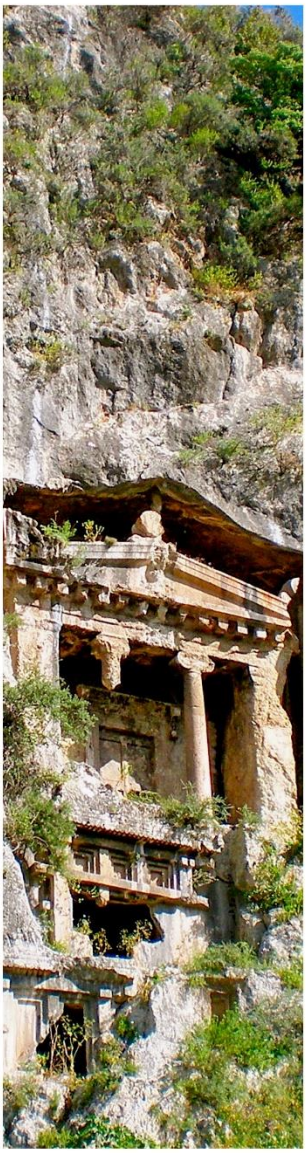
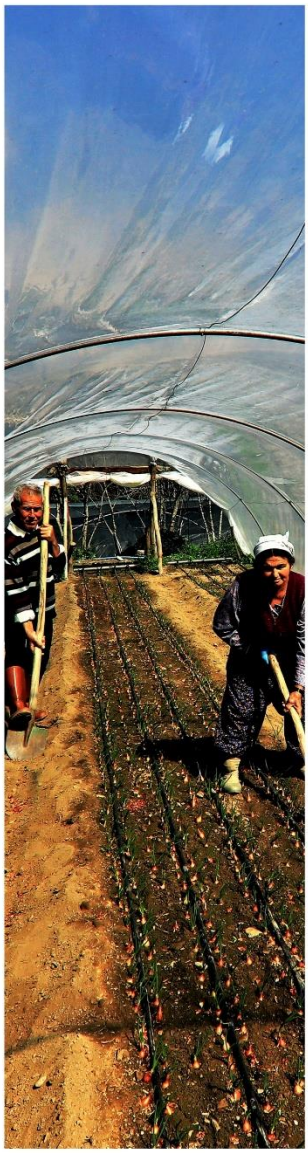
Muğla
Sustainable Energy and Climate Action Plan






2025

T.C. MUĞLA BÜYÜKŞEHİR BELEDİYESİ 2014

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The plan was developed in collaboration with İstanbul Enerji.

MUĞLA

SUSTAINABLE ENERGY AND CLIMATE ACTION PLAN

(2025-2050)

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Ahmet ARAS

President of the Union of Coastal Aegean Municipalities
Mayor of Muğla Metropolitan Municipality

Dear Citizens of Muğla,

The world is now experiencing the impacts of the climate crisis at an unprecedented level and continues to struggle with its consequences. According to reports of the World Meteorological Organization, the ten warmest years on record have all occurred within the last decade. As global carbon emissions continue to rise, it is inevitable that the impacts of climate change will intensify in the coming years. In terms of global average surface temperatures, 2024 was the warmest year recorded compared to the pre-industrial period and marked the first year in which the 1.5°C global warming threshold defined under the Paris Agreement was exceeded.

Climate change is a global phenomenon that creates a wide range of socio-economic, environmental and health-related challenges. The Mediterranean Basin, which includes Muğla, is widely recognized by the scientific community as one of the regions most vulnerable to global climate change. Expected climate-related risks in the Mediterranean region include heatwaves, forest fires, floods, sea level rise, water scarcity, drought, and losses in agricultural production and ecosystems.

Forest fires are among the most significant environmental challenges faced in our region. In Muğla, where dozens of forest fires occur every summer, we experienced devastating fires during July and August of 2021. As a result of these fires, we not only lost valuable carbon sink areas but also observed regional air pollution, as well as marine pollution and acidification caused by ash carried into the sea.

Water is the source of life and one of our most valuable resources. Of the total water resources on Earth, approximately 97.5% is saline water, while only 2.5% is freshwater. Moreover, about 98.5% of these freshwater resources are stored in glaciers and ice caps. In reality, the amount of accessible and drinkable freshwater on Earth represents only a very small portion of the planet’s total water resources.

Of these limited freshwater resources, approximately 70% is used in agriculture, 19% in industry and 11% for human consumption, including drinking and domestic use. Türkiye is not a water-rich country and, due to pollution and drought experienced over the past decade, it has become a country facing increasing water stress. Unplanned development and rapid population growth in coastal tourism destinations, further intensified during the pandemic period, have begun to create serious water supply challenges. For example, Bodrum, which has an official population of around 200,000, receives water supply equivalent to

approximately 400,000 people. During the summer months, water consumption can exceed the equivalent of a population of one million.

In order to reduce climate risks threatening our city, such as drought, urban flooding, extreme heatwaves and forest fires, and to ensure that our efforts gain a lasting presence on the international platform, Muğla Metropolitan Municipality signed the Covenant of Mayors for Climate and Energy following the Metropolitan Municipal Council Decision dated 08 April 2021 and numbered 107. Within the scope of this commitment, our municipality pledged to reduce corporate greenhouse gas emissions by 40% by 2030. In 2025, this commitment was further strengthened and updated to achieve Climate Neutrality by 2050.

Under the goal of achieving Climate Neutrality by 2050, greenhouse gas emissions generated by the activities of our Metropolitan Municipality will be balanced by the amount of emissions reduced by 2050. In this context, the Muğla Sustainable Energy and Climate Action Plan, which we present to our stakeholders and the public through this report, serves as a key roadmap and guiding document for achieving this objective.

Through the implementation of the Muğla Sustainable Energy and Climate Action Plan:

- Alignment will be ensured with Türkiye's 2053 Net Zero Target and the Long-Term Climate Change Strategy, strengthening coherence with national policies and strategies.
- Policies and strategies guiding the future development of Muğla will aim to reduce the city's vulnerability to climate change.
- Muğla will take its place among the cities leading the fight against the climate crisis, contributing to our Metropolitan Municipality's vision of becoming a "World City Muğla."

Muğla Metropolitan Municipality has always been open to and supportive of global and regional cooperation aimed at reducing the negative impacts of climate change and will continue to do so.

On this occasion, I would like to extend my sincere greetings and gratitude to all institutions, organizations and stakeholders who have contributed to the preparation of the Muğla Sustainable Energy and Climate Action Plan.

Ahmet Aras

President of the Union of Coastal Aegean Municipalities

Mayor of Muğla Metropolitan Municipality

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WHY WE NEED SECAP?

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1. Why We Need SECAP?

Climate change is one of the most critical environmental challenges transforming economic systems, natural resources, physical infrastructure and social life at the global scale. In line with the objectives of the Paris Agreement, limiting global temperature increase to below 2°C and achieving the 1.5°C target as soon as possible requires not only the commitment of national governments but also the active engagement of cities. As emphasized in the Sixth Assessment Report of the IPCC, effective and practical responses to the climate crisis can only be achieved through integrated policies implemented within the responsibilities of local governments. For this reason, cities, where energy consumption, population density, infrastructure pressure and demand for social services are most concentrated, have become key actors in both emission reduction and climate adaptation.

Due to its geographical location, Muğla is situated within the Mediterranean Basin, one of the regions most vulnerable to the impacts of climate change. Increasing temperature trends, prolonged drought periods, the growing frequency and intensity of forest fires, sea level rise and coastal flooding, heavy precipitation leading to floods and urban inundations, seasonal infrastructure pressures driven by tourism-related population movements, and increasing pressure on water resources all indicate that Muğla faces a multidimensional climate vulnerability profile. In this context, developing a strategic and science-based approach to address the impacts of climate change has become essential for Muğla's vision of becoming a sustainable city.

This report builds upon the sustainability-oriented initiatives carried out by Muğla Metropolitan Municipality and establishes a Sustainable Energy and Climate Action Plan (SECAP) that concretizes the municipality's long-term approach to climate change mitigation and adaptation. The energy planning process that began with the Sustainable Energy Efficiency Plan (SEEP) published in 2013 was brought into an international framework in 2021 when Muğla became a signatory to the Covenant of Mayors for Climate and Energy (CoM). Within this framework, the city adopted a target of reducing greenhouse gas (GHG) emissions by at least 40% by 2030 compared to the 2020 baseline year.

With the publication of the Muğla Local Climate Change Adaptation Strategy and Action Plan (2025–2030) in March 2025 and the organization of the Local Conference of the Parties (Muğla COP) in the same year, a more participatory and multi-stakeholder governance structure has been established. Furthermore, the SECAP process launched on 29 May 2025 in cooperation with İstanbul Enerji has transformed the vision of a carbon-neutral Muğla into a structured technical planning framework.

The main objective of this report is to evaluate Muğla's climate vulnerabilities through scientific methods, to present the city's greenhouse gas emission profile using up-to-date data sources, and to develop practical, measurable and monitorable actions in line with the city's 2050 climate targets. To achieve this objective, mitigation and adaptation policies are addressed together. The plan establishes an integrated planning framework that increases energy efficiency, strengthens renewable energy capacity, promotes the use of low-carbon

technologies, enhances the resilience of natural and urban ecosystems, and improves the management of climate-related hazards. SECAP is designed not as a static document, but as a dynamic strategic action plan that will be regularly updated in response to changing climatic, socio-economic and technological conditions.

