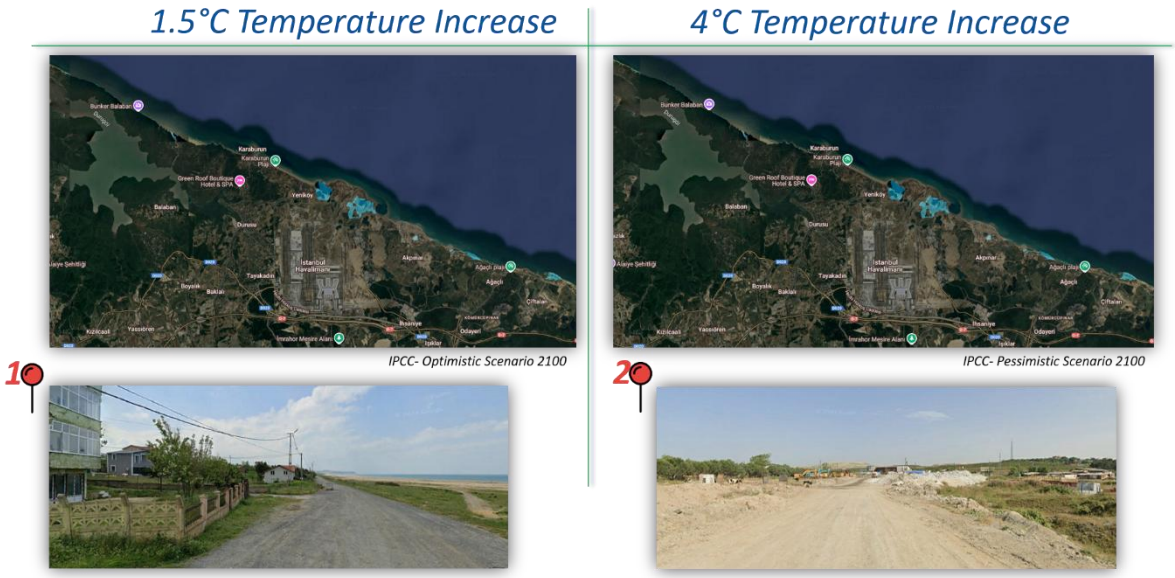


Figure 41 Water level rise expected at 1.5°C and 4°C temperature increases according to IPCC reports

Arnavutköy District is located on the Black Sea coast of Istanbul, with approximately 22 km of shoreline. The area features extensive sandy beaches and low-lying coastal zones, particularly around Karaburun Bay and the northern shores of Lake Terkos. This geographical setting limits the district's natural defense capacity against flooding, erosion and saltwater intrusion caused by sea level rise. According to national analyses conducted along Turkey's coasts, the annual rate of sea level rise is estimated to be between 1–2 mm; however, it has been emphasized that this rate may be higher in certain deltas and low-lying coastal regions. Based on these findings and IPCC research, the Arnavutköy coastline faces risks such as increased likelihood of flooding and erosion, shrinking of sandy areas, vulnerability of coastal roads and infrastructure to inundation and the reduction of natural coastal ecosystems.

Forest Fires

Meteorological conditions have a decisive influence on the occurrence, spread rate, intensity and duration of forest fires. The likelihood of fires caused by human activities or natural factors largely depends on the suitability of these conditions. With the impacts of climate change leading to rising temperatures, forest fires are becoming more frequent, posing a serious threat to forest ecosystems, forest villages and the living organisms that inhabit these areas.

In addition to disasters such as earthquakes, floods and droughts, forest fires have also historically been a significant risk factor in Istanbul. Effective response to potential disasters and emergencies that may arise due to temperature changes triggered by climate change is among the city's primary needs. A clear increasing trend can be observed in fires that occurred in non-structural areas (such as forests and shrublands) in Istanbul between 2016 and 2020.

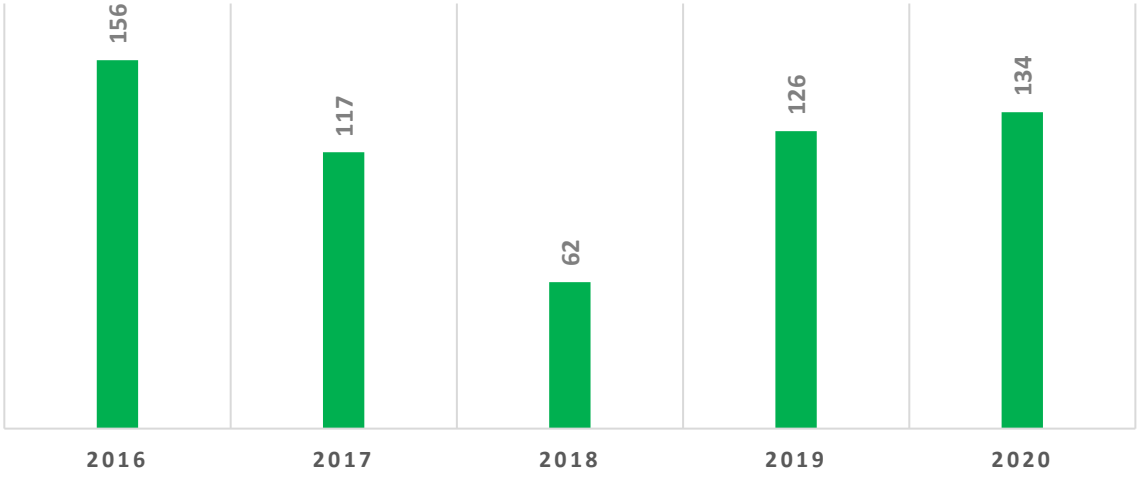


Figure 42 Number of fires occurring in forest and scrubland areas in Istanbul[32]

Approximately 52% (259.4 km²) of the total area of Arnavutköy District is covered by forested land. However, only half of this area consists of well-preserved forests, while the remaining portions are composed of maquis shrublands, degraded forests, or areas that have lost their forest character. Such areas are either used for agricultural purposes or occupied by residential settlements.[33]

In recent years, an increase in the number of forest fires has been observed in Arnavutköy District. For example, the forest fire that occurred on September 8, 2022, in the Turkkose area of Dursunkoy Neighborhood was brought under control through the intervention of teams from neighboring districts. Moreover, with the recent rise in heatwaves, the risk of forest fires has reached a critical level.

Drought

Drought is a natural climatic phenomenon that occurs when precipitation falls below the long-term average. This condition, which can vary in frequency and intensity across different regions, has become more frequent in recent years due to the effects of climate change. At the district level, drought directly impacts water resources, reduces agricultural productivity, causes the drying of green areas and creates challenges in the supply of drinking water. Declines in the levels of dams, ponds and groundwater due to insufficient rainfall also lead to adverse consequences in areas such as the environment, public health, energy and the economy.

The effects of drought are not only related to climatic factors but also to human activities. Population growth, unplanned water use, rapid urbanization and consumption habits increase pressure on water resources. Therefore, efficient water use at the local level, public awareness initiatives and sustainable planning measures are of great importance.

[32] *AFAD, İstanbul İl Afet Risk Azaltma Planı, 2022*
[33] *https://www.Arnavutköy.bel.tr/Arnavutköy-icerik/su-havzalari Erişim Tarihi: Ağustos,2025*

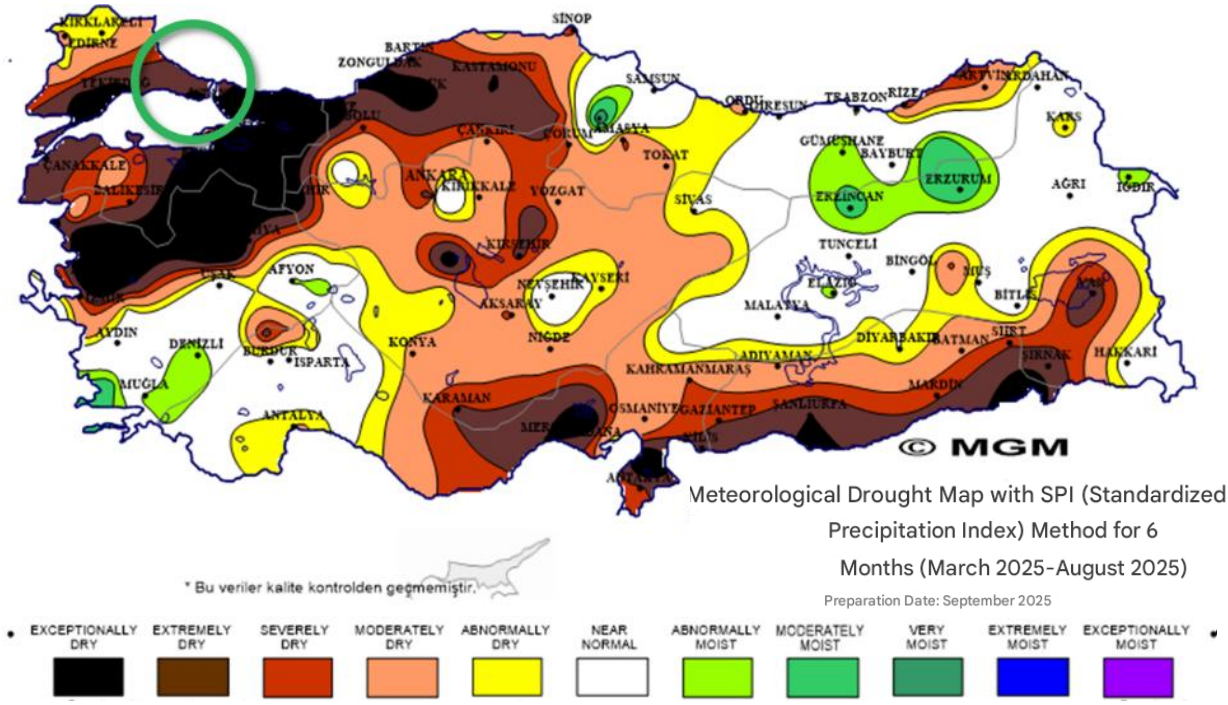


Figure 43 Turkey 6-Month Meteorological Drought Map

Istanbul is among the metropolitan cities that are experiencing the impacts of climate change most intensely. In recent years, increasing temperatures and decreasing precipitation levels have made the risk of drought a major threat to the city's water security more apparent. According to data from the Istanbul Water and Sewerage Administration (İSKİ), as of 2025, the average reservoir occupancy rate has fallen to around 31%. When this situation is considered alongside irregular precipitation patterns and rising water demand, it indicates that Istanbul may face more frequent and prolonged drought periods in the coming years. Furthermore, climate change studies for Istanbul project that by 2030, the areas exposed to both flood and drought risks will increase by 2.5 times. The main causes of this growing risk include rapid urbanization, loss of green spaces, the expansion of impervious surfaces and unsustainable water consumption habits. The northern regions of Istanbul, which are particularly critical for water basins, are more vulnerable due to both climatic changes and increasing development pressures.[34]

Arnavutköy hosts some of Istanbul's most important water resources. Within the district boundaries lie key basins such as Lake Terkos, Sazlıdere Dam and Alibey Dam, which supply a significant portion of the city's drinking water. Therefore, Arnavutköy holds a strategic position in terms of water resource protection. However recent years, decreasing rainfall and declining groundwater levels have intensified drought pressure in the district. Rising summer temperatures and irregular precipitation patterns driven by climate change are causing water stress in both agricultural production and natural ecosystems. The expansion of residential areas, population growth and new zoning developments in Arnavutköy are putting additional pressure on watershed

[34] *İPA, İklim Krizinin İzleri: İstanbul'da Kentsel Isı Adası Etkisi ve Kuraklık, 2025*

protection zones. This situation increases surface runoff, reduces groundwater infiltration and weakens long-term water reserves.

Although Istanbul is a rapidly urbanizing metropolis, agricultural production still maintains its importance in the city's peripheral districts. Silivri, Catalca, Şile and Arnavutköy are among the leading districts in terms of agricultural production in Istanbul.

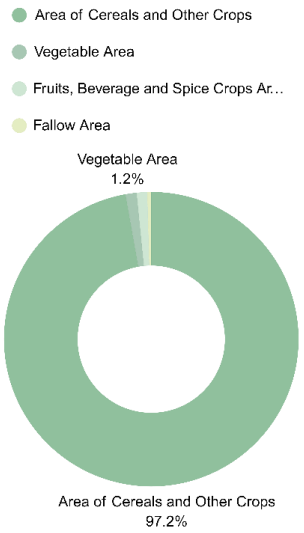


Figure 44 Agricultural production distribution in Arnavutköy

The district's agricultural production largely depends on the rainfall regime, which increases its vulnerability to drought risk. Representing a small but critical portion of Istanbul's total agricultural land, Arnavutköy plays a key role in ensuring food security and maintaining local agricultural continuity. While agricultural lands across Istanbul are gradually decreasing, Arnavutköy still hosts a significant portion of these areas and stands out as one of the few districts preserving the city's agricultural identity. The main agricultural products cultivated in the district include barley, wheat, sunflower and canola crops that are both well-suited to the local climate and compatible with dry farming practices. Although the total agricultural land in Istanbul is around 746,139 decares, Arnavutköy accounts for approximately 8% of this amount. However, the district's agricultural lands are under threat due to both urbanization pressure and the increasing risk of drought linked to climate change. Reduced rainfall leads to lower soil moisture and greater water stress, particularly during the summer months, resulting in higher irrigation costs and decreased production efficiency. Therefore, Arnavutköy has become one of the regions that both represents Istanbul's remaining agricultural potential and experiences the highest levels of drought pressure. Preserving sustainable agriculture, improving water management and enhancing farmers' capacity to adapt to climate change are critical for ensuring the continuity of agricultural production in the coming years.[35]

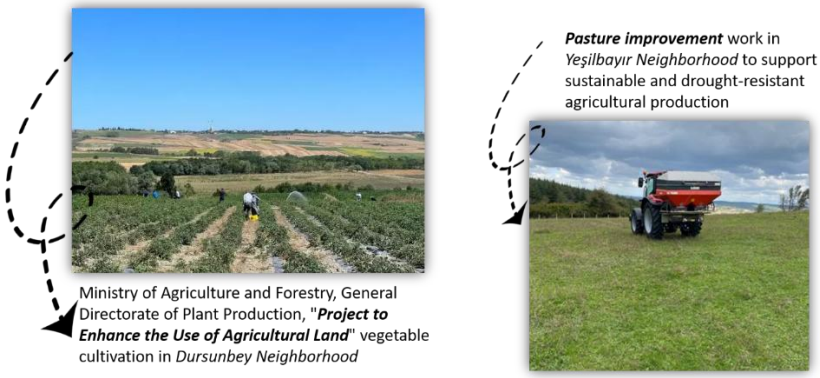


Figure 45 Agricultural projects in Arnavutköy

[35] *Tarım Dünyası, "İstanbul Tarımda Üreten Kent Değil, Tüketen Kent", 2025.*

In the 2023–2027 Agricultural Drought Action Plan of the Istanbul Provincial Directorate of Agriculture and Forestry, key priorities for Arnavutköy located in the northern belt include increasing water efficiency, promoting the use of modern irrigation methods and encouraging the cultivation of drought-resistant crop varieties.

6.3. Socioeconomic Status Assessment

Climate change does not affect all segments of society equally. While geographical and physical conditions may create similar impacts, the level of a community's development largely determines the severity and consequences of those impacts. Factors such as the degree of urbanization, technological and adaptive infrastructure capacity, education level and socio-cultural structure are among the main determinants of vulnerability to climate change. Therefore, identifying the areas most likely to be affected by climate change and assessing the levels of social vulnerability within cities are crucial steps for strengthening preventive measures in regions where vulnerable communities are concentrated.

Identifying vulnerable population groups for each type of climatic hazard is critically important for reducing susceptibility to these risks, accurately targeting the measures to be implemented and enhancing community resilience to climate threats. The Turkish Statistical Institute (TUİK) defines vulnerable populations as groups with a high risk of poverty and social exclusion, including the poor, persons with disabilities, children, youth, women, the elderly, the unemployed and the homeless.[36]

According to 2024 data from the Turkish Statistical Institute (TÜİK), approximately 51.39% of Arnavutköy's population is male, while 48.61% is female. In terms of age distribution, 7.67% of the population consists of elderly individuals, who can be considered a vulnerable group.

Socioeconomic Development

Socioeconomic development indices provide important insights into the demographic and economic structures of districts. In the SEGE-2022 study conducted by the Ministry of Industry and Technology of the Republic of Türkiye, socioeconomic development levels of districts across the country were determined using 56 variables grouped under eight main categories: demography, employment and social security, education, health, finance, competitiveness, innovation and quality of life. Within this framework, Arnavutköy ranks within the top 17.2% among 973 districts. An examination of the socioeconomic status of the neighbourhoods in the district shows that all neighbourhoods fall into Group C.

[36] *TÜİK, 2015*

Figure 46 Istanbul and Arnavutköy SES groups[37]

In the socioeconomic status (SES) classification conducted at the Istanbul scale, districts are categorized into four levels: A, B, C and D. This distribution is based on indicators such as income level, education attainment, employment structure and living standards. According to map data, all districts except Beşiktaş and Kadıköy fall within the C group. Districts classified under the C group SES are characterized by lower-middle income levels, limited access to education and healthcare services and a labor force largely engaged in unskilled or low-income jobs. Arnavutköy is also categorized within the C group. The district's predominantly rural settlement structure, combined with rapid population growth and unplanned development, has led to deficiencies in social services and infrastructure support. Consequently, the district's overall socioeconomic indicators remain below the Istanbul average.

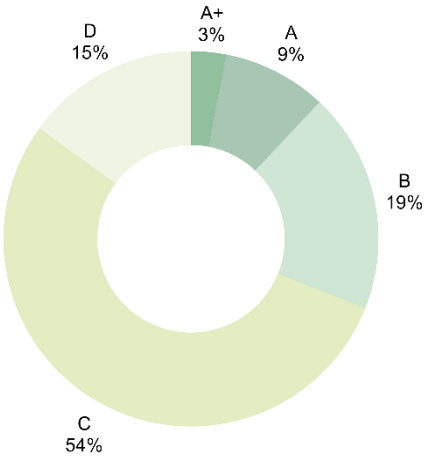


Figure 47 Arnavutköy SES group distribution

Moreover, at the neighborhood scale, the socioeconomic status (SES) distribution within Arnavutköy shows little variation, with all neighborhoods predominantly classified under the C group. This indicates a widespread socioeconomic vulnerability across the district. Overall, the C group accounts for approximately 54% of the population, while the D group which represents more vulnerable segments makes up about 15%. These figures reveal that the majority of Arnavutköy's population belongs to the lower-middle income group.

[37] *https://www.endeksa.com/tr/analiz/Türkiye/istanbul/demografi Erişim Tarihi: Ağustos,2025*

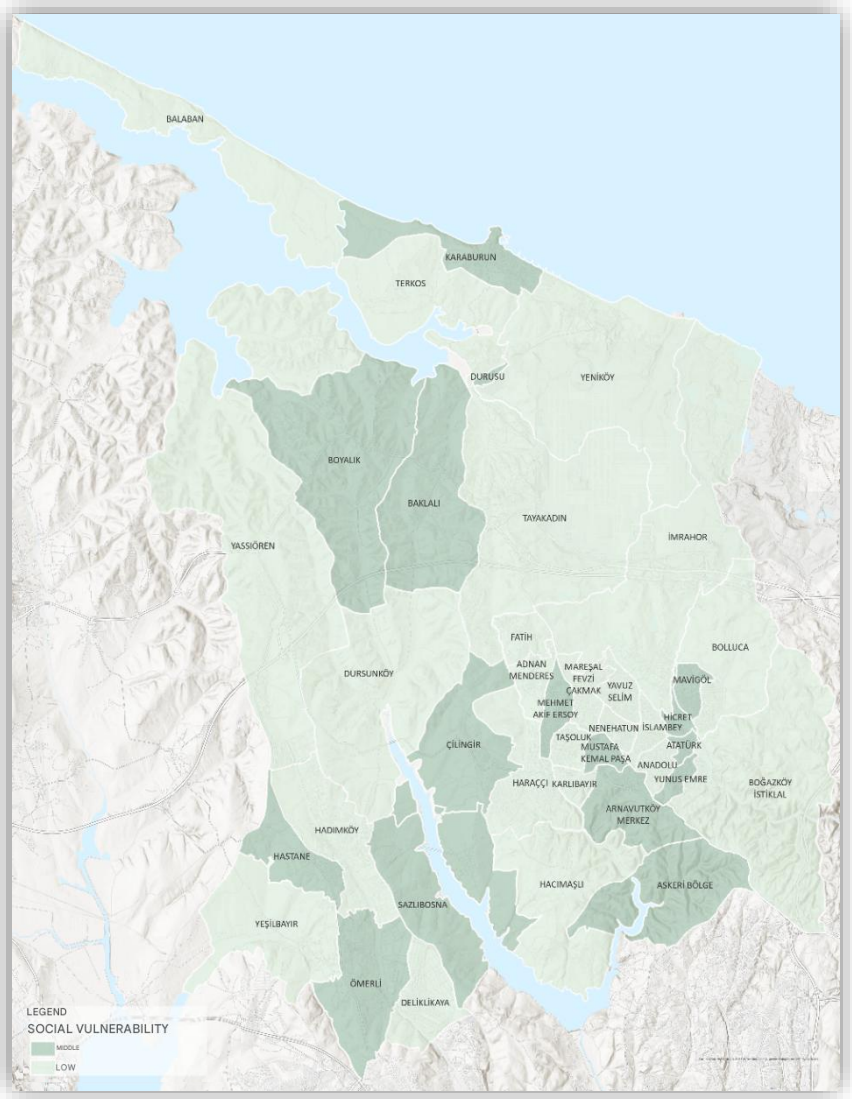


Figure 48 Social vulnerability status of Arnavutköy districts

In 2018, the Istanbul Metropolitan Municipality's Department of Earthquake Risk Management and Urban Improvement, under the Directorate of Earthquake and Soil Investigation, conducted a study titled "Social Vulnerability Analysis Against Disasters in the Province of Istanbul." In the analysis, social vulnerability is defined as "a condition shaped by the pre-disaster circumstances of an individual or community, which determines both the extent of the negative impacts of disasters and their capacity to resist and cope with these impacts." To assess social vulnerability, surveys were conducted based on variables such as the sociodemographic structure of households, length of residence in the district, socioeconomic status, access to healthcare services, level of social solidarity, disaster risk perception and attitudes. The collected data were analyzed at both district and neighborhood levels. As a result of this study, Arnavutköy ranked 8th among Istanbul's 39 districts in terms of social vulnerability to disasters.

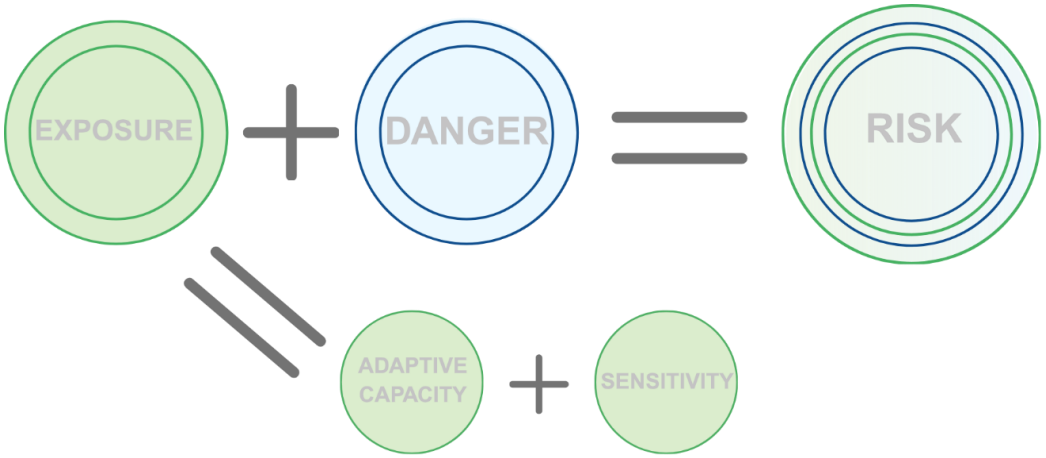
In the analysis, which considered indicators such as household economic status, education level, access to healthcare services, social solidarity capacity and risk perception and attitudes toward hazards like earthquakes, floods, fires, erosion and rising temperatures, vulnerability scores were also calculated at the neighborhood level. Within Arnavutköy District, the neighborhoods identified as having relatively higher vulnerability scores include Durusu, Cilingir, Sazlıbosna, Hastane, Arnavutköy Merkez, Mehmet Akif Ersoy, Yunus Emre, Atatürk, Hicret, Mavigol, Mustafa Kemal Paşa, Omerli, Karaburun, Baklalı and Boyalık.[38]

[38] *İBB, Deprem Zemin İnceleme Müdürlüğü'nün İstanbul İli Genelinde Afetler Karşısında Sosyal Hasar Görebilirlik Analizi İçin Anket Çalışması'nda yer alan verilerden yararlanılarak çalışma kapsamında hazırlanmıştır*

6.4. Risk and Vulnerability Assessment

Assessing vulnerability to climatic risks is critically important for developing adaptation strategies, enhancing resilience and building stronger social and economic structures. This assessment represents one of the fundamental steps toward creating a sustainable and resilient future in the fight against climate change.

Climate risks emerge when systems, individuals, or natural elements exposed to climatic hazards (extreme weather events) face high sensitivity and limited adaptive capacity. Since the IPCC's Fifth Assessment Report, *vulnerability* has been defined as the degree to which something is susceptible to adverse effects and it is considered a function of both sensitivity and adaptive capacity. In this context, sensitivity and adaptive capacity are the two main components of vulnerability. Adaptation efforts, therefore, focus on reducing sensitivity and enhancing adaptive capacity to mitigate climate risks.



Cities and regions build resilience to climate-related shocks and stresses and strengthen their adaptive capacity by implementing climate adaptation actions. However, in order to develop such adaptation strategies, it is first necessary to conduct comprehensive analyses of the climatic risks of the region or city and to establish a place-based understanding. Therefore, after assessing Arnavutköy's climate risks, district-specific policies are developed to reduce vulnerability and enhance resilience.