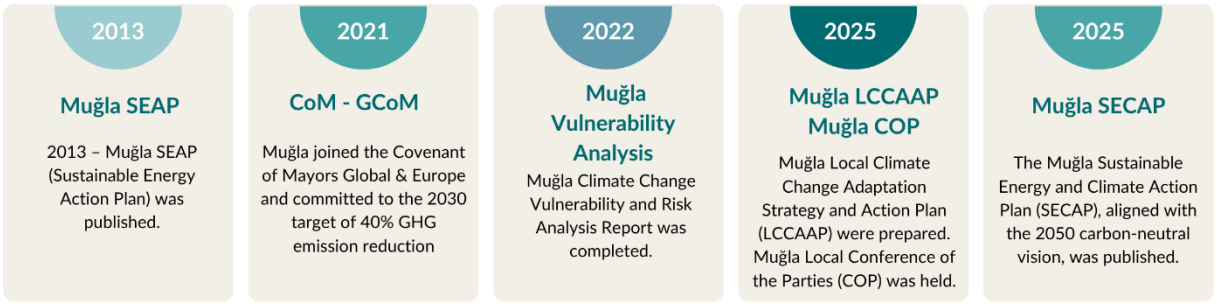

Figure 1 Carbon Neutral Muğla Timeline

The methodology used in preparing this plan is based on the European Commission's guide "How to Develop a Sustainable Energy and Climate Action Plan" and the Global Covenant of Mayors (GCoM) methodology, following a scientific approach aligned with IPCC emission accounting principles, the Covenant of Mayors Emission Inventory Guide, and Risk and Vulnerability Assessment Framework standards. Within the scope of the study, a greenhouse gas inventory was prepared; sectoral energy consumption and emission sources were evaluated through a comprehensive perspective; climate risks and vulnerabilities were assessed based on parameters such as hazards, exposure, sensitivity and adaptive capacity; and mitigation and adaptation strategies were developed using spatial data, scenario analyses and spatial risk assessments. The plan has been developed through a participatory process supported by internal stakeholder trainings and workshops conducted in 2025 to strengthen the institutional capacity of municipal departments.

In this respect, the Muğla Sustainable Energy and Climate Action Plan serves not only as a strategic roadmap for reducing greenhouse gas emissions and strengthening climate resilience, but also as a guiding framework supporting Muğla's transition towards a sustainable, low-carbon and climate-resilient city.

EXECUTIVE SUMMARY

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2. Executive Summary

The Muğla Sustainable Energy and Climate Action Plan (SECAP) provides a strategic framework aimed at improving the efficiency of energy use at the urban scale, reducing fossil fuel-based consumption, and developing a more resilient settlement structure against the current and future impacts of climate change.

Within the scope of the study, 2024 was determined as the baseline year, and based on the greenhouse gas emission inventory for this year, the total emissions of Muğla Province were calculated as 4,958,824 tCO_2e (4.58 tCO_2e per capita). When the sectoral distribution is examined, approximately half of the emissions originate from Stationary Energy with a share of 49.7%, followed by Transport with 45.1% and Waste with 5.2%. In addition to the core calculation sectors, emissions from agriculture and livestock activities were also estimated separately for Muğla Province. Emissions originating from agriculture and livestock were calculated as 791,219 tCO_2e.

Based on the greenhouse gas emission inventory prepared for the baseline year 2024, the total emissions of Muğla Metropolitan Municipality were calculated as 27,192 tCO_2e. Of this total, 24,398 tCO_2e originate from Scope 1 direct emissions, including municipal vehicle fleets, fuel consumption and other direct operational activities in the field. 2,764 tCO_2e correspond to Scope 2 indirect emissions resulting from the consumption of imported electricity. The results indicate that the largest share of the municipality's carbon footprint originates from direct emissions, highlighting the importance of prioritizing improvements in fuel consumption and municipal operations within emission reduction strategies.

Under the Business as Usual (BAU) scenario, which assumes the continuation of current trends without the implementation of mitigation measures, total greenhouse gas emissions are projected to reach 6,936,533 tCO_2e by 2050. However, with the implementation of the actions developed within the SECAP framework, emissions are expected to be reduced by 80% in line with Muğla's carbon neutrality target, decreasing to 1,387,307 tCO_2e.

Muğla Province is a region with high climate vulnerability, where the impacts of climate change are spatially concentrated and closely linked with economic activities. Along the Bodrum–Marmaris–Datça corridor, sudden heavy precipitation and coastal flooding pose major risks to tourism infrastructure. In the Marmaris–Köyceğiz–Ortaca–Dalaman–Seydikemer basin, drought and irregular precipitation patterns negatively affect agricultural production and local income structures. In Milas and its surrounding areas, increasing

temperatures and declining humidity levels have made forest fires the most critical climate-related threat.

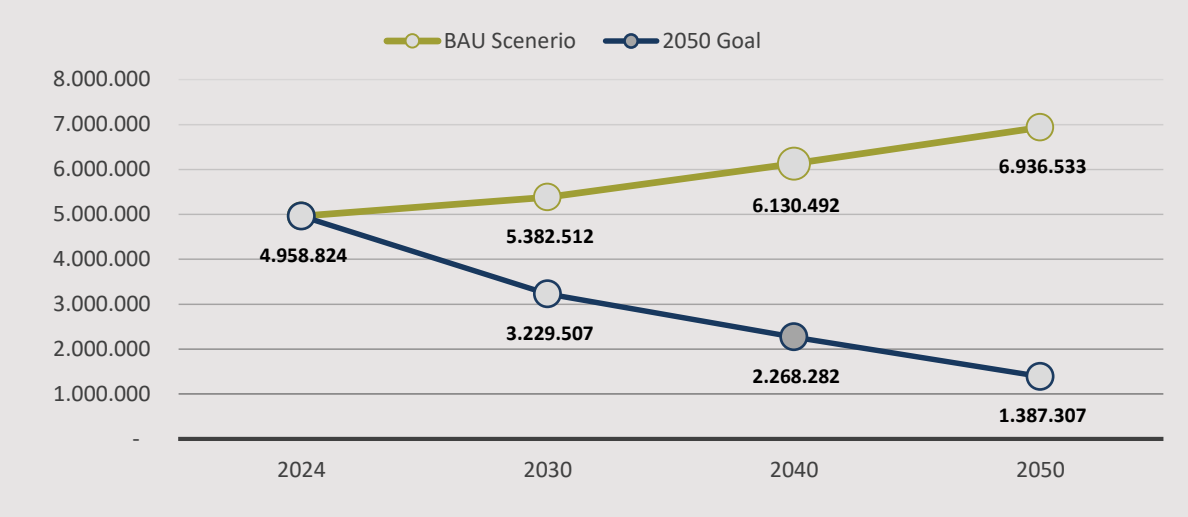


Figure 2 Muğla GHG Emission Projection

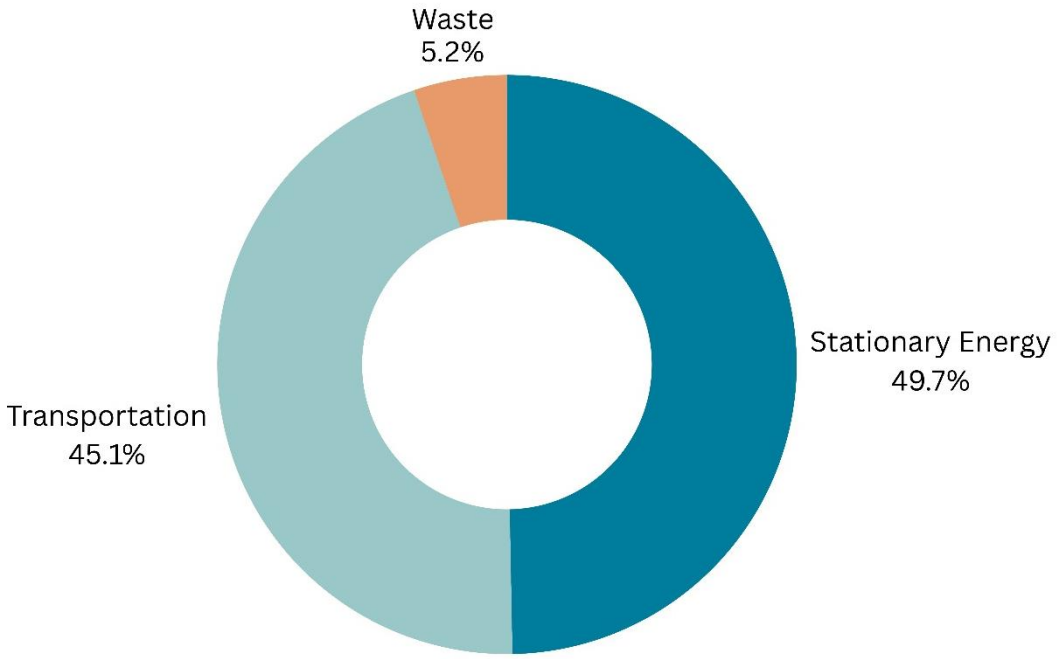


Figure 3 Muğla GHG Inventory Distribution

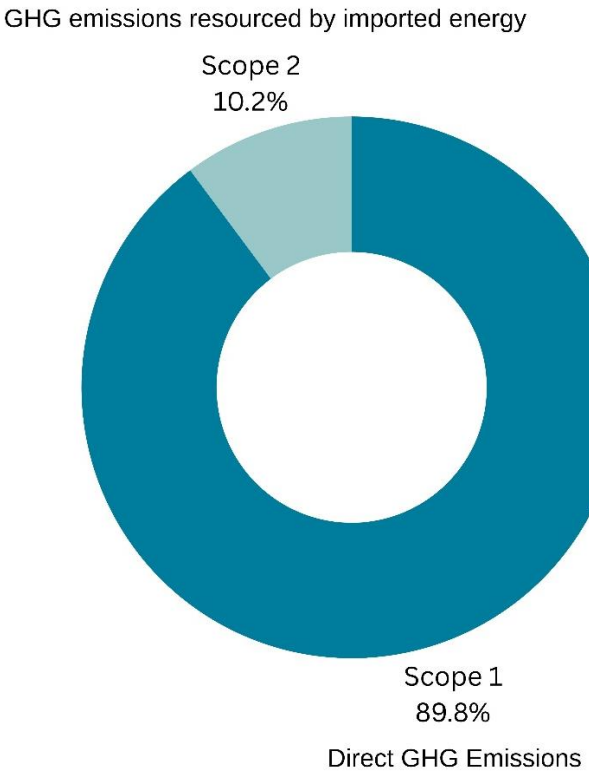


Figure 4 Corporate Greenhouse Gas Inventory Distribution of Muğla Metropolitan Municipality

AN OVERVIEW OF MUĞLA

3

GENERAL CHARACTERISTICS OF MUĞLA

POPULATION

1,081,867
inhabitants

POPULATION DENSITY

86.89
inhabitants per km²

NUMBER OF DISTRICTS

13

NUMBER OF NEIGHBORHOODS

574

FEMALE MALE RATIO

DEPENDENT POPULATION

%44,11

HOUSEHOLD SIZE

2,7

POPULATION GROWTH (2013-2024)