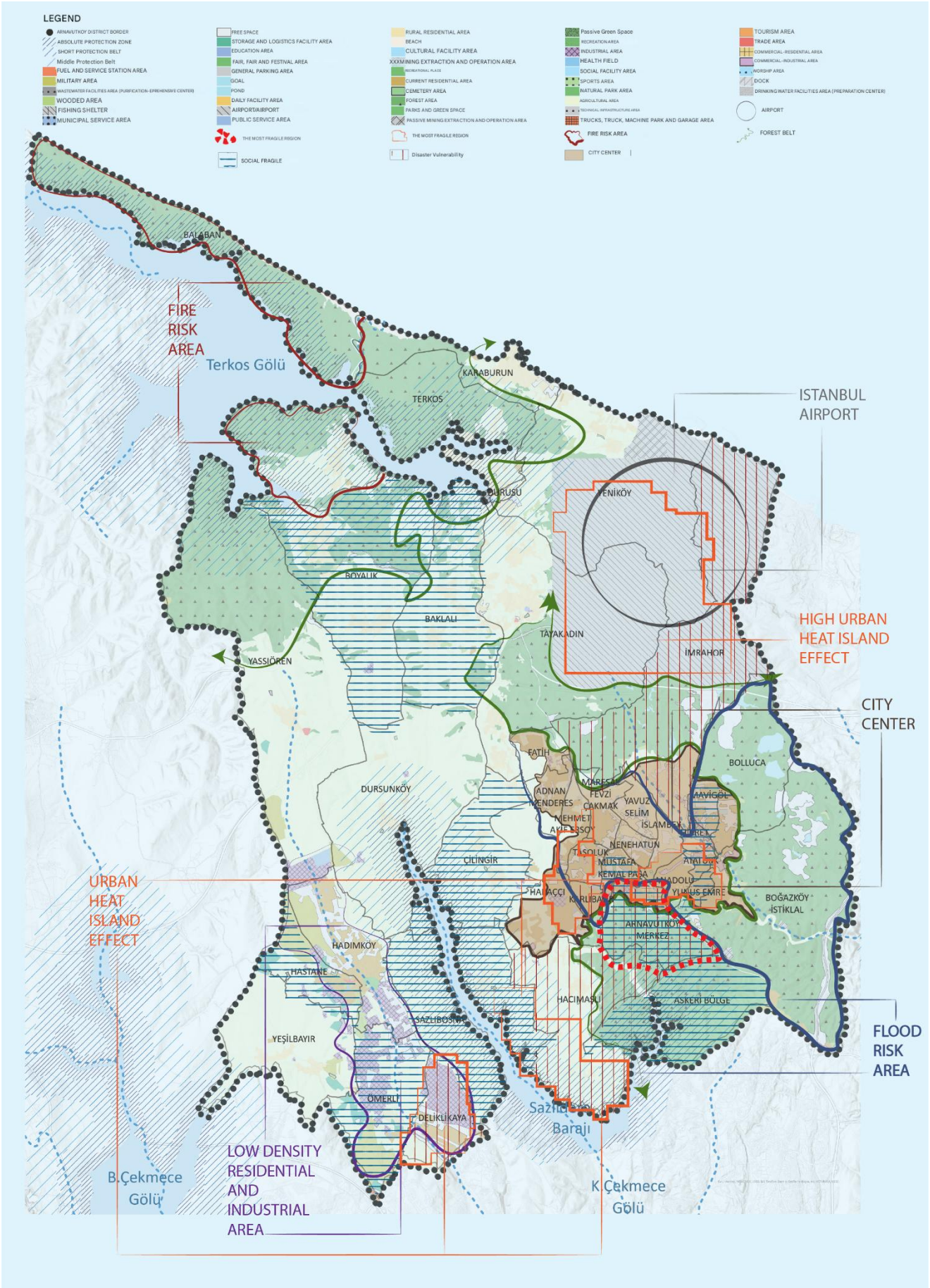


Figure 49 Arnavutköy Risk Analysis

In identifying climate change vulnerabilities, it is essential to define risks not only thematically but also spatially. This approach helps reveal areas where impacts are concentrated at the local level, enabling the prioritization of adaptation actions and the development of risk-based decisions in spatial planning. When the risks analyzed thematically across Arnavutköy such as fire, flooding, urban heat islands, industrial impact and social vulnerability are also assessed spatially, multi-layered vulnerability zones to climate change emerge throughout the district.

In the northern part of the district, particularly around Karaburun and Lake Terkos, the density of forest cover, summer drought conditions and increasing recreational activities make wildfire risk a prominent concern. These areas also contain ecologically sensitive zones designated as drinking water basins; therefore, wildfire risk and ecological pressure coexist. This overlap poses threats to both water quality and ecosystem integrity.

Figure 50 Terkos Lake Area

In the eastern part of the district, particularly around Istanbul Airport and its surroundings, extensive built-up areas, a low proportion of green spaces and heavy traffic contribute to a strong urban heat island effect. The areas around Tayakadın and Yeniköy experience this effect most prominently. The widespread presence of concrete and various impervious surfaces in this region also increases the potential for local flooding. Consequently, the urban heat island effect and flood risk overlap within the same spatial zones.

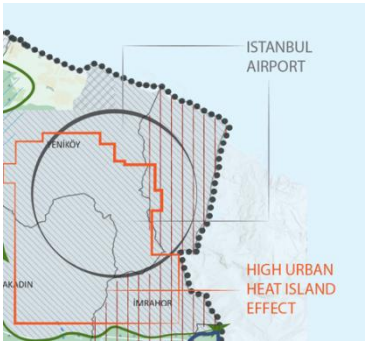


Figure 51 Istanbul Airport Area

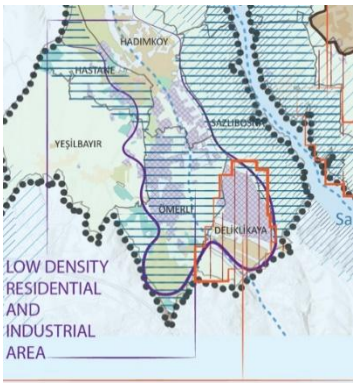
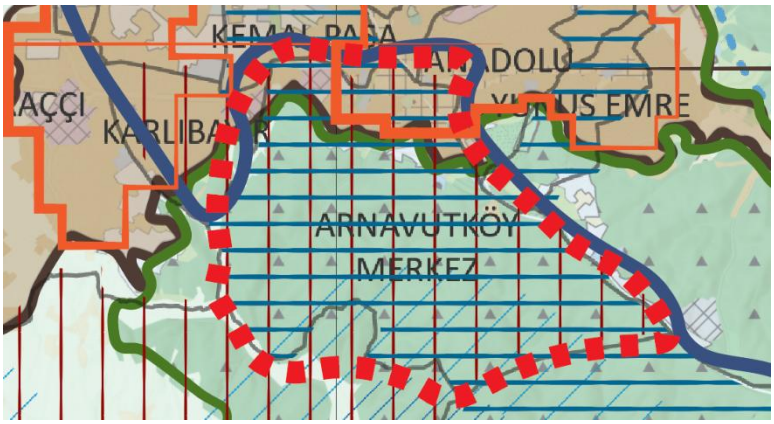


Figure 52 Risk layers in Sazlıbosna and its surroundings

In the southwestern part of the district, around Deliklikaya, Hadımköy and Yeşilbayır, there are low-density residential and industrial zones. Due to the concentration of industrial activities, high energy consumption and air pollution, a moderate level of urban heat island effect is observed in these areas. Industrial heat generation and social vulnerability intersect here, creating a risk that should be closely monitored in terms of energy poverty.

The area around the Sazlıdere Dam exhibits the highest level of flood risk. Increasing construction along the stream beds that feed the dam heightens both flood potential and social vulnerability. Neighborhoods in and around Ömerli, Deliklikaya and Hadımköy are the zones where this overlap is most pronounced.



In the central and eastern settlement zones of Arnavutköy, the high population density and large proportion of impervious surfaces contribute to a pronounced urban heat island effect and increased infrastructure pressure. In these areas, where social vulnerability is also high, the combined effects of heat stress and inadequate infrastructure create conditions that reduce overall urban resilience.

Figure 53 Arnavutköy Central Neighborhood Risk Layers

Overall, three main overlapping risk zones stand out in Arnavutköy. In the northeast, the Karaburun–Terkos–Yenikoy corridor represents an area where wildfire and ecological risks intersect. In the south, around Sazlıdere and Haraççı, flood risk, social vulnerability and urban pressure converge, creating a complex risk environment. In the central part of the district, along the Arnavutköy–Hadımkoy corridor, the urban heat island effect, industrial impact and social vulnerability are most concentrated. These areas represent the key spatial zones where climate adaptation priorities should be defined. Strengthening the protection of natural areas, enhancing green infrastructure, reducing impervious surfaces and implementing resilience programs in socially vulnerable neighborhoods are fundamental strategies to increase Arnavutköy's resilience to climate change.

Risk Matrix

In the climate change adaptation workshop held with the participation of Arnavutköy Municipality units and relevant stakeholders, participants' perceptions regarding climate hazards affecting the district were assessed. As part of this assessment, the workshop also evaluated which neighborhoods are most vulnerable, which sectors are expected to be most affected by climate change, and which climate hazards the district is likely to face or has already faced.

Figure 54 Fragile neighbourhoods identified as a result of the workshop

According to the workshop findings, the climate hazards that Arnavutköy is most likely to be exposed to in the future are extreme heat and flood/overflow events.

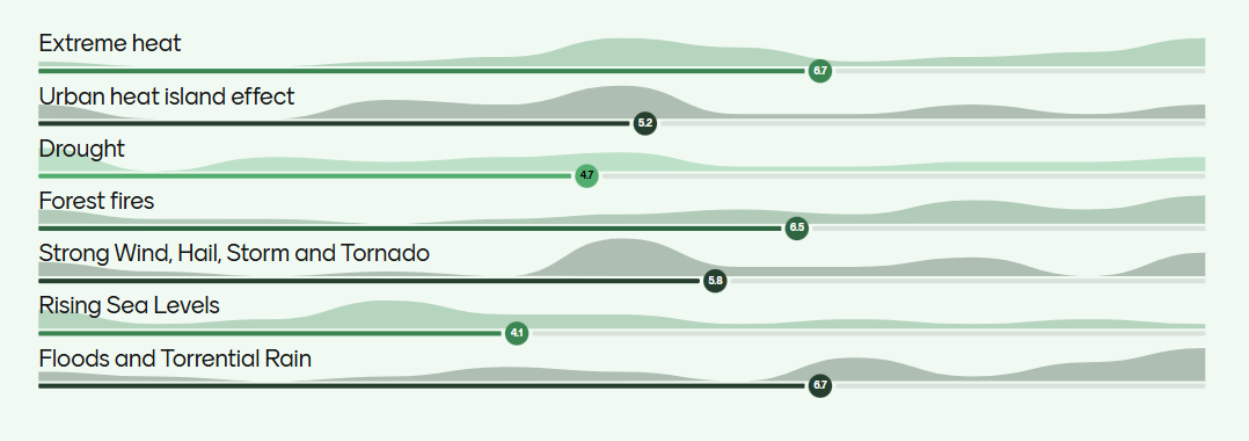


Figure 55 Perception survey on climate threats facing Arnavutköy

When examining the sectors in Arnavutköy that may be affected by climate change, workshop participants identified the highest levels of vulnerability in transportation, urban infrastructure, and buildings/disaster management. These findings indicate that, due to both the growing population and the developing urban fabric, infrastructure and transportation networks stand out as priority sectors in the face of climate impacts.

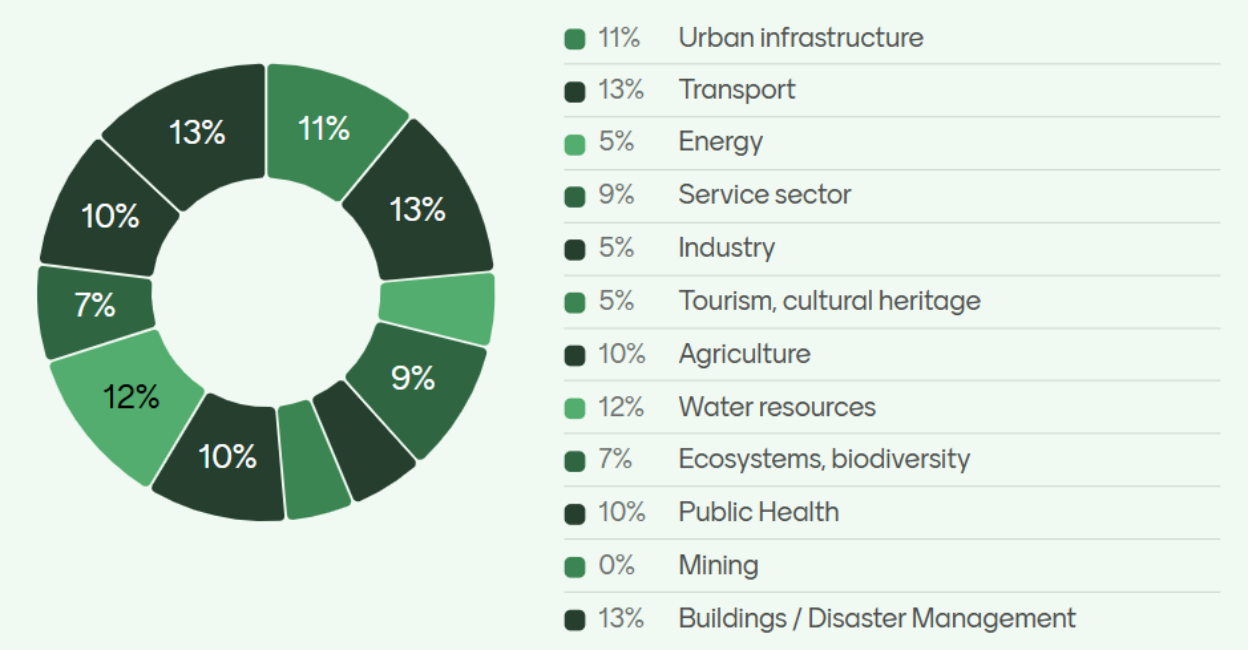


Figure 56 Assessment of susceptible areas

In terms of sectoral vulnerability, agriculture, public health, and water resources also stand out as key areas. Due to Arnavutköy's strategic role and geographical position within Istanbul, these sectors are particularly sensitive to the impacts of climate change.