+%20.9

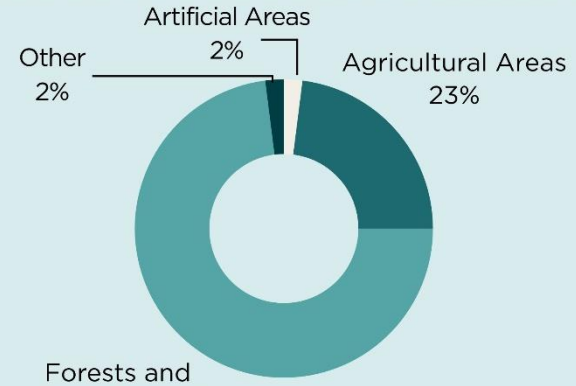
LAND AREA

13,338 km²

COASTLINE LENGTH

1,480 km

LAND USE



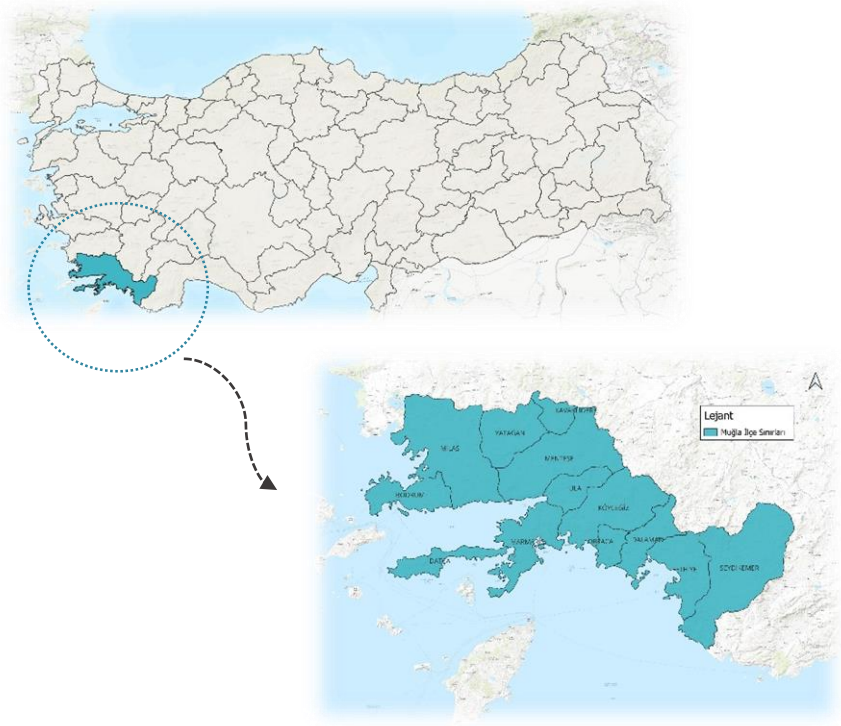
3. An Overview of Muğla

3.1. Location

Located in the southwestern part of the Aegean Region, Muğla Province is the only province in Türkiye with coastlines on both the Aegean Sea and the Mediterranean Sea. It is bordered by Aydın to the north, Denizli and Burdur to the east, and Antalya to the southeast. The province covers an area of approximately 13,338 km², and its total coastline extends for about 1,480 kilometers. In terms of topography, 77% of the province consists of mountainous areas, 12% plateaus, and 11% plains.

The provincial center is located inland in the Menteşe district, and the province is administratively composed of 13 districts and 574 neighbourhoods. Muğla stands out with coastal districts such as Bodrum, Fethiye, Marmaris, and Datça, which have high tourism potential, while agriculture and mining activities are more dominant in inland districts such as Yatağan, Kavaklıdere, and Seydikemer.

Approximately 68% of the provincial land area is covered by forests and shrublands, making Muğla one of the most forested provinces in Türkiye. Its mountainous terrain has formed numerous bays, gulfs, and peninsulas along the coastline, and this natural landscape has significantly shaped both the ecological and economic character of the province.



Map 1 Geographical Location and Administrative Boundaries of Muğla Province (Prepared by İstanbul Enerji)

3.2. Historical Development

Located in the ancient core of Caria in southwestern Anatolia, Muğla has been part of a multi-centered settlement system since the earliest periods of habitation. This system, shaped around the Milas, Stratonikeia, and Halicarnassus axis, established strong interactions between coastal trade and maritime centers and the agricultural and religious settlements located in the inland areas.

During the Hellenistic and Roman periods, expanding trade networks supported the development of urban infrastructure and public spaces. In the Byzantine period, while coastal cities experienced relative decline, inland settlements focused on defense and production gained greater importance.

With the establishment of the Menteşe Principality in the late 13th century, the region came under Turkish rule, and new rural and urban networks emerged through the settlement of Germiyan and Oghuz tribes. The development of marketplaces, mosques, inns and bazaars around Beçin, Milas and Muğla created typical examples of urban structures seen in Anatolian principalities.

Following the incorporation of the region into the Ottoman Empire in 1424, Muğla became an administrative and commercial center as a sanjak capital. The construction of madrasas, inns, roads and public buildings strengthened the city's urban identity. During the Tanzimat reforms of the 19th century, municipal institutions and infrastructure investments were introduced, laying the foundations for modern urban development.

During the Turkish War of Independence (1919–1921), Muğla became one of the important centers of the Kuva-i Milliye resistance movement organized against occupation. The city regained its freedom relatively early with the end of the Italian occupation in 1921.

In the Republican period, Muğla underwent planned urban development. The construction of the Government House, community centers, schools, squares and road arrangements reshaped the city center, while water supply, public health and sanitation infrastructure were modernized. From the 1950s onwards, improvements in transportation networks strengthened connections with coastal settlements, and after the 1970s, tourism-driven growth transformed Muğla into a multi-centered urban region.

Today, Muğla maintains its identity as a multi-nodal urban system shaped by its central role in administration, education and services, together with coastal towns characterized by tourism, cultural heritage and environmental values.

3.3. Natural Structure

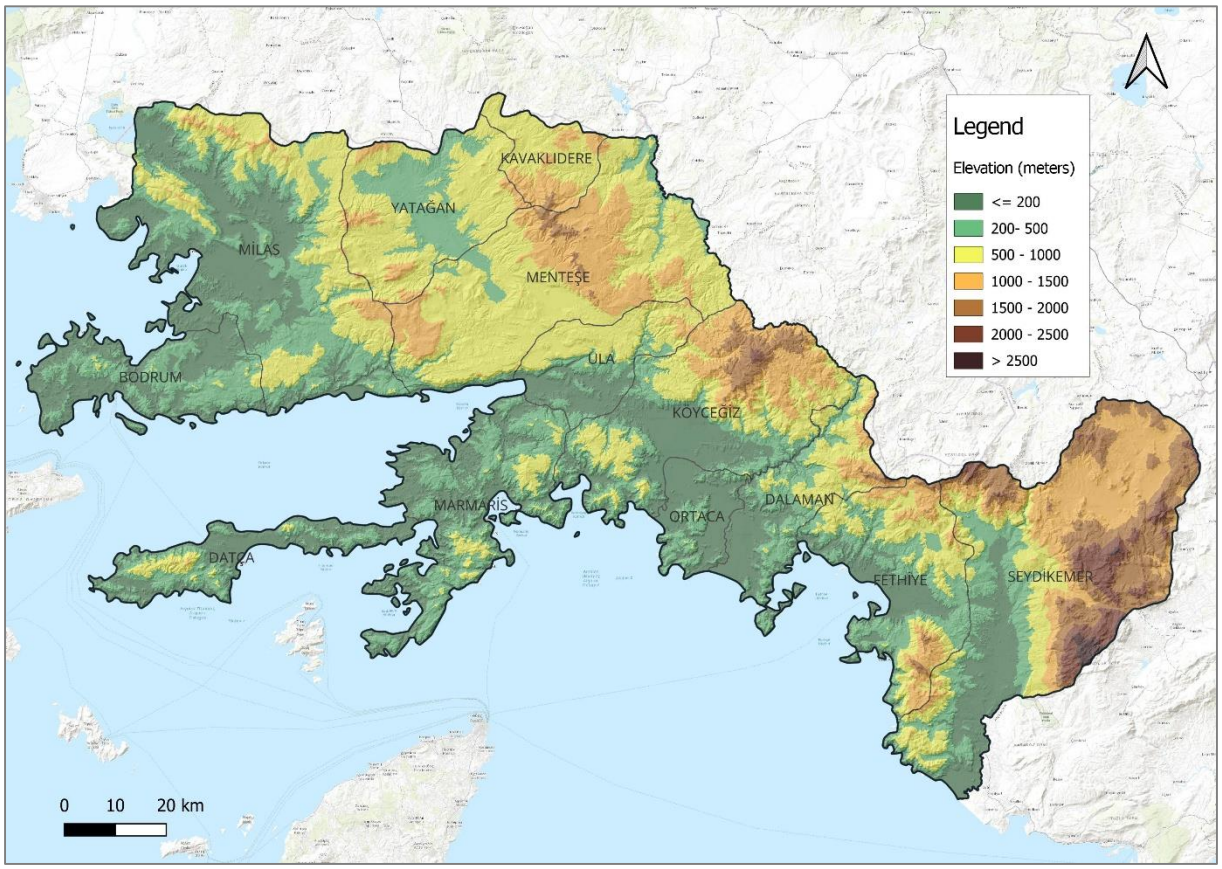
A large portion of Muğla Province consists of mountainous and rugged terrain, which has generally developed on calcareous (karstic) geological formations. This characteristic leads to the widespread occurrence of karst landforms in the region, such as caves, sinkholes and underground water systems.

According to elevation data, the topography of the province is largely concentrated between 200 and 1500 meters above sea level. Elevation values increase particularly around Menteşe, Kavaklıdere, Seydikemer and Yatağan, while low-lying coastal plains close to sea level are observed in coastal districts such as Bodrum, Datça, Dalaman and Fethiye. This morphological diversity is an important factor shaping the microclimatic characteristics of the province and the diversity of its vegetation cover.

Major mountain ranges in Muğla include Akdağlar (3014 m), Göktepe (2234 m), Çiçekbağı Mountain (2295 m), Oyluk Mountain (1892 m), as well as the Menteşe and Beşparmak mountain ranges. The plains are primarily alluvial accumulation areas formed along river valleys. The main plains include Yatağan, Dalaman, Ortaca, Milas, Ula and Muğla Plains, which together account for approximately 11% of the province's total surface area.

The province hosts numerous rivers, most notably the Dalaman, Eşen and Namnam streams. These rivers play an important role in irrigating agricultural lands and maintaining ecosystem balance. In addition, Köyceğiz, Bafa, Denizcik and Hacat Lakes constitute key components of the province's hydrological structure and natural ecosystems.

Overall, Muğla's natural landscape exhibits a geomorphological structure composed of high mountainous areas, narrow coastal plains and karstic formations. This physical structure directly influences the spatial distribution of settlements and economic activities, particularly agriculture and tourism.



Map 2 Elevation Map of Muğla Province (Prepared by İstanbul Enerji)

3.4. Land Use

According to CORINE Land Cover (CLC) data, significant structural changes in land cover occurred in Muğla Province between 1990 and 2018. During this period, artificial surfaces increased noticeably, while agricultural areas declined. In contrast, forests and semi-natural areas remained largely stable.

Artificial surfaces, which accounted for 1.4% of the total surface area in 1990, increased to 2.4% in 2018. This growth is largely associated with urban expansion and tourism investments, particularly concentrated in coastal areas.Agricultural areas declined from 23.8% to 22.5% during the same period, indicating the conversion of rural land into built-up areas and a gradual reduction in agricultural activities.

Forests and semi-natural areas have largely been preserved, maintaining an approximate share of 73% across the province. This reflects Muğla's strong forest ecosystem, which contributes significantly to regional carbon sink capacity and the maintenance of ecological balance.

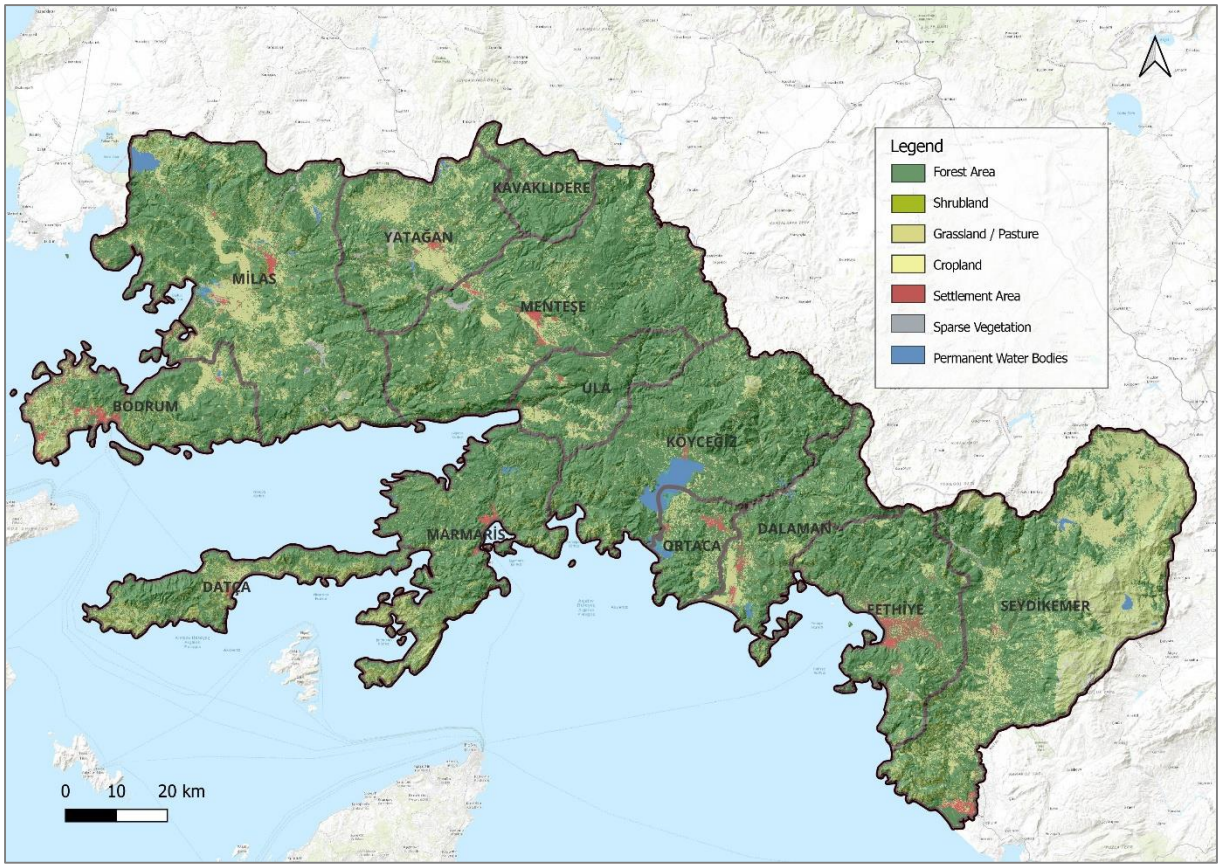
Table 1 1990-2018 Land Use

Land Use	**Areas**									
	1990 (ha)	**%**	**2000 (ha)**	**%**	**2006 (ha)**	**%**	**2012 (ha)**	**%**	**2018 (ha)**	**%**
Artificial Areas	13.802,09	1,46	26.588,38	2,12	28.066,55	2,23	30.258,3	2,41	3.1175.50	2,46
Agriculture	299.785,23	23,85	297.456,55	23,46	24.536	23,17	245.936	23,07	229.835	22,55
Forest and Semi Natural Areas	929.467,69	73,41	918.903,33	73,12	924.089,25	73,49	923.225,35	73,35	928.450.1	73,89
Wetlands	4.478,80	0,36	4.660,25	0,37	4.276,89	0,34	4.143,25	0,33	4.138.92	0,33
Water Bodies	11.659.43	0,93	11.855,64	0,94	9.578,05	0,76	10.263,75	0,82	16.068,61	1,28
Total	**1.257.690,22**	**100**	**1.257.503,25**	**100**	**1.257.588,00**	**100**	**1.257.846,8**	**100**	**1.265.094,27**	**100.00**

The current land cover distribution has been mapped using WorldCover (2021) data developed by the European Space Agency (ESA). A large portion of the province is covered by forest areas, which are particularly concentrated along the Yatağan–Kavaklıdere–Menteşe axis.

In coastal areas such as Bodrum, Marmaris and Fethiye, maquis and shrubland formations are widespread. In these regions, tourism development and second-home construction have created a tendency toward fragmentation of natural vegetation.Agricultural activities are mainly concentrated in the fertile alluvial plains around Ortaca, Dalaman and Milas, while settlement areas are largely clustered in coastal districts.

Areas characterized by sparse vegetation and permanent water bodies, particularly around Lake Köyceğiz and the Dalaman Basin, play an important role in the preservation of ecological diversity. Overall, Muğla Province maintains a high proportion of natural land cover and strong spatial ecological continuity, which contributes significantly to its ecological resilience.



Map 3 Land Use and Land Cover Map of Muğla (Prepared by İstanbul Enerji)

3.5. Demographical Structure

Population Change

The population of Muğla Province has shown a steady upward trend between 2013 and 2024. While the population was 866,665 in 2013, it reached 1,081,867 as of 2024. Accordingly, the population increased by approximately 24.8% over the past 11 years.

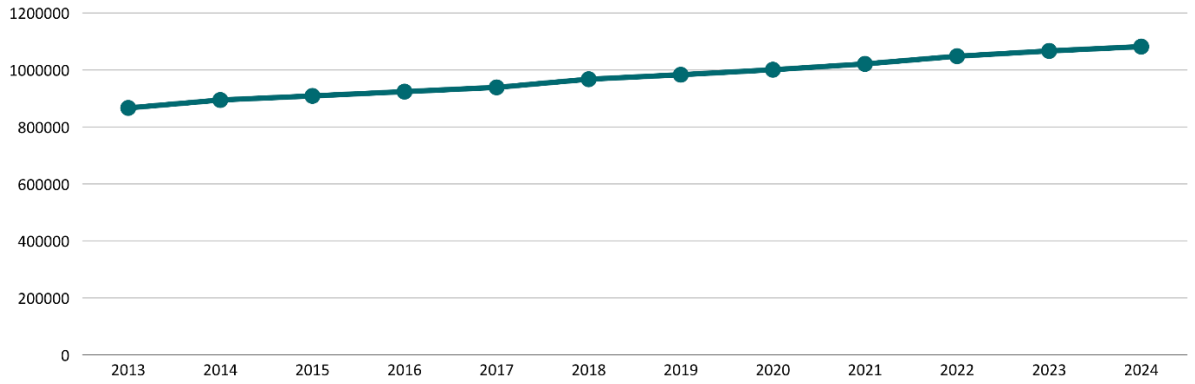


Figure 5 Population Change in Muğla (2013–2024)

Household Composition and Average Household Size

According to TÜİK 2024 data, the average household size in Muğla is 2.7 persons, which is below the national average of 3.1 persons. Among the districts, the lowest value is observed in Datça (2.3), while the highest value is recorded in Seydikemer (2.9). Districts such as Fethiye, Milas and Kavaklıdere are above the provincial average, whereas Bodrum, Menteşe and Ula remain below it. This distribution indicates that smaller household structures are more common in tourism-oriented districts, while more traditional family structures are relatively prevalent in inland areas.

Population Dependency Ratio

The age dependency ratio indicates the size of the population that the working-age population (15–64) is responsible for supporting, namely children (0–14) and older adults (65+). In other words, it represents the number of dependents per 100 people of working age.

As of 2024, the total age dependency ratio in Muğla is 44.1%, which is below the Türkiye average of 46.2%. Of this ratio, 23.7% consists of child dependency and 20.4% of elderly

dependency. This distribution suggests that while Muğla has a relatively balanced working-age population, the share of the elderly population is gradually increasing.