As part of the Risk and Vulnerability Assessment, quantitative data obtained from municipal units, as well as base maps containing topographic and hydrological information, were examined to identify climate-related hazards and disaster risks for the district of Arnavutköy. Existing projections and academic and institutional studies focusing on the region were also evaluated. In addition, expert insights were incorporated to conduct a comprehensive analysis.

Considering Istanbul's current climate projections together with Arnavutköy's geographical position, land-use characteristics, rapid urbanization dynamics, forested areas, water basins, and coastline, the district's priority climate hazards have been identified as follows:

- **Extreme Heat / Heatwaves**
- **Urban Heat Island Effect**
- **Heavy Rainfall / Flooding**
- **Storms and Tornadoes**
- **Drought**
- **Wildfires**
- **Sea Level Rise**

Based on climate projections, analyses conducted for Arnavutköy, the district's land-use structure, sectoral composition, and its physical and institutional characteristics, the levels of climate-related risk were assessed across relevant sectors. Accordingly, the sectors with the highest vulnerability in Arnavutköy are transportation, water resources, disaster management, and public health. In contrast, industry, tourism, and energy are evaluated as the sectors with the lowest vulnerability to climate risks.

Climate Hazards	Vulnerable Sectors										
	Urban Infrastructure	Transport	Tourism	Industry	Biodiversity	Water Resources	Disaster Management	Public Health	Agriculture	Services Sector	Energy
Heatwaves											
Urban Heat Island Effect											
Heavy Rainfall / Flooding											
Storms / Tornadoes											
Drought											
Forest fire											
Sea Level Rise											
Legend											
	Low Risk Level										
	Medium Risk Level										
	High Risk Level										

CLIMATE ADAPTATION ROADMAP

7. CLIMATE ADAPTATION ROADMAP

7.1. Adaptation Workshop

In order to enhance Arnavutköy's social, economic and environmental resilience to climate change, the actions planned for implementation in the district have been grouped under thematic categories. These actions were evaluated during the Climate Change Adaptation Workshop, which was carried out with the participation of relevant departments of Arnavutköy Municipality and external stakeholders involved in the topic.

Figure 57 Climate change adaptation workshop visuals

Participants specialized in green areas, water management, disaster management and agriculture were asked to rate the level of importance and feasibility of the proposed actions for Arnavutköy.

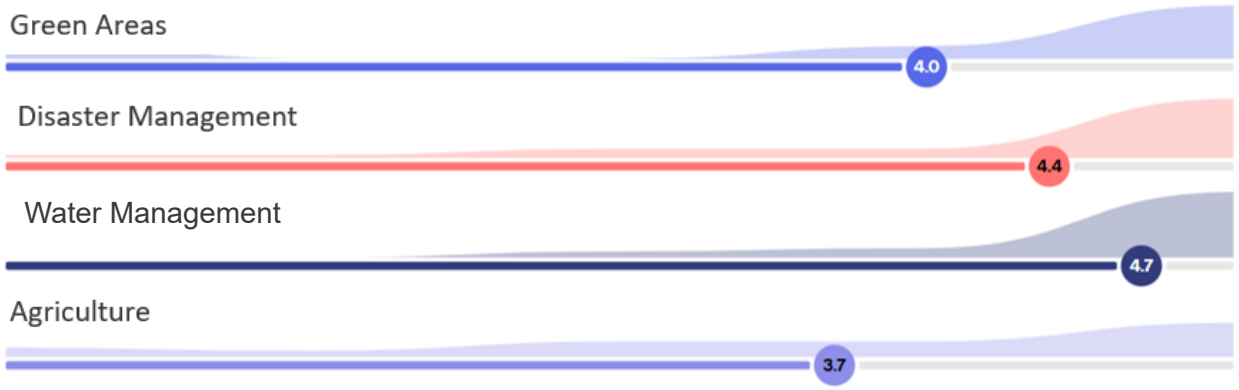


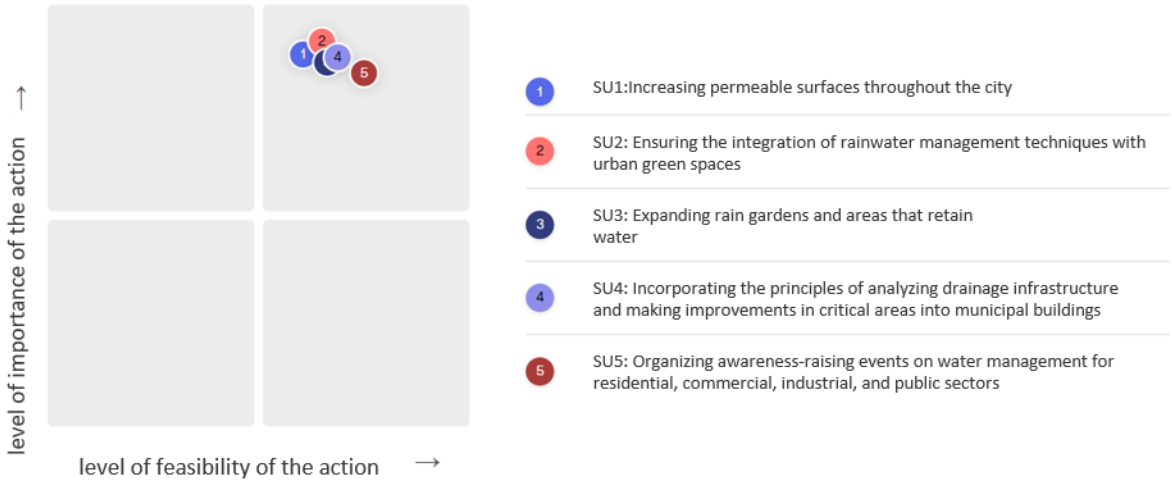
Figure 58 Prioritisation of objectives

Participants evaluated the adaptation goals in terms of their importance for Arnavutköy. In this assessment, a priority order emerged among the goals of Water Management, Green Areas, Disaster Management and Agriculture.

Water Management

Among the actions evaluated under the Water Management theme, the action with the highest level of importance and feasibility was Ensuring the integration of rainwater management techniques with urban green areas. In addition, the following actions were also assessed as having high importance and feasibility;

- Promoting rain gardens and areas that enable water retention
- Including principles such as analyzing the drainage infrastructure and improving critical areas within municipal buildings.



Green Areas

According to the evaluations of the workshop participants, the action with the highest level of importance and feasibility was “Identifying potential afforestation areas and carrying out afforestation and soil conservation works.” In addition;

- Promoting rain gardens and areas that enable water retention
- Including principles such as analyzing the drainage infrastructure and improving critical areas within municipal buildings were also evaluated as actions with high levels of importance and feasibility.

1 Y1: Improving the quality of green spaces

2 Y2: Identifying potential afforestation areas, carrying out afforestation and soil conservation work

3 Y3: Establishing green corridors along transportation corridors

4 Y4: Developing a shading strategy for urban areas

5 Y5: Identifying and implementing techniques to reduce the urban heat island effect at the urban planning and building scales

6 Y6: Integrating green and blue infrastructure to create microclimate areas that provide cooling within the city

Disaster Management

Among the disaster management actions, the action with the highest level of feasibility was “Taking measures for constructions located within the designated stream buffer zones of the city and identifying flood-prone areas.” The action “Providing professional training for disaster and emergency response teams on climate emergencies and conducting drills at regular intervals” was evaluated by participants as the most important action.

1 AF1: Taking measures regarding construction within the designated river protection buffer zones for the city and identifying flood-prone areas

2 AF2: Identifying areas susceptible to weather events such as extreme heat, excessive rainfall, rising sea levels, storms, tornadoes, and hail

3 AF3: Identifying and mapping vulnerable groups, developing evacuation plans for necessary situations

4 AF4: Strengthening public infrastructure and facilities to withstand the anticipated impacts of climate and disaster risks

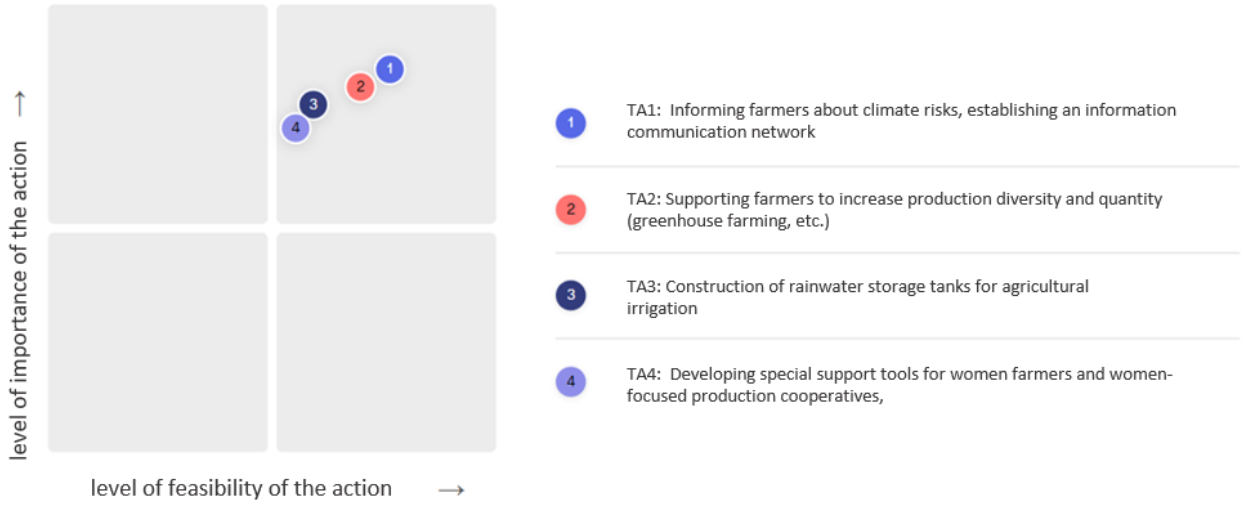
5 AF5: Providing information on the health effects of climate hazards (such as extreme heat)

6 AF6: Conducting risk assessments and awareness campaigns regarding forest fires

7 AF7: Providing professional training on climate emergencies to disaster and emergency response teams and conducting drills at regular intervals

Agriculture

According to the evaluations of the workshop participants, the action with the highest level of importance and feasibility was “Informing farmers according to climatic risks and establishing an information and communication network.”.



In addition, participants were asked about the barriers to implementing adaptation actions. The most prominent issues identified as barriers were bureaucracy, budget and economic constraints, lack of awareness and knowledge and lack of coordination leading to insufficient ownership.

Figure 59 Barriers to the implementation of harmonisation actions

Finally, participants were asked about the factors that could facilitate the implementation of adaptation actions. The most prominent facilitating factors identified were budget support, the involvement of the Istanbul Metropolitan Municipality and the Arnavutköy District Governorship.

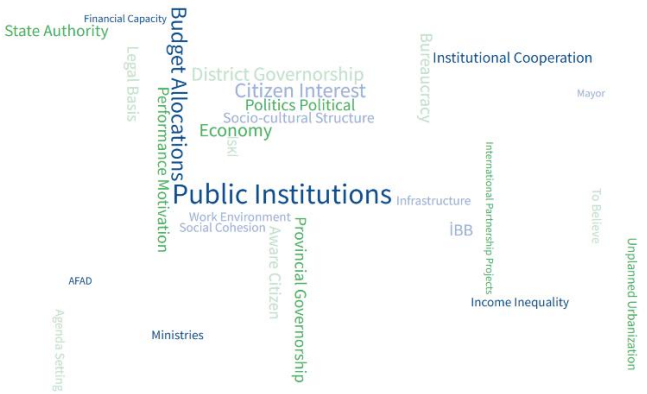


Figure 60 Facilitating factors in the implementation of harmonisation actions

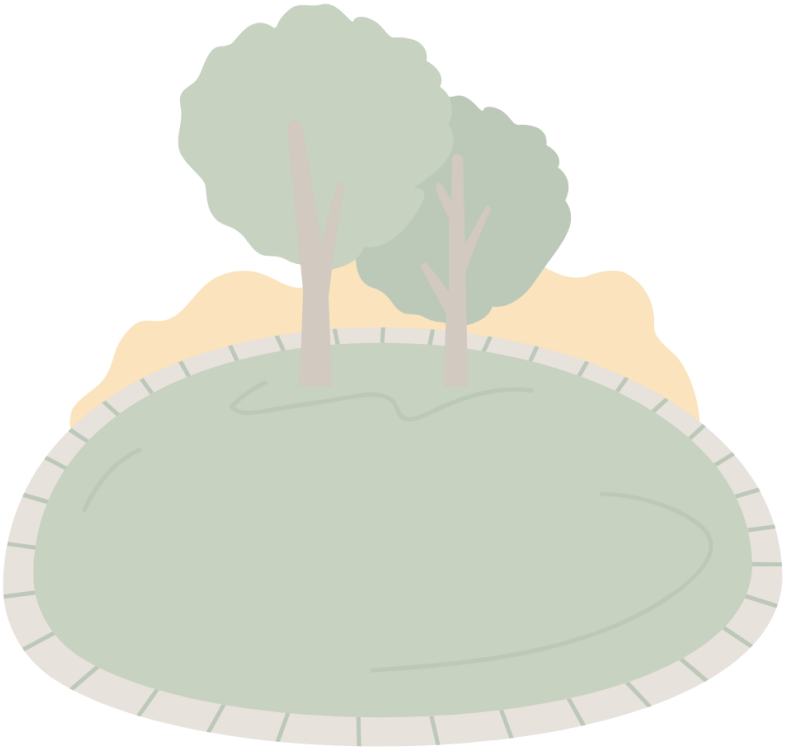
7.2. Actions

The main thematic areas of the climate change adaptation targets have been defined as green spaces, water management, agriculture and disaster management & public health. Within these topics, the adaptation goals have been prepared in line with national climate adaptation objectives, the Istanbul Provincial Disaster Risk Reduction Plan, the Istanbul Metropolitan Municipality Sustainable Energy and Climate Action Plan and the strategic plan targets of Arnavutköy Municipality.