According to 2024 data, the age dependency ratio across districts in Muğla varies between 38% and 55%. The lowest ratios are observed in Menteşe (38.1%) and Marmaris (39.8%), while the highest ratios occur in Datça (55.3%) and Kavaklıdere (54.9%).

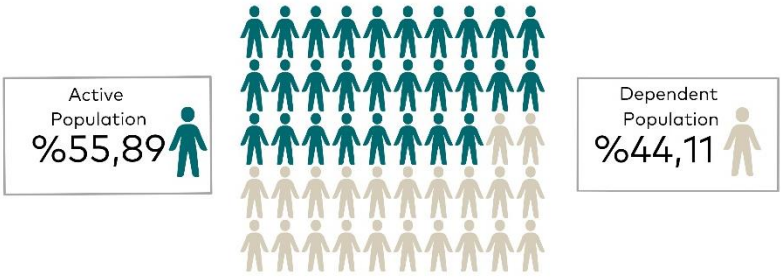


Figure 6 Active and Dependent Population Distribution in Muğla

Educational Attainment

According to 2024 data, approximately 780,000 people in Muğla belong to the literate population group. The province has an education level above the national average, with the share of individuals with high school education or higher reaching approximately 55%.

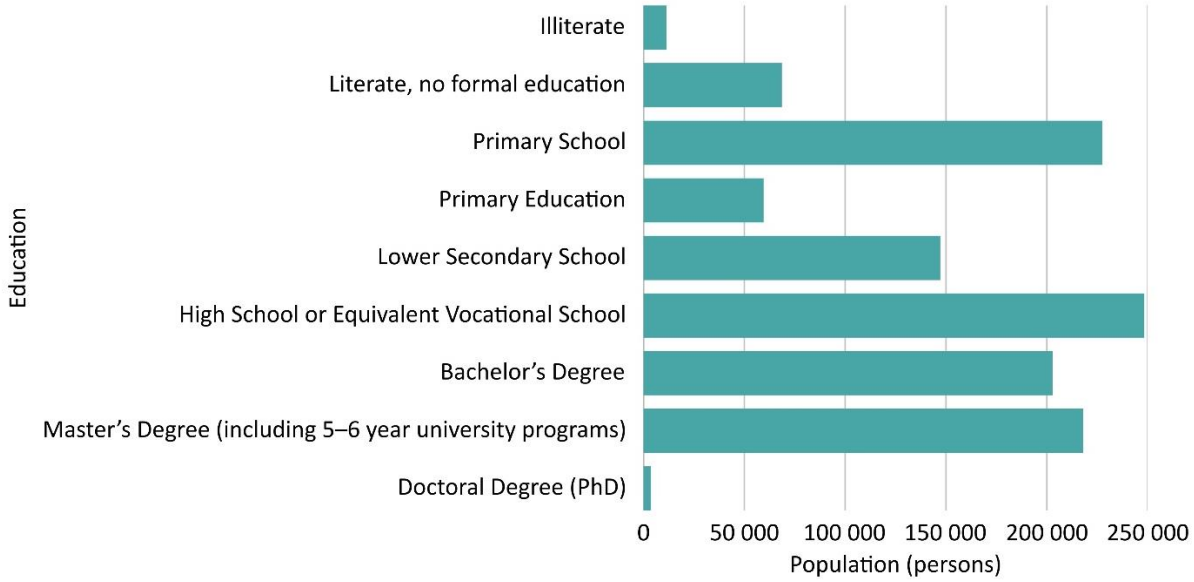


Figure 7 Educational Attainment (2024)

Population Distribution and Change by District

Muğla consists of 13 districts. The districts with the highest population are Bodrum (approximately 203,035), Fethiye (182,280), Milas (150,250), and Menteşe (124,825). The spatial distribution of population growth is concentrated primarily in coastal and central

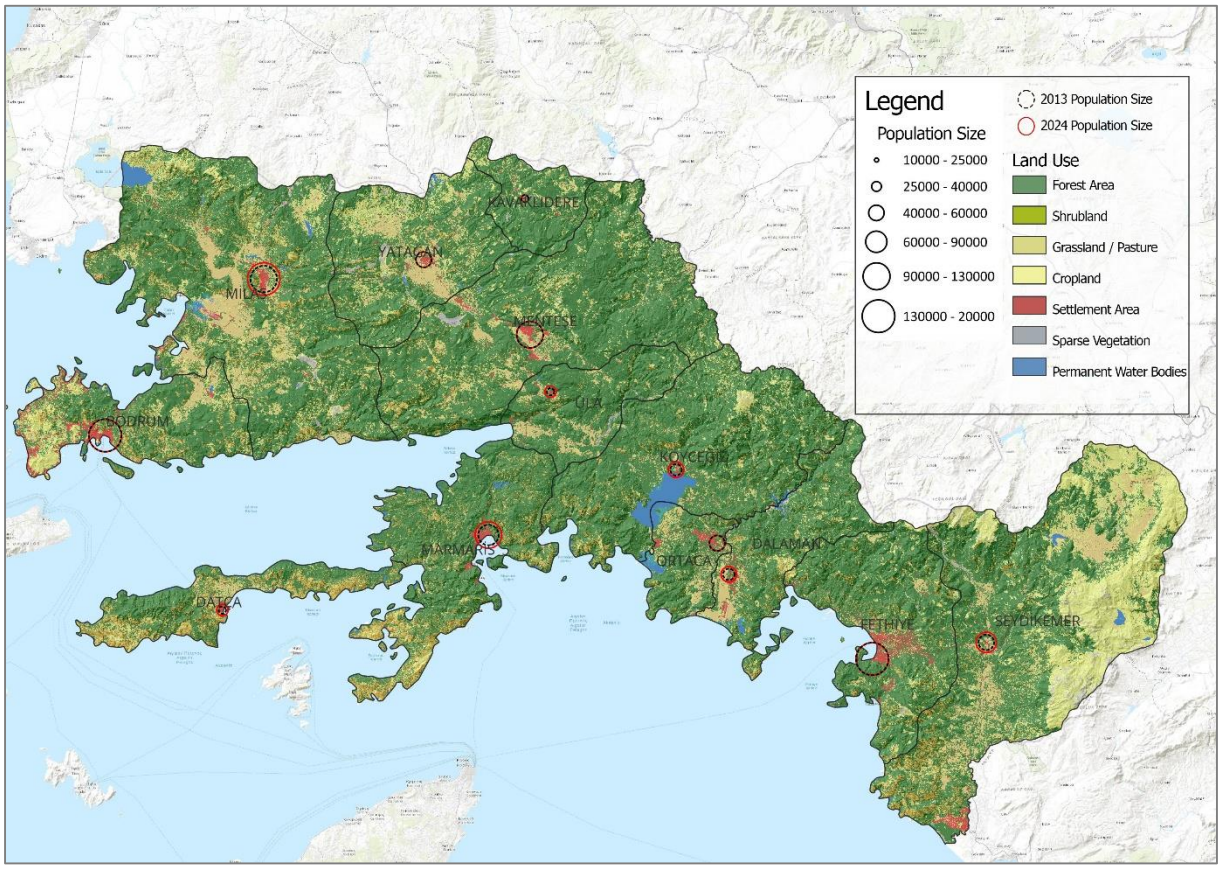
districts. The largest absolute increases were recorded in Bodrum (+62,319) and Fethiye (+41,771). In proportional terms, the highest growth rates were observed in Dalaman (44.5%), Bodrum (44.3%), and Datça (43.8%).Districts with the lowest population growth were Kavaklıdere (-0.4%) and Yatağan (-0.2%). In these areas, the aging rural population dependent on agriculture and the migration of younger populations to urban centers have been influential factors

The population change map for the 2013–2024 period indicates that population growth in Muğla has largely concentrated in coastal districts and tourism-oriented settlements. Districts such as Bodrum, Fethiye, Milas, Menteşe, Ortaca, and Dalaman have experienced notable population increases during this period. This growth has been driven primarily by tourism-related attraction, improved transportation accessibility, and the expansion of the service sector. The map also reveals that population growth has remained limited in inland areas characterized by extensive forest cover and mountainous topography, while in some rural areas the population has stagnated or declined. The spatial distribution of settlements within grasslands, pastures, cultivated agricultural lands, and forested landscapes confirms that population growth has been concentrated particularly in accessible coastal zones, plains, and transitional areas. This spatial trend suggests that population pressure in Muğla is likely to continue increasing in coastal areas, which will have implications for future urban development, infrastructure planning, and the management of natural areas.

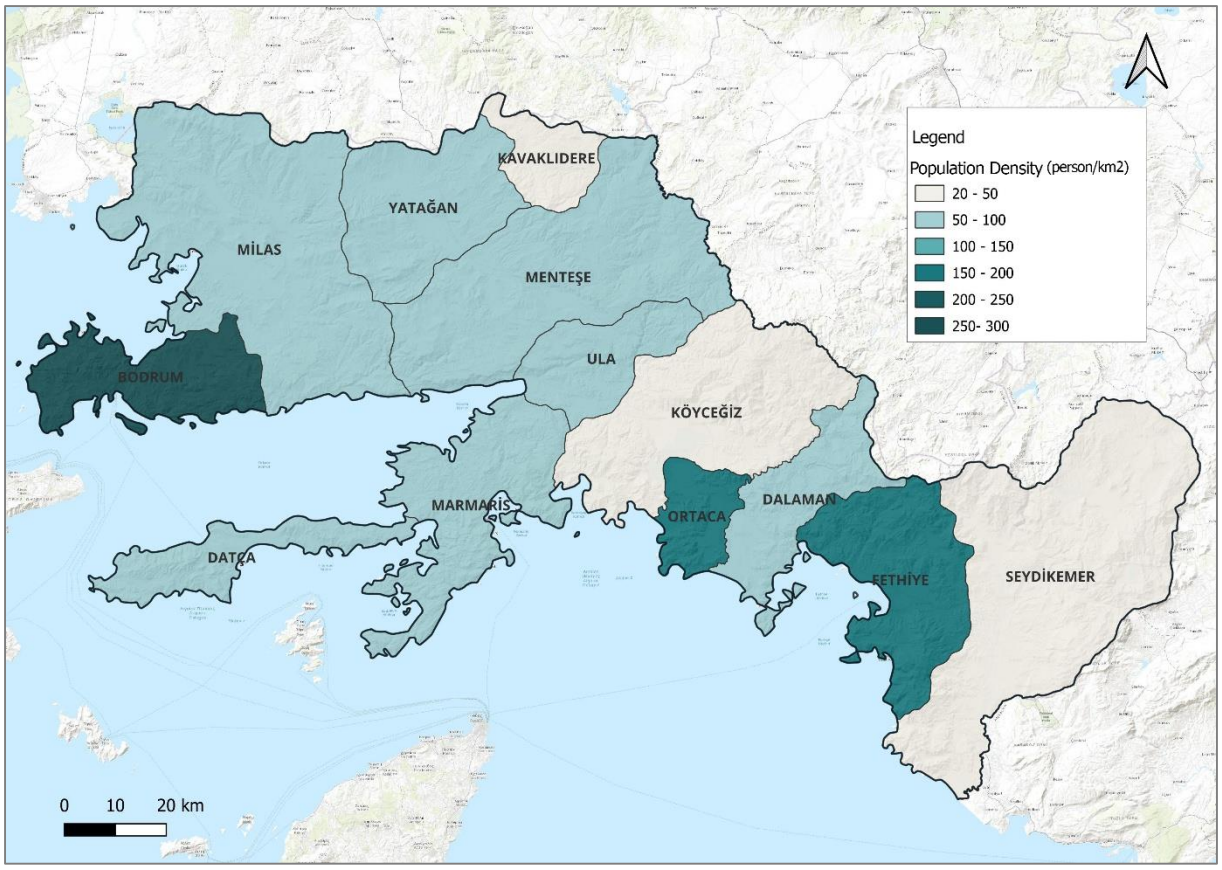
Table 2 Population Change in Muğla (2013–2024)

DISTRICT	2013	2024	DIFFERENCE (PERSON)	DIFFERENCE (%)
BODRUM	140.716	203.035	62.319	%44,3
DALAMAN	35.362	51.088	15.726	%44,5
DATÇA	17.983	25.866	7.883	%43,8
FETHİYE	140.509	182.280	41.771	%29,7
KAVAKLIDERE	10.878	10.834	-44	%-0,4
KÖYCEĞİZ	33.777	41.205	7.428	%22,0
MARMARİS	85.801	96.589	10.788	%12,6
MENTEŞE	99.911	124.825	24.914	%24,9
MİLAS	129.128	150.520	21.392	%16,6
ORTACA	44.227	57.155	12.928	%29,2
SEYDİKEMER	59.660	65.861	6.201	%10,4
ULA	23.418	27.392	3.974	%17,0
YATAĞAN	45.295	45.217	-78	%-0,2
TOTAL	886.665	1.081.867	195.202	%22

Tourism-oriented coastal districts such as Bodrum, Fethiye and Marmaris have the highest population densities in terms of persons per km². This pattern is closely linked to the attractiveness created by tourism, seasonal population mobility, and the concentration of settlements along the coastline. Ortaca, Dalaman, Milas and Menteşe exhibit moderate population densities, reflecting a mixed demographic structure shaped by both agricultural activities and the service sector. In contrast, inland districts such as Seydikemer, Ula, Yatağan and Kavaklıdere have relatively low population densities, largely due to their extensive land areas, rural settlement patterns and the presence of large forested landscapes.This spatial distribution highlights the need to consider regional differences in urban planning, infrastructure investments, transportation systems, tourism management and disaster risk planning.



Map 4 Population Change in Muğla (2013–2024) (Prepared by İstanbul Enerji using TÜİK data)



Map 5 Population Density in Muğla – 2024 (Prepared by İstanbul Enerji using TÜİK data)

3.6. Economic Structure

Muğla is one of Türkiye's most prominent tourism destinations, following Antalya and İstanbul, and its economic structure reflects a multi-sectoral character shaped by tourism, agriculture, industry and trade. Within this framework, the economic structure of Muğla is examined under three main sectors: agriculture and livestock, industry and trade, and tourism.

3.6.1. Agriculture and Livestock

Muğla has a total of 229,835 hectares of agricultural land. Of this area, 53% consists of fruit cultivation areas, 32% cereals and other crop production, 6% vegetables, 7% fallow land and 2% greenhouse production. According to the Farmer Registration System (ÇKS), 27,163 producers operate on a total of 107,240 hectares of registered agricultural land, including 46,591 hectares of irrigated and 60,649 hectares of rainfed farmland. In addition, the province hosts 38,213 livestock enterprises, 16,288 food production enterprises, 4,377 beekeeping enterprises and 203 agricultural cooperatives. Agricultural areas in Muğla account for approximately 0.9% of Türkiye's total agricultural land and 8.2% of the total in the Aegean Region. Fruit cultivation areas correspond to 3.5% of Türkiye's total and 14.7% of the Aegean Region, while vegetable gardens represent 2.4% of the national total and 13.7% of the regional total.

In terms of the spatial distribution of agricultural land, Milas (33%) and Seydikemer (22%) are the leading districts, together accounting for 55% of the province's total agricultural area. The main agricultural products of Muğla include olives, greenhouse tomatoes, citrus fruits, pine honey, almonds, pomegranates and aquaculture products. According to TÜİK 2020 data, the province ranks first in Türkiye in the production of fresh cowpea, fresh kidney beans and aquaculture products; second in sesame; third in lemon, almonds, table tomatoes and honey; fourth in oranges and pomegranates; and seventh in olive oil production.

In livestock production, cattle farming is concentrated in Milas (31%), Seydikemer (15%) and Yatağan (13%). In small ruminant farming, hair goats are the dominant species, with the highest livestock numbers recorded in Seydikemer. Muğla is also one of the world's significant centers for beekeeping, and Marmaris is widely known as the "World Capital of Pine Honey Production" due to its high level of pine honey production. In terms of aquaculture, Muğla ranks first in Türkiye in marine aquaculture production.

3.6.2. Industry and Commerce

The industrial sector in Muğla remains relatively limited despite the province's strong agricultural base, and the production structure is largely composed of small and medium-sized enterprises. Constraints in transportation infrastructure, difficulties in accessing national markets, and geographical conditions have limited the development of large-scale industrial investments. Industrial activities are mainly concentrated in the districts of Milas, Yatağan, Menteşe, Fethiye, Köyceğiz and Bodrum. Among these, Milas and Yatağan stand out for marble and natural stone production, while Bodrum and Fethiye are prominent for boat and yacht manufacturing.

Organized Industrial Zones (OIZs), which form the backbone of the province's industrial structure, reflect this spatial distribution. Milas OIZ hosts production focused on marble, natural stone and construction materials, while the Fethiye–Seydikemer Specialized OIZ for Agriculture-Based Industries stands out with its focus on aquaculture and greenhouse production. In addition, Yatağan OIZ contributes to industrial diversification through its energy and mining-oriented structure. Across the province, enterprises operating in sectors such as food processing, quarrying, textiles, forest products, metal goods and agricultural machinery production are distributed across different districts.

3.6.3. Tourism

Muğla ranks as the third most visited province in Türkiye after İstanbul and Antalya, standing out as a destination with strong tourism potential. The provincial economy is largely driven by tourism, and districts such as Marmaris, Bodrum, Fethiye, Datça, Köyceğiz, Ula, Ortaca and Dalaman constitute the main tourism development areas due to their high accommodation capacity, visitor numbers and tourism diversity. According to 2018 data, tourist arrivals to Muğla were most concentrated between June and September, during which arrivals increased by approximately 32–38%. In the same year, the province hosted a total of 2.8 million tourists, of which 54.3% entered through Dalaman Airport.

Muğla's rich natural and cultural assets, together with favorable climatic conditions, support tourism activities throughout the year and form the main driving force of the regional economy. The economic momentum created by tourism stimulates significant expansion in sectors such as accommodation, food and beverage services, transportation, trade and construction, making tourism a key structural component that enhances the province's economic diversity. In addition to sea–sand–sun (3S) tourism, Muğla also offers strong potential in alternative tourism segments including cultural tourism, agrotourism, congress tourism, health tourism, rural tourism and nature-based sports tourism.