Green Areas

Green space systems are one of the fundamental components of sustainable urban development. These areas not only provide a healthy physical environment but also support psychological well-being and directly influence overall societal welfare. Among the effective adaptation measures against climate change–induced risks, the creation of high-quality green spaces and the preservation of their continuity hold critical importance. Green infrastructure offers a resilient solution to climatic threats such as floods, inundations and the urban heat island effect.

In planning decisions and urban design processes where building and population density are increasing and infrastructure systems are affected, it is essential to consider urban heat island formation as well as flood and inundation risks. Particularly in areas with older building stock and dense, contiguous housing patterns, the amount and design criteria of green spaces in new planning zones should be revisited by taking climate change impacts into account.



GOAL 1

GREEN AREAS

ACTION *Increasing the quantity and quality of green spaces*

TYPE OF ACTION Plan / Strategy

It is aimed to increase the amount of active green space per capita, which is currently 4.75 m² in the Arnavutköy district. The sub-actions towards achieving this goal are listed below.

Y.1.1	Identifying areas where green space expansion can be implemented—such as vacant public parcels, school and public building gardens, and private property gardens—by prioritizing regions with high urban heat island effects and limited green space (related to Target 2).
Y.1.2	Identifying potential afforestation areas, primarily including buffer zones along urban streams.
Y.1.3	Ensuring the continuity of green areas within urban and peri-urban zones to establish a green network system.
Y.1.4	Identifying areas along transportation corridors within the jurisdiction that can be utilized as green spaces and implementing pilot projects.
Y.1.5	Integrating planning notes into new development and urban transformation projects to encourage the increase of green spaces.
Y.1.6	Fostering collective awareness by involving citizens in afforestation activities.
Y.1.7	Selecting climate-appropriate and ecosystem-enhancing natural/native plant species to minimize the maintenance costs of green spaces, and seeking support from academia and/or NGOs when necessary.
Y.1.8	Establishing a regular, trackable, and updatable database for green spaces and developing management tools.

THE CONTRIBUTION OF THE MUNICIPALITY
Implementing and guiding

RESPONSIBLE
Arnavutkoy Municipality

STAKEHOLDERS
MoEUCC Provincial Directorate, Ministry of Agriculture and Forestry, Istanbul Metropolitan Municipality (IBB), NGOs, Universities

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2025-2027

INDICATORS

- *Per capita green space area*
- *Identified potential afforestation area*
- *Number of trees planted*
- *Increase in the number of park areas*
- *Number of climate-related revised/updated planning notes or strategies*

GOAL 2

GREEN AREAS

ACTION *Reducing the impacts and risks of the urban heat island effect*

TYPE OF ACTION Plan / Strategy

Through these actions, it is aimed to reduce the urban heat island effect by implementing the mentioned practices. (This action is also related to Target 1.)

Y.2.1	Identifying techniques to reduce the Urban Heat Island Effect at both urban planning and building scales (e.g., ensuring the creation of “air corridors” in zoning plans to enhance urban comfort and facilitate clean air circulation within the city).
Y.2.2	Implementing white/green roof applications in all existing and planned public buildings.
Y.2.3	Incorporating water elements (e.g., ponds, etc.) into public space designs alongside green elements to provide a cooling effect.
Y.2.4	Using light-colored building materials for ground coverings to reduce solar energy absorption and lower surface temperatures.
Y.2.5	Integrating green and blue infrastructure to create microclimate zones that provide cooling within the city (related to Target 3).
Y.2.6	Identifying alternative spaces (e.g., schools, stadiums, libraries, etc.) that can enhance green space use, support the existing system, and serve as shelters for vulnerable populations during heatwave events.
Y.2.7	Preparing an emergency roadmap for potential heatwave events.

THE CONTRIBUTION OF THE MUNICIPALITY
Implementing and guiding

RESPONSIBLE
Arnavutkoy Municipality

STAKEHOLDERS
MoEUCC Provincial Directorate, Ministry of Agriculture and Forestry, Istanbul Metropolitan Municipality (IBB), NGOs, Universities

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2025-2030

INDICATORS

- *Number of heatwave events*
- *Number of awareness-raising activities on heatwaves and participants involved*
- *Number of white/green roof applications*
- *Number of blue/green infrastructure implementations integrated into urban areas*
- *Number of public spaces available to accommodate vulnerable populations during heatwave events*

Water Management

To ensure sustainable urban drainage, prevent flooding caused by heavy rainfall and support the mineral nourishment of soil, it is planned to increase the proportion of permeable surfaces in line with municipal goals. In this context, the primary objective is to strengthen the natural permeability provided by green areas. The widespread use and integration of permeable natural stones, permeable pavement applications, rain gardens and pervious concrete surfaces into urban areas enhance water retention capacity by enabling rainwater to infiltrate the soil more rapidly, thereby reducing flood risks associated with extreme rainfall.

Water scarcity poses an increasing threat in Türkiye, particularly in Istanbul. Therefore, planning rainwater harvesting systems at the building scale, underground and integrated with green areas is of great importance to ensure efficient use of water resources and maximize the benefits of existing supplies. The 2021 amendment to the Planned Areas Zoning Regulation published in the Official Gazette made it mandatory to install a “rainwater harvesting system” in all buildings to be constructed on parcels larger than 2,000 m², in response to the growing risk of drought. Implementing this requirement especially in public buildings and subsequently in all new constructions offers significant improvements in water management and resilience against climate-related disasters.

GOAL 3

WATER MANAGEMENT

ACTION *Improvement of existing water management infrastructure and storage systems, and increase of permeable surfaces*

TYPE OF ACTION Investment Project (Public)

SY.1.1	Conducting a feasibility study on rainwater harvesting on rooftops in both renovated and newly constructed buildings
SY.1.2	Integration of storage systems and Sustainable Urban Drainage principles into all existing and planned public buildings
SY.1.3	Implementation of rainwater management and storage systems in new buildings, and municipal inspections to ensure compliance with regulations
SY.1.4	Ensuring the integration of rainwater and greywater harvesting project techniques with urban green areas or public buildings (Target 1)
SY.1.5	Identification of impervious surfaces in public areas and determination of priority zones
SY.1.6	Incorporation of Water Sensitive Urban Design (WSUD) planning into land use planning and regulation
SY.1.7	Establishment of rain gardens in open-green public spaces where needed (There are relevant guidelines issued by the Ministry of Environment, Urbanization and Climate Change)
SY.1.8	Implementation of water efficiency measures in water fixtures within municipal buildings through the Sustainable Water Management and Efficiency Project

THE CONTRIBUTION OF THE MUNICIPALITY
Responsible for implementing the activity within areas under the authority of the local government, and collaborating with relevant institutions and organizations in other areas

RESPONSIBLE
Arnavutkoy Municipality

STAKEHOLDERS
Istanbul Metropolitan Municipality (IBB), Istanbul Water and Sewerage Administration (İSKİ), Financial institutions

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2025-2030

INDICATORS

- *Permeable surface area integrated into public spaces*
- *Number of rain gardens established in public spaces*

GOAL 4

WATER MANAGEMENT

ACTION *Developing guidelines to promote water conservation for residential buildings, commercial buildings, industrial facilities, and public buildings.*

TYPE OF ACTION Behavioral

SY.2.1	Conducting a target group analysis (identifying different social and commercial groups within the district, such as income groups, students, and business operators).
SY.2.2	Preparing water conservation guides and conducting awareness-raising activities for citizens, commercial buildings, industrial facilities, and public buildings.
SY.2.3	Distributing aerators to selected households as a pilot implementation and monitoring activity.

THE CONTRIBUTION OF THE MUNICIPALITY
Implementing and guiding

RESPONSIBLE
Arnavutkoy Municipality

STAKEHOLDERS
Istanbul Metropolitan Municipality, Ministry of National Education, Chambers of Industry and Commerce, NGOs, Universities

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2025-2027

INDICATORS

- *Number of feasibility studies on rooftop rainwater harvesting*
- *Number of water conservation guides developed (brochures, posters, etc.)*
- *Number of awareness-raising activities conducted*

Agriculture

Climate change threatens the productivity and continuity of agricultural production, thereby increasing global food security risks. Rising temperatures, irregular precipitation patterns, extreme weather events and diminishing water resources negatively affect agricultural areas and heighten the risk of drought. In Arnavutköy, where agricultural production is present, drought is also expected to pose a significant threat in the coming years.

To address these risks, it is crucial to promote sustainable irrigation methods, adopt climate-resilient agricultural practices, implement soil conservation measures and expand training activities for farmers. Climate change adaptation policies enhance the resilience of the agricultural sector while supporting environmental sustainability. In this context, priority agricultural actions to be implemented across Arnavutköy in coordination with relevant stakeholders have been identified.

GOAL 5

AGRICULTURE

ACTION *Ensuring the continuity of agricultural production and food security*

TYPE OF ACTION Investment Project (Public and Private), Awareness-Raising

T.1.1	Providing support to farmers to increase the diversity and quantity of agricultural production
T.1.2	Establishing rainwater storage systems for agricultural irrigation
T.1.3	Informing farmers about climate risks, establishing an up-to-date and dynamic information network for farmers, and organizing training programs on climate-resilient agriculture.
T.1.4	Promoting sustainable and innovative (vertical) farming practices
T.1.5	Introducing dedicated support mechanisms for women farmers, female agricultural workers, and women-focused agricultural cooperatives, prioritizing women's access to support programs, and enhancing their adaptive capacity through additional assistance.

THE CONTRIBUTION OF THE MUNICIPALITY
Guiding, educational, collaborative

RESPONSIBLE
Arnavutkoy Municipality , Istanbul Provincial Directorate of Agriculture and Forestry

STAKEHOLDERS
Istanbul Provincial Disaster and Emergency Directorate (AFAD), Universities, Professional Chambers, Istanbul Provincial Directorate of Agriculture and Forestry

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

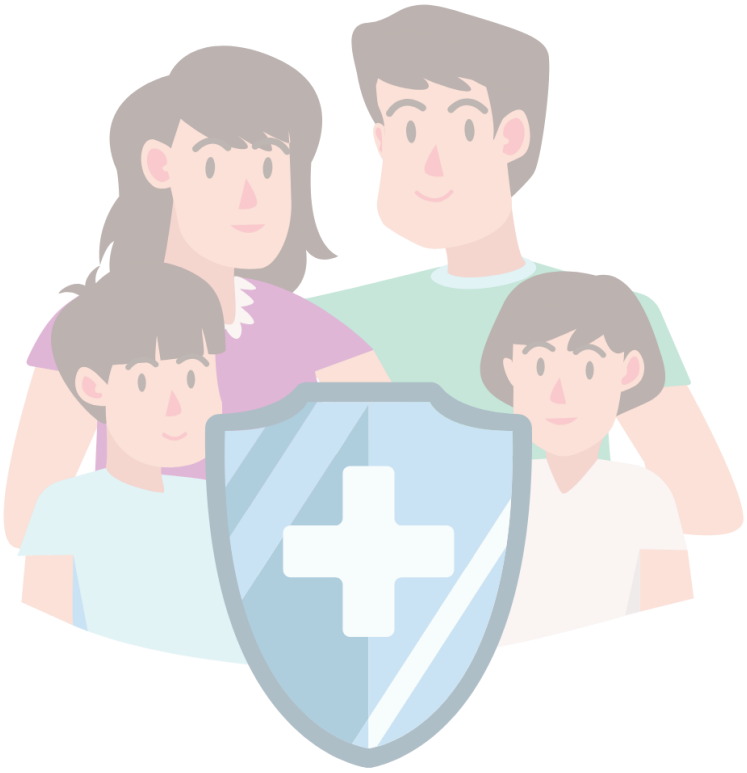
TIMING
2025-2030

INDICATORS

- *Number of supported investments*
- *Number of protected livestock breeds and plant species*
- *Number of related projects*
- *Number of supported women farmers/workers/cooperatives in pilot districts/villages*

DISASTER MANAGEMENT & PUBLIC HEALTH

Istanbul is a city frequently exposed to floods and inundations caused by extreme rainfall. Climate projections indicate that the number of days with heavy precipitation will increase in the future. There are also several structural challenges in reducing urban flooding. The lack of permeable surfaces and the inability of existing infrastructure to cope with intense rainfall occurring in short periods make cities vulnerable to sudden flooding events.