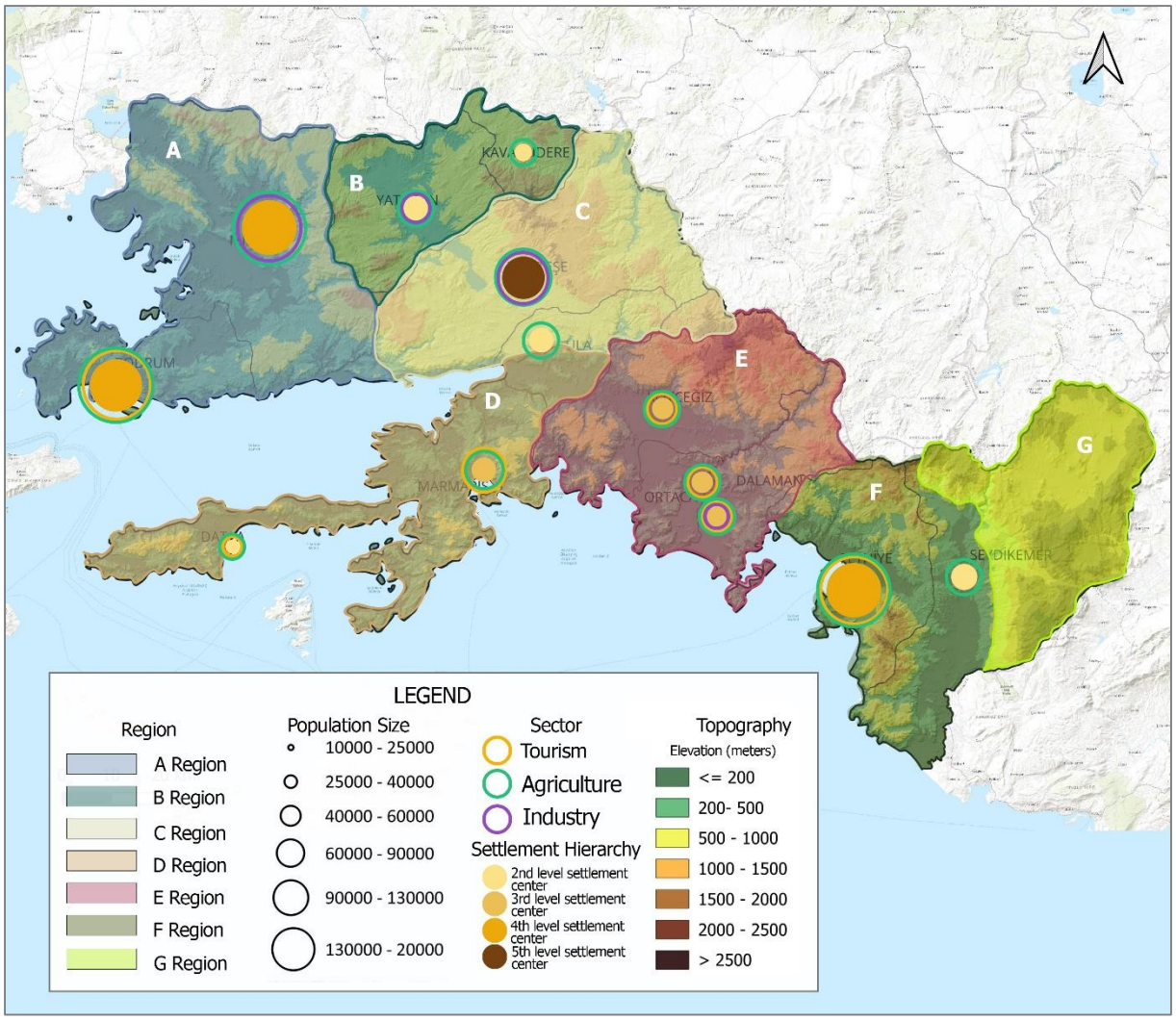
As of 2019, Muğla hosted 1,270 accommodation facilities certified by municipalities and the Ministry, offering a total capacity of 168,460 beds. In addition, 50 environmentally certified facilities, with 12,593 rooms and 27,311 beds, contribute to the development of sustainable tourism. In the same year, Muğla ranked as the third province in Türkiye in terms of overnight stays by international tourists with 8.9 million stays, and the leading province for domestic tourist overnight stays with 3.8 million. The province also had 102 Blue Flag beaches, 7 Blue Flag marinas and 1 Blue Flag yacht, indicating that approximately 22% of Türkiye's Blue Flag beaches are located in Muğla.

3.7. Zoning

The regional analysis map prepared for this study evaluates the prominent economic sectors, population sizes, spatial hierarchy levels and topographic differences across the districts of Muğla. The map illustrates the spatial concentration of tourism, agriculture and industrial activities across the province, while also revealing the distribution of population size and settlement hierarchy.

Table 3 Zone Characteristics

Region	District	Household	Population	2022 SEDI	Primary Sector	Industry	Agriculture
A	Bodrum	2,63	203.035	A+	Tourism - Agriculture	Boat and Yacht Manufacturing	Beekeeping, Field Crops, Perennial Crops (Olive, Anise)
	Milas	2,8	150.520	A-	Agricultural Industry	Marble and Natural Stone Production – Organized Industrial Zone (OIZ)	Vegetable Production, Fisheries, Beekeeping
B	Kavaklıdere	2,9	10.834	B-	Agriculture	-	Field Crops
	Yatağan	2,76	45.217	B+	Agricultural Industry	Energy and Mining	Field Crops
C	Menteşe	2,6	124.825	A-	Industry-Agriculture-Service	-	Field Crops
	Ula	2,48	27.392	B+	Agriculture	-	Field Crops
D	Marmaris	2,66	96.589	A+	Tourism - Agriculture	-	Beekeeping
	Datça	2,36	25.866	A-	Tourism - Agriculture	-	
E	Köyceğiz	2,77	41.205	B+	Tourism - Agriculture	-	Perennial Crops
	Ortaca	2,74	57.155	A-	Tourism - Agriculture	-	Perennial Crops
	Dalaman	2,73	51.088	A-	Tourism – Agriculture – Industry	-	Perennial Crops
F	Fethiye	2,84	182.280	A-	Tourism - Agriculture	Boat and Yacht Manufacturing	Vegetable Production
	Seydikemer	2,91	65.861	C+	Agriculture	Aquaculture and Greenhouse Production – OIZ	Vegetable Production
G	Seydikemer	2,91	65.861	C+	Agriculture	-	Vegetable Production



Map 6 Regional Zoning Analysis Map of Muğla (Prepared by İstanbul Enerji)

Coastal districts such as Bodrum, Marmaris, Fethiye, Dalaman and Datça constitute the main centers of the tourism sector and stand out as first- and second-tier settlement centers with high population densities. Districts such as Milas, Seydikemer, Ortaca and Köyceğiz have extensive agricultural hinterlands and are areas where agricultural activities are dominant. Although industrial activities are more limited, they are mainly concentrated around Yatağan, Milas and Menteşe. The slope and elevation values presented on the map also reflect the influential role of topography in the spatial distribution of economic sectors.

GREENHOUSE GAS INVENTORY

4

4. Greenhouse Gas Inventory

Monitoring and update activities have been carried out in line with climate change mitigation and sustainable development goals at both the institutional and city scales, as a continuation of the Sustainable Energy and Climate Action Plan prepared by Muğla Metropolitan Municipality in 2013.

Within the scope of this plan, 2024 was defined as the base year, and the greenhouse gas emission inventory was recalculated using updated data.

Table 4 Greenhouse Gas Inventory Calculation Data for Muğla

	Sector	Data Resources	Data Year
1	***Stationary Energy***		
1.1	Natural Gas	İGDAŞ, EPDK, Municipality	2024
1.2	Fuel Oil	EPDK, Municipality	2024
1.3	Electricity	ADM, EPDK, Municipality	2024
1.4	LPG	EPDK, Municipality	2024
2	***Transportation***		
2.1	Gasoline	EPDK, Municipality	2024
2.2	Diesel	EPDK, Municipality	2024
2.3	LPG	EPDK, Municipality	2024
2.4	Electricle Vehicle	EPDK, Municipality	2024
3	***Waste***		
3.1	Solid waste disposal	Municipality, Provincial Directorate of Environment, Urbanization and Climate Change	2024
3.2	Wastewater treatment and discharge	Municipality, MUSKİ	2024
4	***Agriculture, Forestry and Other Land Use***		
4.1	Enteric fermentation	TÜİK, Provincial Directorate of Agriculture and Forestry	2024
4.2	Urea Application	TÜİK, Provincial Directorate of Agriculture and Forestry	2024
4.3	Manure Management	TÜİK, Provincial Directorate of Agriculture and Forestry	2024

The inventory update studies were carried out in accordance with the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC), covering sectors such as energy, transportation, waste, agriculture and livestock, as well as other relevant sectors. The calculations were conducted in line with the methodologies published by the Intergovernmental Panel on Climate Change (IPCC). The study process was coordinated by the Muğla Metropolitan Municipality Department of Climate Change and Zero Waste, and implemented in cooperation with public institutions, universities, private sector representatives and civil society organizations. Through this process, a comprehensive and participatory approach was adopted that takes into account the region’s socio-economic structure, energy consumption profile and local environmental dynamics.

Figure 8 SECAP Internal and External Stakeholders of Muğla Metropolitan Municipality

This updated inventory has been prepared to support the monitoring of Muğla's low-carbon development pathway, enhance energy efficiency, and strengthen awareness of climate change mitigation efforts across the city. It also serves as a guiding and monitoring tool that encourages collective action among local authorities, citizens and stakeholder institutions.

4.1. Greenhouse Gas Inventory Methodology

The updated greenhouse gas inventory has been prepared to support the monitoring of Muğla's low-carbon development pathway, to enhance energy efficiency, and to strengthen awareness of climate change mitigation efforts across the city. It also serves as a guidance and monitoring tool that enables local authorities, citizens and stakeholder institutions to act collaboratively.

This study, conducted in cooperation with Muğla Metropolitan Municipality, constitutes a continuation and monitoring effort of the Sustainable Energy Action Plan prepared in 2013. The study aims to present the amount, sources and sectoral distribution of greenhouse gas emissions released into the atmosphere within a specific period across the province. The inventory has been prepared to monitor progress in Muğla's climate change mitigation efforts,

evaluate changes in greenhouse gas emissions, and support the updating of local strategies and action plans aimed at reducing emissions.

In updating the inventory, the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) was adopted as the primary methodological framework, and the BASIC/BASIC+ approach was applied in a manner consistent with the previous study. This methodology enables the calculation of emissions based on available datasets in line with the capacity of local governments.

The updated Muğla Greenhouse Gas Inventory has been evaluated according to GPC principles under four main sectors (stationary energy, transportation, waste, and agriculture and livestock) and across three scope levels, enabling comparative analysis with the previous period and the monitoring of emission trends.

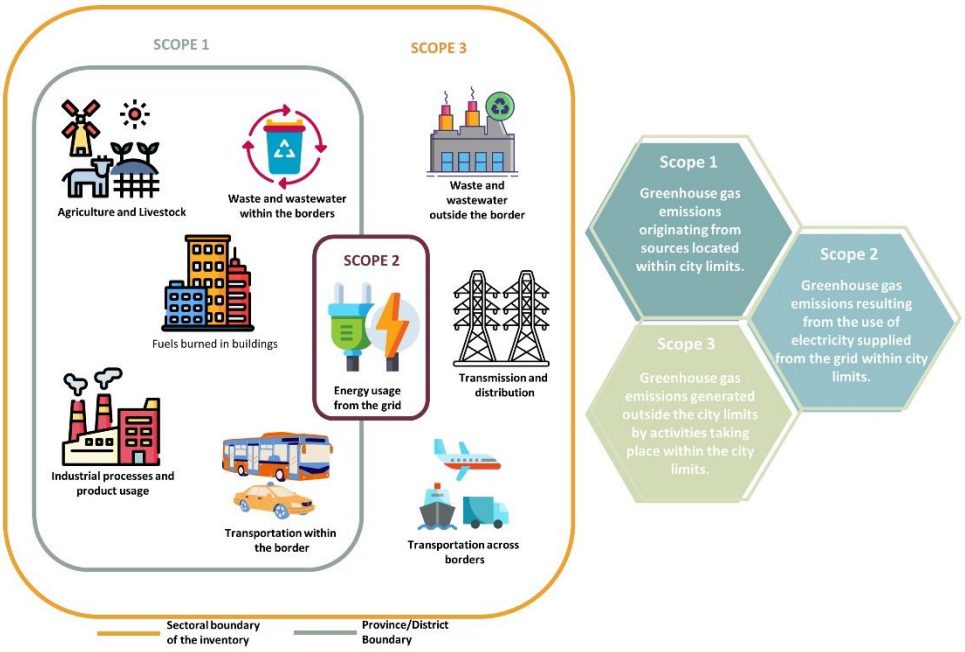


Figure 9 Inventory Scopes

Figure 9 illustrates how greenhouse gas emissions resulting from activities within the city boundaries are classified according to emission scopes (Scope 1, Scope 2 and Scope 3).