GOAL 6

DISASTER MANAGEMENT & PUBLIC HEALTH

ACTION *Identifying areas with climate and disaster risks and implementing measures for these areas*

TYPE OF ACTION Plan/Strategy, Training

AF.1.1	Conducting risk analyses using geographic information systems (GIS) and simulation methods to identify areas vulnerable to extreme weather events such as heatwaves, heavy rainfall, sea-level rise, storms, tornadoes, and hail.
AF.1.2	Identifying inter-district and intra-neighborhood routes that are at risk of being affected by disasters and determining alternative routes for emergency situations.
AF.1.3	Increasing inspections to prevent uncontrolled construction and development along stream beds.
AF.1.4	Establishing alternative rainwater collection line routes to reduce stormwater load on streams (linked to water management).
AF.1.5	Strengthening public infrastructure and facilities to withstand the anticipated impacts of climate and disaster risks.
AF.1.6	Establishing safety zones between forest areas and residential settlements.
AF.1.7	Afet ve acil durum müdahale ekiplerine iklim acil durumlarına yönelik profesyonel eğitimler verilmesi ve belli periyotlarda tatbikatlar gerçekleştirmesi

THE CONTRIBUTION OF THE MUNICIPALITY
Guiding, educational, collaborative

RESPONSIBLE
Arnavutkoy Municipality

STAKEHOLDERS
Istanbul Provincial Disaster and Emergency Management Directorate (AFAD), Universities, Professional Chambers, Istanbul Provincial Directorate of Agriculture and Forestry

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2027-2030

INDICATORS

- *Risk-prone construction areas identified around riverbeds*
- *Proportion of population living in areas at risk*
- *Analyses conducted for flood-prone areas*
- *Number or percentage of buildings (public/residential/non-residential) damaged due to extreme weather events*
- *Number of days with interruptions in public services (e.g., energy/water supply, health/civil protection/emergency services, waste management)*

GOAL 7

DISASTER MANAGEMENT & PUBLIC HEALTH

ACTION *Identification of vulnerable groups and development of strategies to enhance their resilience under extreme climate conditions*

TYPE OF ACTION Plan/Strategy

AF.2.1	Identification and mapping of vulnerable groups, and preparation of evacuation planning when necessary
AF.2.2	Providing information on the health impacts of climatic hazards (e.g., extreme heat, etc.)

THE CONTRIBUTION OF THE MUNICIPALITY
Implementing/Collaborative

RESPONSIBLE
Arnavutkoy Municipality

STAKEHOLDERS
Istanbul Metropolitan Municipality (IBB), Istanbul Provincial Disaster and Emergency Management Directorate (AFAD), Istanbul Provincial Health Directorate

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2025-2027

INDICATORS

- *Proportion of vulnerable groups within the district population*
- *Proportion of elderly population*
- *Proportion of children under 14 years old*
- *Proportion of population without access to disaster assembly areas within 250 meters*


ENERGY
POVERTY

8. ENERGY POVERTY

Energy poverty is one of the complex and multidimensional social issues of our time that cannot be explained merely by the lack of infrastructure. In many parts of the world, millions of people are deprived of access to reliable, clean and affordable energy services, which are considered a fundamental human right. Energy poverty is not limited to whether a household has electricity; rather, it is defined as the inability of individuals to continuously access reliable, clean, sustainable and affordable energy services. This situation transforms energy poverty from being a purely technical problem into a holistic development issue connected to social justice, income inequality and climate policies. Preventing energy poverty is possible not only by increasing energy supply but also by developing policies that make energy services accessible to all social groups.

Various indicators have been developed to measure energy poverty. The most common among them is the “10% rule,” which defines a household as energy poor if its energy expenditures exceed 10% of its total income. In addition, the Multidimensional Energy Poverty Index (MEPI) evaluates multiple indicators together, such as access to electricity, use of clean fuels, availability of heating and cooling facilities and access to information.[39] However, energy poverty is a condition that is difficult to assess using a single indicator. Therefore, threshold values and definitions may vary depending on the location. Local factors such as geographical position, climatic conditions, housing characteristics, the quality of heating and cooling systems and energy prices are key determinants in the assessment of energy poverty.

Goal 7 of the Sustainable Development Goals, “Affordable and Clean Energy for All,” emphasizes the right to access energy as a fundamental component. This right is directly linked to other global objectives such as poverty reduction, health, education and combating climate change.[40] Therefore, the reduction of energy poverty should be addressed in conjunction with comprehensive development policies.

8.1. Arnavutköy’s Energy Poverty Profile

Istanbul, accounting for 17.21% of Turkey’s total energy consumption, is the city with the highest energy use in the country. As one of the cities where electricity and natural gas price increases are most strongly felt, it faces growing challenges, particularly among low-income households, where the inability to pay utility bills has deepened energy poverty. Following the economic crisis that emerged after the pandemic, difficulties in paying electricity, water and natural gas bills have become more visible. In addition, the limited availability of payment facilities due to the privatization of electricity distribution has further increased the need for social assistance across the city. [41]

A simplified framework based on three main factors is commonly used in the literature to conceptualize energy poverty. These factors are low-income levels, an energy-inefficient housing

[39] *EU Energy Poverty Observatory, 2024*
[40] *UN SDGs, 2023*
[41] *İstanbul Planlama Ajansı (2022). İstanbul’da Enerji Yoksulluğuna Doğru: Elektrik Zamlarının Nedenleri, Güncel Gelişmeler ve Çözüm Önerileri Üzerine Politika Notu.*

stock and high energy prices. When Arnavutköy's energy poverty profile is evaluated within this framework, household income levels, building conditions and energy use practices emerge as the key determinants.

Arnavutköy is one of Istanbul's relatively vulnerable districts in socioeconomic terms and is among the areas most affected by energy poverty. The high concentration of low-income households, rapidly growing population and the prevalence of energy-inefficient housing contribute to this vulnerability. According to the Istanbul Data Bulletin, housing sales in Arnavutköy increased by 7.1% in the first half of 2024 compared to the previous year. However, despite this increase, the burden of rising energy costs continues to weigh heavily on households with limited purchasing power. In this context, Arnavutköy stands out as one of the districts with a high number of social assistance applications, particularly for food and fuel support.

Examining the socioeconomic structure of Arnavutköy reveals several parameters that determine the vulnerability levels of households. Variables such as age groups, proportion of elderly population, property and rental values, education level, household size and spending habits indicate that lower-income socioeconomic groups are particularly more sensitive to energy poverty. In the distribution of socioeconomic status groups, Group C constitutes the largest share in Arnavutköy with 54%, while the vulnerable Group D accounts for 15%. This rate is above the Istanbul average of 11%, highlighting the district's vulnerability to energy poverty.

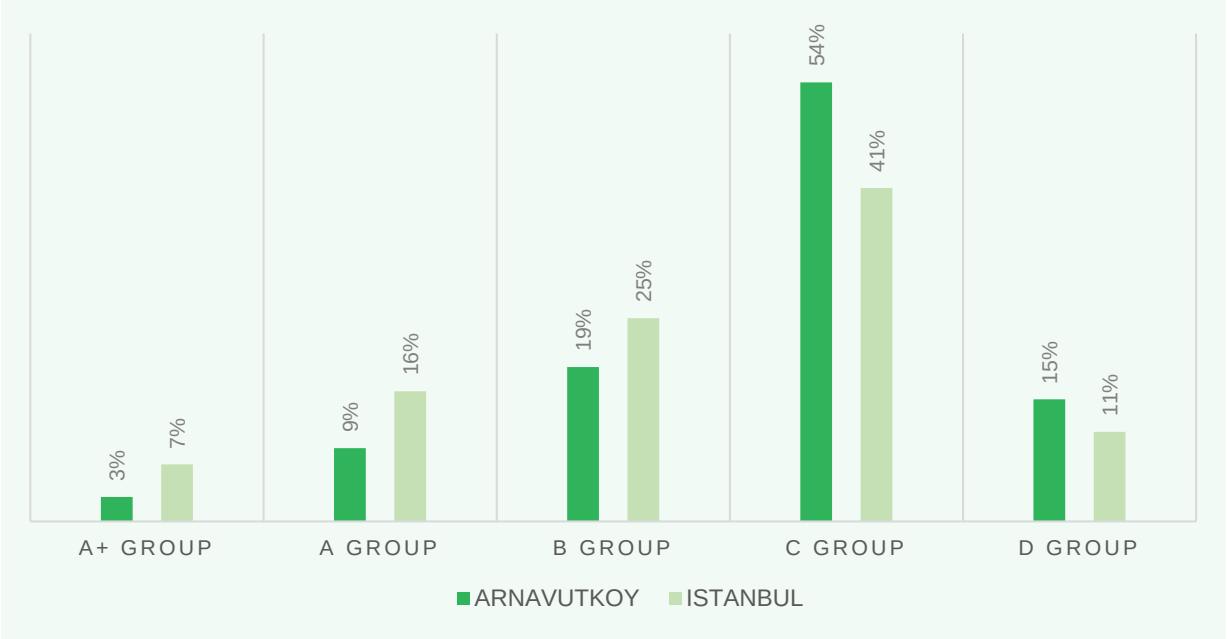


Figure 61 Distribution of socioeconomic status groups in Arnavutköy and Istanbul

The increasing energy costs and structural economic challenges across Istanbul have deepened energy poverty and this situation has become more pronounced in socioeconomically disadvantaged districts such as Arnavutköy. The concentration of low-income households, the prevalence of energy-inefficient housing stock and the high demand for social assistance make Arnavutköy more vulnerable to energy poverty. [42]

[42] *İstanbul İstatistik Ofisi (2024). İstanbul Veri Bülteni – Ocak-Haziran 2024. s. 7.*

Table 8 The ratio of households requesting social support in Arnavutköy and Istanbul to the total number of households

Ratio of Number of Households Requesting Social Support to Total Number of Households	
ıstanbul	% 4,7
Arnavutkoy	%3,4

In order to assess the socioeconomic conditions of households in relation to energy poverty, households receiving social assistance in the Arnavutköy district were analyzed. According to data obtained from the Istanbul Metropolitan Municipality's Open Data Portal[43], households receiving social assistance make up 4.7% of the total number of households in Istanbul, while this rate is 3.4% in Arnavutköy.

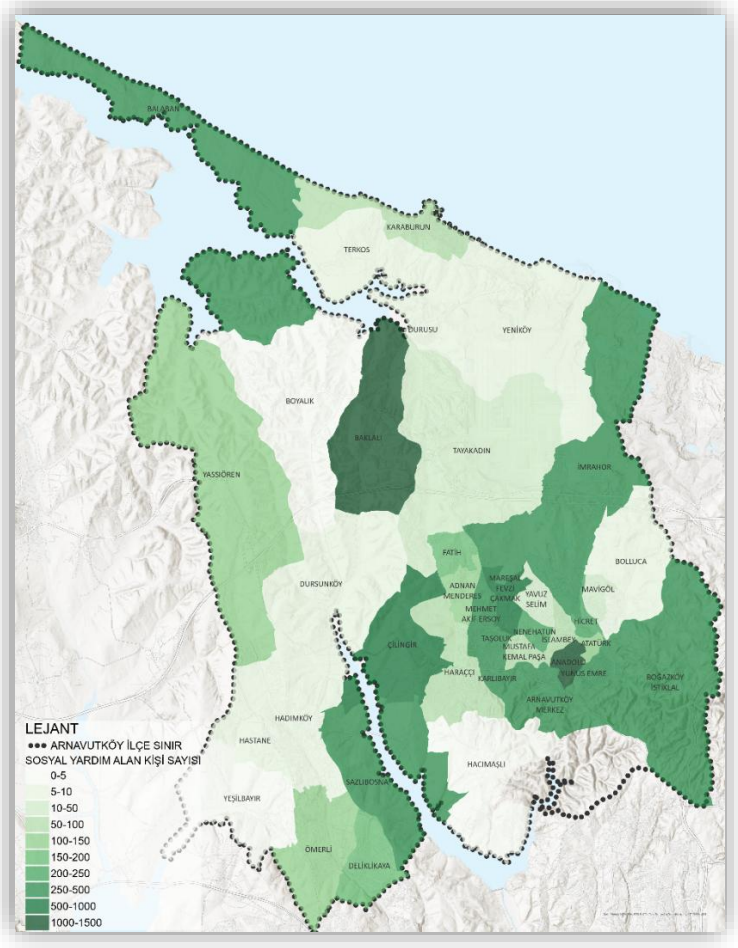


Figure 62 Arnavutköy Neighbourhoods receiving social assistance

When examining social assistance in Arnavutköy on a neighborhood basis, Anadolu, Yunus Emre, İslambey and Boğazkoy Istiklal neighborhoods stand out respectively.

[43] *https://data.ibb.gov.tr/*

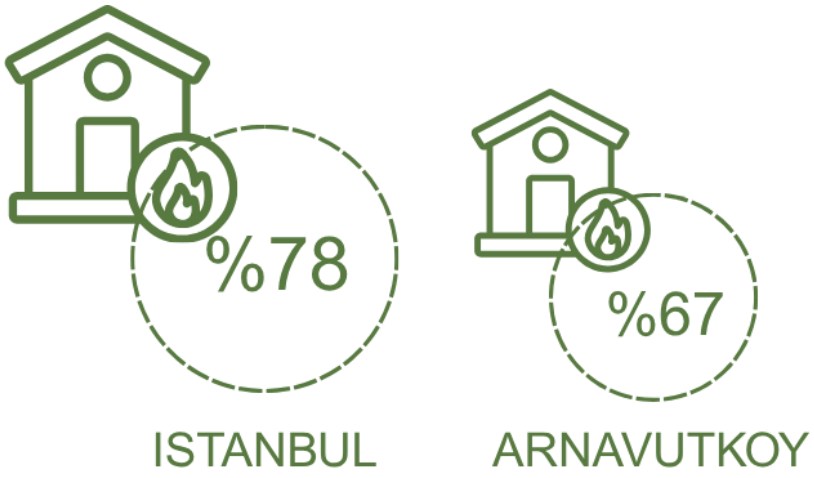


Figure 63 Proportion of households connected to the gas network

The use of central heating systems in buildings plays an important role in minimizing heat loss. Preventing heat loss and reducing heating-related energy consumption are key factors in combating energy poverty. In Arnavutköy, only 3% of buildings are equipped with central heating systems, compared to 10% in Istanbul overall.

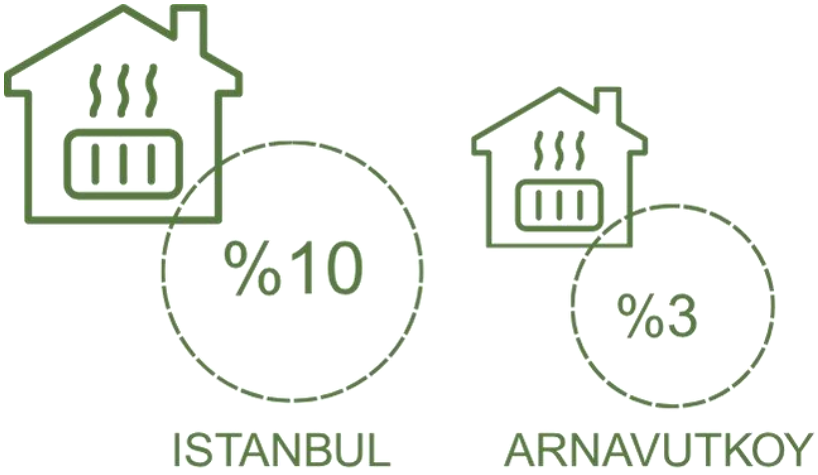


Figure 64 Proportion of households with central heating

Due to the multidimensional and complex nature of energy poverty, a single indicator is not sufficient to assess this phenomenon. Therefore, approaches that integrate various indicators and consider social, economic and environmental conditions at different scales are employed. The Covenant of Mayors (CoM) initiative has also developed a set of indicators to measure and monitor energy poverty at the local level. These indicators are grouped under the themes of climate conditions, buildings (residential and public facilities), mobility, socioeconomic factors, policy and regulatory framework and participation and awareness. Within this framework, the current state of energy poverty indicators in the Arnavutköy district has been examined.

Table 9 Summary table of indicators for energy poverty

MACRO DOMAIN HEADER	INDICATOR	ITEM	VALUE	YEAR
BUILDINGS	Energy consumption per capita / national energy consumption per capita	%	44	2023
	Total number of households connected to the electricity grid	Number of Households	145.653	2024
	Total number of households connected to the gas network	Number of Households	116.890	2024
	Proportion of households with central heating system	%	3	2023
	Proportion of vulnerable households	%	32	2024
	Average electricity price	€	0,106	2025
	Average gas price	€	0,187	2025
	Population/households below the poverty line	%	17.06	2024
	Ratio of households/population with social support	%	4,8	2022
	Unemployment rate	%	12,3	2022
	Proportion of population under 14 years of age	%	27	2024
	Proportion of population over 65 years of age	%	5	2024
	Proportion of population with less than secondary education	%	49	2024
POLICY AND REGULATORY FRAMEWORK	Existence of strategies to address Energy Poverty	Yes/No	Yes	
	Existence of rules for rent regulation	Yes/No	Yes	
	Specific measures to address energy poverty	Yes/No	Yes	
	Existence of programs and incentives for landlords	Yes/No	Yes	

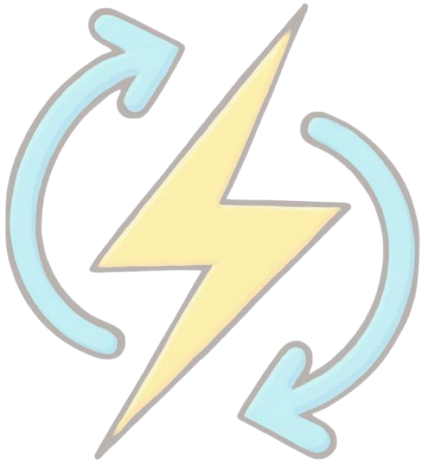
PARTICIPATION & AWARENESS	Existence of awareness raising programs for vulnerable people	Yes/No	Yes
	Engagement and collaboration with local stakeholders on energy poverty	Yes/No	Yes

8.1. Actions

In Arnavutköy, actions addressing energy poverty are considered within the framework of buildings, households and policies. The assessment of energy poverty encompasses various socioeconomic factors such as building characteristics, energy costs and household income levels. Since a significant portion of energy consumption in buildings stems from essential heating, cooling, ventilation and lighting needs, designing new structures with energy efficiency principles and improving the performance of existing buildings play a key role in reducing the energy burden on households.

Energy poverty is defined as the inability of households to meet their basic energy needs due to insufficient income, despite having access to energy infrastructure. Therefore, identifying households with limited access to energy, inadequate indoor comfort, or difficulty covering energy expenses is of critical importance.

Possible municipal actions include improving building efficiency, supporting energy-efficient technologies, strengthening social assistance and expanding awareness-raising activities. This comprehensive, locally tailored approach provides an important roadmap for reducing energy poverty in Arnavutköy.



ACTION BN1

BUILDINGS

ACTION *Inventorying the heating systems and current conditions of buildings located within the boundaries of Arnavutkoy*

TYPE OF ACTION Pre-Implementation Analysis / Data Collection

In order to reduce energy consumption and emissions from buildings in Arnavutkoy, the following steps will be taken to conduct a detailed analysis of the current building stock's energy use and efficiency status:

BN.1.1 **Establishment of a Building Inventory:**
Classification of all existing buildings according to their year of construction

BN.1.2 **Identification of Heating Fuel Types:**
Identification of energy sources used for heating in buildings (natural gas, electricity, coal, wood, etc.) and mapping of areas where the use of polluting solid fuels is widespread

BN.1.3 **Identification of Energy Performance Classes and Insulation Status:**
Numerical identification of buildings with low energy performance (class D and below) and determination of whether they have insulation

BN.1.4 **Examination of Heating Systems:**
Identification of buildings with central heating systems

THE CONTRIBUTION OF THE MUNICIPALITY
Implementer

RESPONSIBLE
Arnavutkoy Municipality

STAKEHOLDERS
Ministry of Environment, Urbanization and Climate Change

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2025-2027

INDICATORS
- *Total number of households connected to the electricity grid*
- *Total number of households connected to the gas grid*
- *Share of households with central heating systems*
- *Average electricity price*
- *Average gas price*
- *Per capita energy consumption / national per capita energy consumption*

ACTION H1

HOUSEHOLDS

ACTION *Collection of data to assess energy poverty among households located within the boundaries of Arnavutkoy*

TYPE OF ACTION Pre-Implementation Analysis / Data Collection

H.1.1

Household Surveys:
Conducting survey studies with households to identify indicators of energy poverty, determining criteria such as thermal comfort level, the share of energy expenses in household income, health status, and employment as vulnerability factors

H.1.2

Mapping Energy-Poor Areas Using Geographic Information Systems (GIS):
Analyzing survey data with Geographic Information Systems (GIS) to map areas at risk of energy poverty, and preparing feasibility studies that include locally tailored priority solution proposals for these regions

THE CONTRIBUTION OF THE MUNICIPALITY
Implementer

RESPONSIBLE
Arnavutkoy Municipality

STAKEHOLDERS
District Governorates, Ministry of Family and Social Services

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2025-2027

INDICATORS

- *Unemployment rate*
- *Proportion of vulnerable households*
- *Population/households below the poverty line*
- *Share of households/population receiving social support*
- *Proportion of population aged 65 and over*
- *Proportion of population with education below lower secondary level*
- *Proportion of population under 14 years old*

ACTION P1

POLICIES

ACTION *Carrying out awareness activities, small-scale implementation support, and social assistance projects for energy-poor areas*

TYPE TO ACTION Awareness-Raising / Policy Development

P.1.1	**Organizing Public Information and Awareness-Raising Campaigns:** Carrying out awareness activities such as seminars, leaflets, and social media campaigns on energy saving, efficient appliance use, proper heating habits, and available support programs.
P.1.2	**Small-Scale Energy Efficiency Measures for Low-Income Households:** Implementing low-cost, quick-impact measures for energy-poor households, such as distributing free LED bulbs, installing window sealing strips, and applying insulation foils.
P.1.3	**Expansion of Energy Bill Support Programs or Social Assistance Schemes** Developing direct social support mechanisms for identified at-risk households, such as electricity–natural gas assistance, fuel support, and grant programs for acquiring energy-efficient appliances.

THE CONTRIBUTION OF THE MUNICIPALITY
Implementer, guiding, supporting

RESPONSIBLE
Arnavutkoy Municipality

STAKEHOLDERS
District Governorates, Ministry of Family and Social Services

IMPACT OF THE ACTION ON CLIMATE ADAPTATION GOALS

TIMING
2025-2027

INDICATORS

- *Existence of strategies addressing energy poverty*
- *Presence of regulations related to rent control*
- *Specific measures targeting energy poverty*
- *Availability of programs and incentives for homeowners*

IMPLEMENTATION & MONITORING

9. IMPLEMENTATION & MONITORING

Preparing an action plan is only the first step in climate and energy work. For the plan to be truly effective, it requires strong cooperation among institutions, the mobilization of necessary financial resources and increased awareness and capacity both within the institution and across the community. Regular monitoring of the selected indicators is essential to understand the extent to which the planned actions are being implemented.

To ensure the sustainability of ongoing efforts, Arnavutköy Municipality has developed separate indicator sets for mitigation, adaptation and energy poverty. In line with the requirements of the Covenant of Mayors (CoM), the greenhouse gas inventory is expected to be updated every two years to maintain a healthy monitoring process. Within this framework, it is possible to detail which data will be monitored by whom and at what intervals throughout the monitoring cycle.

9.1. Mitigation Action Indicators

Arnavutköy district provides the opportunity to conduct a comprehensive assessment through various indicators defined for monitoring its sustainability efforts. Indicators related to buildings and urban areas cover key elements such as energy efficiency, integration of renewable energy and the transformation capacity of the existing building stock. Among these indicators, thermal insulation practices, the energy performance classes of buildings, the proportion of structures renewed within the scope of urban transformation and the level of use of renewable energy technologies on rooftops or in municipal facilities stand out. Additionally, the share of municipal buildings that are designed or retrofitted in line with the net-zero energy target is considered an important metric. Indicators related to energy use include the transition to low-emission fuels, the reduction of coal use and the level of adoption of alternative energy solutions. For the transport sector, the indicators include the number of electric vehicles, the proportion of low-emission vehicles in public transport fleets, the availability of charging infrastructure in the district and the total length of pedestrianized public spaces. In the context of waste and wastewater management, indicators such as per capita waste generation, the share of waste sent to sanitary landfills, recycling performance and wastewater volumes provide important insights for environmental sustainability. These indicators offer a critical monitoring framework for evaluating Arnavutköy's progress toward its sustainability goals and for strengthening future strategic planning.

Table 10 Mitigation Action Monitoring Indicators

BUILDINGS AND RENEWABLE ENERGY		
ACTION CODE	**INDICATORS**	**UNIT**
B1	Number of schools/institutions reached through awareness activities	units/year
	Number of people trained	units/year
	Number of communication materials distributed/reached	units/year

B2	Annual reduction achieved in energy consumption	kWh
	Number of energy efficiency measures implemented	units/year
	Solar PV capacity	kW
B3	Number of buildings approved according to nZEB criteria	units/year
	Energy performance class of buildings (BEP-TR data)	units/year
B4	Number of renovated buildings	units/year
	Number of installed energy monitoring systems	units/year
	Change in energy consumption after implementation	kWh/m²
B5	Installed solar PV capacity	kWp
	Amount of energy produced	kWh
	Emission reduction	ton CO_2e
	Number of buildings benefited	

WASTE AND WASTEWATER

ACTION CODE	INDICATORS	UNIT
A1	Number of restaurants/shopping malls/marketplaces implementing circular economy practices	units/year
	Number of installed separate collection equipment and the number of areas covered	ton/person
	Amount of organic waste directed to animals	ton/year
	Number of household composting systems implemented or number of trainings/workshops conducted on this topic	units/year
	Number of municipal composting/recovery facilities established	units/year
	Number of surveys conducted and number of people reached (awareness activities)	person/year
A2	Number of newly developed and implemented wastewater projects	units/year
	Number of students and staff trained on wastewater	person/year
	Number of individuals/institutions benefiting from the incentive and reward system	units/year person/year
	Amount of animal wastewater reused in agriculture	m³/year
	Number of information/awareness activities conducted for firms and participation rate	person/year

	Number of wastewater violations detected before complaints	units/year
	Number of newly installed monitoring, control or automation systems	units/year
	Total amount of treated wastewater and reuse rate	%
	Amount of separately collected special wastewater (e.g., airport-generated)	m³/year

AGRICULTURE AND LIVESTOCK

ACTION CODE	INDICATORS	UNIT
TH1	Amount of organic fertilizer produced	kg/year
	Number of composting facilities established	units/year
TH2	Number of training workshops organized	units/year
	Number of local markets organized	units/year

TRANSPORTATION

ACTION CODE	INDICATORS	UNIT
U1	Annual increase in the number of electric vehicles	units/year
	Number of converted fossil-fuel vehicles	units/year
	Number of training/awareness events organized on electric vehicle use	units/year
	Number of installed electric vehicle charging stations	units/year
U2	Number of installed electric vehicle charging stations	units/year
	Utilization rate of the charging infrastructure	%
	Completion rate of feasibility studies	%
	Number of awareness-raising events for citizens	person/year
U3	Length of bicycle lanes (km)	km/year
	Number of micro-mobility points integrated with public transportation	units/year
	Number of bicycle/scooter users	person/year
	Number of awareness events organized	units/year

U4	Number of people trained (staff/citizens)	units/year
	Number of completed trainings	units/year
	Post training evaluation survey results	units/year

9.2. Adaptation Action Indicators

The indicators developed for monitoring adaptation actions are used to assess the effectiveness of climate change adaptation efforts in Arnavutköy and to ensure that the process is managed properly. These indicators make it possible to measure the alignment of the policies, strategies and projects implemented with their intended targets. Regular monitoring helps reveal the strengths and weaknesses of current practices, enabling corrective measures to be taken when necessary. At the same time, these indicators provide an important feedback mechanism for future adaptation strategies and policies. Therefore, the defined indicators serve as a fundamental tool that supports the efficient use of resources, the continuous improvement of adaptation efforts and the enhancement of the community's resilience to climate change. The indicators used for the adaptation targets defined for Arnavutköy and the actions developed to achieve these targets are presented in Table 11.

Table 11 Adaptation Action Monitoring Indicators

GREEN SPACE		
ACTION CODE	**INDICATORS**	**UNIT**
Y1	Amount of green space per capita	m^2
	Amount of identified potential afforestation area	m^2
	Number of trees planted	units/year
	Number of increased park areas	units/year
	Number of climate-related plan notes/strategies revised or updated	units/year
Y2	Number of heatwaves occurred	units/year
	Awareness activities conducted on heatwaves and number of participants	units/year person/year
	Number of white/green roof applications	units/year
	Blue/green infrastructure applications integrated into urban areas	units/year
	Number of public spaces available to shelter vulnerable populations during heatwave events	units/year

WATER MANAGEMENT		
ACTION CODE	**INDICATORS**	**UNIT**
SY1	Permeable surface area integrated into public spaces	m^2
	Number of rain gardens established in public spaces	units/year
SY2	Number of feasibility studies on rooftop rainwater harvesting	units/year
	Number of guides developed for promoting water conservation (brochures, posters, etc.)	units/year
	Number of awareness-raising activities conducted	units/year

AGRICULTURE		
ACTION CODE	**INDICATORS**	**UNIT**
T1	Number of supported investments	units/year
	Number of protected breeds and plant species	units/year
	Number of relevant projects	units/year
	Number of women farmers/workers/cooperatives supported in pilot districts/villages	units/year

PUBLIC HEALTH & DISASTER MANAGEMENT		
ACTION CODE	**INDICATORS**	**UNIT**
AF1	Identified risky development area around stream beds	m^2/number of buildings
	Proportion of population living in areas at risk	%
	Analyses conducted for flood-prone areas	yes/no
	Number or percentage of buildings damaged due to extreme weather conditions/events (public/residential/non-residential)	%
	Number of days with public service disruptions (e.g., energy/water supply, health/civil protection/emergency services, waste)	units/year

AF2	Proportion of vulnerable groups within the district population	%
	Proportion of elderly population	%
	Proportion of population under the age of 14	%
	Share of population without access to disaster assembly areas within 250 meters	%

9.3. Energy Poverty Indicators

The indicators defined to assess and regularly monitor energy poverty in Arnavutköy have been selected to measure the effectiveness of implemented plans and policies and to manage efforts to reduce energy poverty efficiently. These indicators help quantitatively evaluate the progress made in combating energy poverty in the district and reveal how closely the implemented programs and support mechanisms align with their intended targets. Through a regular monitoring process, the strengths of the applied strategies and the challenges encountered can be identified, allowing adaptive and corrective measures to be taken when necessary.

Tracking indicators related to energy poverty is also critically important for better understanding inequalities in access to energy within the district and for strengthening social justice in this field. These indicators guide decision-makers in improving support mechanisms, enhancing strategies to combat energy poverty and making access to energy services more inclusive. Ultimately, the defined indicators serve as a fundamental tool to ensure the efficient use of resources, develop sustainable policies that reduce energy poverty and enhance household energy security in Arnavutköy.

Table 12 Energy Poverty Action Monitoring Indicators

CLIMATE	
INDICATORS	**UNIT**
Frequency of heatwaves	Annual average
Frequency of cold waves	Annual average
Annual number of heatwave days	units/year
Annual number of cold wave days	units/year

BUILDINGS	
INDICATORS	**UNIT**
Number of dwellings in EPC bands F + G + H / total number of dwellings	%
Per capita energy consumption / national per capita energy consumption	%

Annual share of renovated buildings	%
Percentage of households or individuals experiencing heating problems	%
Number of households connected to the electricity grid / total number of households	%
Number of individuals or households connected to the gas network / total number of individuals or households	%
Number of households with heating/cooling systems / total number of households	%
Number of households with central heating systems / total number of households	%
Number of households with central cooling systems / total number of households	%
Low absolute energy expenditure	
Number of households with only fuel oil boilers, wood boilers, or conventional gas boilers / total number of households	%
Average age of buildings	yıl
Homeownership rate	%

SOCIO-ECONOMIC	
INDICATORS	**UNIT**
Annual average household income	€
Average annual amount spent on energy	€
Share of vulnerable households in total households	%
Households with electricity bill arrears / total households	%
Percentage of people unable to keep their home adequately warm	%
Average electricity price	€
Average gas price	€
Amount spent to support energy-poor households or individuals / local GDP	%
Share of population below the poverty line	%
Risk-of-poverty rate	%
Share of households receiving social assistance	%
Unemployment rate	%
Proportion of population under 14	%

Proportion of population over 65	%
Share of individuals with education below lower secondary level	%

PARTICIPATION AND AWARENESS RAISING ACTIVITIES	
INDICATORS	**UNIT**
Awareness-raising programs for vulnerable groups	units/year
Participation and cooperation activities with local stakeholders within the scope of energy poverty	units/year

POLICY AND REGULATORY FRAMEWORKS	
INDICATORS	**UNIT**
Existence of strategies addressing energy poverty	Yes/No
Existence of regulations on rent control	Yes/No
Existence of specific measures related to energy poverty	Yes/No
Existence of programs and incentives for homeowners	Yes/No

10. GENERAL EVALUATION

Within the scope of this study carried out for the Arnavutköy district and resulting in the Sustainable Energy and Climate Action Plan (SECAP), priority areas have been identified in terms of reducing the city's greenhouse gas emissions and enhancing climate change adaptation, and a strategic roadmap to be followed in the short, medium, and long term has been established. In this respect, the study serves as a comprehensive reference document that provides guidance to decision-makers. However, the completion of the SECAP process does not represent the end of the journey; rather, it marks the beginning of the implementation, monitoring, and continuous improvement phases.

The effective implementation of the mitigation, adaptation, and energy poverty actions defined in the action plan, together with the efficient operation of monitoring and evaluation mechanisms, is of critical importance for the success of the plan. Since the implementation of Sustainable Energy and Climate Action Plans involves multiple disciplines and institutions, one of the most significant risks that may be encountered during the implementation phase is the lack of intra-institutional and inter-institutional cooperation and coordination. In this context, establishing the necessary institutional, technical, and digital infrastructures to enable the regular collection and reporting of data related to the defined indicators is among the top priorities.

In addition, insufficient citizen participation and constraints in access to financial resources for climate actions emerge as key risk areas. The tendency to focus primarily on initial investment costs when assessing investments may lead to the economic and social benefits achievable over the life cycle being overlooked. This situation can hinder the widespread adoption of actions, particularly for households with limited resources. However, citizen participation plays a decisive role in ensuring the success and long-term sustainability of actions in the areas of mitigation, adaptation, and the fight against energy poverty.

Within this framework, awareness-raising activities, participatory planning approaches, and the dissemination of good practice examples are of great importance. Through an implementation process in which risks are addressed holistically and stakeholder cooperation is strengthened, it will be possible to effectively implement the Arnavutköy Sustainable Energy and Climate Action Plan and to increase the level of achievement of the defined targets.

EK-1 Workshop Participants

MITIGATION WORKSHOP PARTICIPANTS

Esra DEMİR / Demir Enerji - Msc. Business Engineer
Melda KARADEMİR / Demir Enerji –Phd. Environmental Engineer
İrem ORMAN / Demir Enerji - Environmental Engineer

Yavuz YALÇIN / Arnavutköy Municipality – Department of Innovation and Technology

Zeynep IŞIK / Arnavutköy Municipality – Directorate of Innovation and Technology
Erol KUTLUYER / Arnavutköy Municipality – Directorate of Innovation and Technology
Emre TOPUK / Arnavutköy Municipality – Directorate of Innovation and Technology
Melike Nur GÜNEŞ / Arnavutköy Municipality – Directorate of Coordination
Abdusamet YILMAZ / Arnavutköy Municipality – Directorate of Strategy Development
Gülşen PAKYÜREK / Directorate of Climate Change and Zero Waste
Sait DİNYAMAN / Arnavutköy Municipality – Directorate of Mukhtar Affairs

Yasin AKDERE / SSTech Energy
Ahmet ÇAKIR / Arnavutköy Municipality – Directorate of Planning and Projects
Büşra KARADAĞ ERBAŞ / Arnavutköy Municipality – Directorate of Intelligent Transportation Systems

Duygu KEYF / IGA Airport Operation Inc.
Hasan Fehmi AKYÜZ / Çatalca Municipality – Directorate of Climate Change and Zero Waste
Ozan ASLAN / Çatalca Municipality – Directorate of Climate Change and Zero Waste
Büreyde KUL AĞDUR / Arnavutköy Municipality – Directorate of Building Control

Caner DEMİR / Demir Enerji – Msc. Mechanical Engineer
Dilan CENGİZ/ Demir Enerji – Urban Planner

Beyzanur KÜÇÜKDİNÇER / Demir Enerji– Urban Planner
Esin DÜZGÜN / Kağıthane Municipality – Directorate of Environmental Protection and Control
A. Canan ASMAZ / Kağıthane Municipality – Directorate of Environmental Protection and Control
Emel GÜNLÜ / Kağıthane Municipality – Directorate of Environmental Protection and Control
Seyhan TÜRKAN / Arnavutköy Municipality – Directorate of Financial Services
Eren AYYILDIZ / YEO Technology and Energy Industry Inc.
Baran MEMİŞBEY / YEO Technology and Energy Industry Inc.
Nihat ISMUK / YEO Technology and Energy Industry Inc.
Pınar ARSLAN KAYA / Avcılar Municipality – Directorate of Strategy Development
Zafer Onur KAYA / Avcılar Municipality – Directorate of Public Works
Zeynep Simge Baysal / Istanbul Chamber of Commerce – Sustainability and Environment Unit

Yılmaz AKARSU / Boğaziçi Electricity Distribution Inc.
Serhat YAŞAR / Arnavutköy Municipality – Directorate of Municipal Police
Ahmet ÇAKIR / Istanbul Metropolitan Municipality – Directorate of Transportation
Buse KUTLUER / Arnavutköy Municipality – Directorate of Administrative Affairs
Kair AYDIN / Arnavutköy Municipality – Directorate of Cleaning Services

Esatcan ÇAĞLAYAN / Arnavutköy Municipality – Directorate of Public Works
Barış KUŞ / Arnavutköy Municipality – Directorate of Public Works
Sefa ÇELİKER / Arnavutköy Municipality – Directorate of Youth and Sports Services
Arzu DİNÇER / Arnavutköy Municipality – Directorate of Climate Change and Zero Waste
Ömer Faruk ASLAN
Mehmet SARITAŞ
Eren GÜNGÖR
Tarık Buğra TEKİN
Adnan KABİL
Oktay DAYAN

Gökçe ÇEBİ AKGÜN

ADAPTATION WORKSHOP PARTICIPANTS

Esra DEMİR / Demir Enerji - Msc. Business Engineer
Melda KARADEMİR / Demir Enerji –Phd. Environmental Engineer
İrem ORMAN / Demir Enerji - Environmental Engineer

Ayça KORKMAZ / IGA Airport Operation Inc.

Duygu KEYF / IGA Airport Operation Inc.
Salih Güven ALŞAK / Arnavutköy Municipality – Directorate of Public Relations
Yavuz Selim TÜRKMEN / Istanbul Metropolitan Municipality – Directorate of Parks and Gardens
Barış KUŞ / Arnavutköy Municipality – Directorate of Public Works
Sefa ÇELİKER / Arnavutköy Municipality – Directorate of Youth and Sports Services
Gülten BAĞBAZ / 1st Regional Directorate of Meteorology
Dila Ece ÖZTAN / 1st Regional Directorate of Meteorology

Kemal TALİ / Provincial Directorate of Health
M. Esat AKSOY / Arnavutköy Municipality – Directorate of Disaster Affairs
Gülsüm TOPÇU / Arnavutköy Municipality – Directorate of Veterinary Services
Caner DEMİR / Demir Enerji – Msc. Mechanical Engineer
Dilan CENGİZ/ Demir Enerji – Urban Planner

Beyzanur KÜÇÜKDİNÇER / Demir Enerji– Urban Planner
Damla ÇOBAN / Arnavutköy Municipality – Directorate of Cultural Affairs
Şükran Anıl DAĞLI / Arnavutköy Municipality – Directorate of Municipal Police
Naile AKDAĞ / 14th Regional Directorate of State Hydraulic Works (DSI)

Kübra KABAKALE / Arnavutköy Municipality – Directorate of Cleaning Services
Ebru GENÇ / Disaster and Emergency Management Authority (AFAD)
Afet YURTSEVEN / Istanbul Metropolitan Municipality – Climate Branch Directorate
Kemal KARAHAN / Istanbul Metropolitan Municipality – Fire Department
Melike Nur GÜNEŞ / Arnavutköy Municipality – Directorate of Coordination
Burçin KARABULUT / Beylikdüzü Municipality – Directorate of Disaster Affairs
Barış TÜRK / Beylikdüzü Municipality – Directorate of Disaster Affairs
Hatice BAYĞIN / Arnavutköy Municipality – Directorate of Cultural Affairs