Scope 1 covers direct emissions occurring within the city boundaries, including emissions from stationary fuel consumption, industrial processes, agriculture and livestock activities, fuel consumption in buildings, and transportation taking place within the city.

Scope 2 refers to indirect emissions generated outside the city during the production of electricity that is consumed within the city. Scope 3 includes other indirect emissions associated with activities occurring outside the city boundaries but resulting from the city's operations, such as transportation, industrial processes, transmission and distribution activities, and externally managed wastewater treatment.

This classification provides a systematic framework for evaluating emission sources and forms the basis for the development of climate action plans at the city scale.

Table 5 Sectors and Sub-Sectors Included in the GHG Inventory

Reference No	Sector and Sub-sectors	Scope
1	**Stationary Energy**	
1.1	Residential buildings	
1.2	Commercial and institutional buildings and facilities	
1.3	Manufacturing industries and construction	
1.4	Energy industries	
1.5	Agriculture, forestry and fishing activities	
1.6	Other (Fugitive emissions from coal mining, oil and natural gas systems)	Data could not be obtained.
2	**Transportation**	
2.1	On-road Transportation	
2.2	Railways	Not occurring.
2.3	Aviation	
2.4	Off-road transportation	Included in the on-road Transportation Sector.
3	**Waste**	
3.1	Solid Waste Treatment and Disposal	
3.2	Biological Treatment of Waste	Not occurring.
3.3	Incineration and open burning	Not occurring.
3.4	Wastewater Treatment and Discharge	
4	**Industrial Processes and Product Use**	
4.1	Industrial Processes	Not included in the reporting.
5	**Agriculture, Forestry and Other Land Use**	
5.1		

Sectors Included in the Scope of Reporting

Sectors Included in the Inventory

4.2. Greenhouse Gas Inventory Summary

The greenhouse gas emission inventory of Muğla has been comprehensively examined under the main sectors of stationary energy, transportation, waste, and agriculture–livestock, and detailed analyses have been conducted for each sector.

Within the boundaries of Muğla, the Kemerköy, Yatağan and Yeniköy thermal power plants continue their operations. In order to calculate the greenhouse gas emissions resulting from electricity generation in these plants, the Muğla Provincial Environmental Status Report (2023) was used as the main reference. (The Muğla Provincial Environmental Status Report for 2024 has not yet been published.)

According to the GPC BASIC approach, the total greenhouse gas emissions calculated for Muğla for the year 2024 amount to 5,902,931 tCO_2e. (Fuel consumption used for electricity generation has not been included in the calculation.)

Table 6 Greenhouse Gas Emissions Inventory (Including Thermal Power Plants and Aviation)

Sectors	*GHG Emission (tCO_2e)*	*Percentage (%)*
Residential buildings	*1.004.345*	*%6,5*
Commercial and institutional buildings and facilities	*1.133.910*	*%6,8*
Industry	*259.338*	*%1,7*
Private Vehicles	*2.200.679*	*%13,8*
Municipal Fleet Vehicles	*25.860*	*%0,2*
Public Transport Vehicles	*11.782*	*%0,1*
Civil Aviation	*152.799*	*%0,9*
Solid Waste Treatment and Disposal	196.296	*%1,2*
Wastewater Treatment and Discharge	61.374	*%0,4*
Enteric Fermantation (CH_4)	551.115	*%3,5*
Manure Management (CH_4)	98.161	*%0,6*
Manure Management (N_2O)	67.530	*%0,4*
Chemical Fertilizers (N_2O)	74.413	*%0,5*
Fuel Consumption for Electricity Generation	*10.010.415*	*%63*
Agricultural Irrigation	*65.329*	*%0,4*
Total	***15.913.346***	***%100***

Emissions from energy production (thermal power plants) have been calculated within the greenhouse gas inventory for Muğla. However, since these facilities fall outside the direct authority and responsibility of local governments, they have not been included within the scope of the 2024 SECAP. For Muğla, the distribution of emissions across the stationary energy, transportation, and waste sectors indicates that, as shown in Table 6, emissions amount to 2,462,832 tCO_2e under stationary energy (residential, commercial and institutional buildings, industry, and agricultural irrigation), 2,391,122 tCO_2e under transportation (private vehicles, municipal service vehicles, public transport vehicles, and civil aviation), and 257,670 tCO_2e under waste (solid waste disposal and wastewater treatment and discharge).

Stationary Energy

In the stationary energy **sector**, energy use in residential buildings, commercial and **institutional buildings,** and **industrial facilities** was taken in account. Greenhouse gas emissions were calculated by analyzing **energy consumption** for building services such as heating, cooling, and lighting.

Transportation

In the **transportation** sector, greenhouse gas emissions across the district were **calculated by** considering road and air **transport activities**, including travel patterns and the types of fuel used.

Waste

In the **waste sector**, the effects of solid waste disposal and **wastewater treatment processes** on greenhouse gas emissions were examined. Emissions released at each stage of disposal and treatment were identified, and the total emission value for the waste sector was calculated.

Agriculture and Livestock

In the **agriculture** and **livestock** sector, the effects of **crop production activities** and **animal production** processes on greenhouse **gas emissions** were examined. Emissions arising at each stage of production were identified, and the sector's total emission value was calculated.

The total greenhouse gas emissions of Muğla have been analyzed in detail using internationally recognized calculation methodologies established by the Intergovernmental Panel on Climate Change (IPCC). Within the scope of the study, energy consumption, transportation activities, waste management, agriculture and livestock, and energy industry processes across the province were evaluated through a comprehensive and integrated approach.

The results of the Muğla greenhouse gas inventory indicate that the stationary energy and transportation sectors account for the largest share of total emissions. In particular, the stationary energy sector plays a decisive role due to emissions originating from residential heating, cooling, lighting and electricity consumption. Similarly, the transportation sector constitutes a significant share of emissions, with the intensive use of fossil fuels in road transport emerging as a key factor contributing to greenhouse gas emissions across the province.

Table 7 Muğla GHG Inventory

	GHG *(tCO_2e)*	*Percentage* *(%)*
Stationary Energy	*2.462.832*	*%49,7*
Transportation	*2.238.322*	*%45,1*
Waste	*257.670*	*%5,2*
Total	***4.958.824***	***%100***

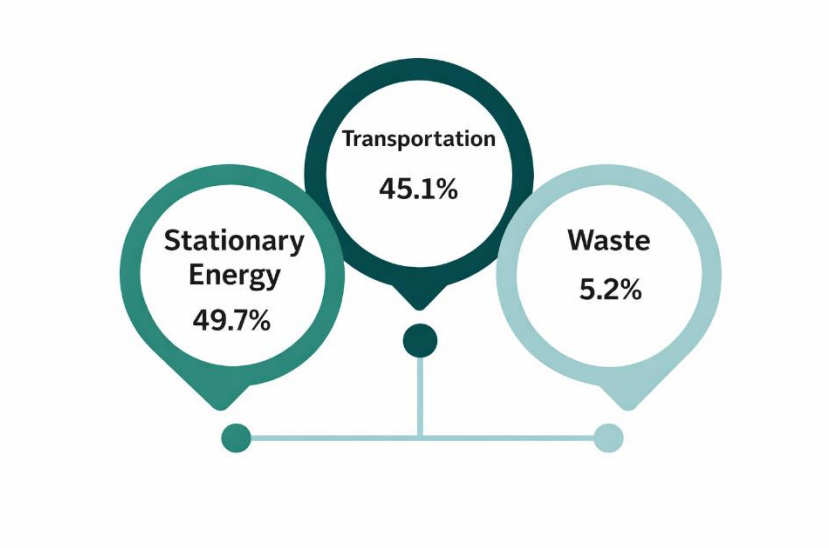


Figure 10 GHG Inventory Distribution in Muğla

In the analyses conducted for Muğla, it was determined that greenhouse gas emissions from the Stationary Energy, Transportation, and Waste sectors, calculated in line with the BASIC approach, contribute to the overall increase in total emissions through their respective sector-specific activities and processes.

Emissions originating from agriculture and livestock were also calculated separately; however, since this sector is not included within the BASIC calculation scope, it has been presented as an additional category.

4.2.1. Stationary Energy

In Muğla, the Stationary Energy sector covers a wide range of energy consumption activities, from residential buildings and industrial facilities to commercial establishments and public institutions. The greenhouse gas (GHG) emissions assessed under this sector primarily result from the use of electricity, natural gas, LPG, coal, and other fossil fuels.

The economic and spatial prominence of the tourism sector in Muğla indicates that it likely contributes significantly to the greenhouse gas inventory. However, due to the limited availability of sector-specific data, emissions originating directly from tourism activities could not be calculated under a separate category. Nevertheless, the fact that emissions from commercial and institutional buildings are higher than those from residential buildings suggests that the energy consumption of tourism facilities plays a decisive role in this difference. In addition, considering the significant seasonal population fluctuations between summer and winter, the increase in energy consumption associated with the rising tourist population, particularly between June and September, indirectly reflects the weight of the tourism sector in the province's overall greenhouse gas emissions. Across the province, heating, cooling, lighting, and production processes in buildings constitute a large share of total energy demand and directly contribute to emission increases. Furthermore, municipal service buildings, infrastructure facilities, and street lighting systems are also important components of stationary energy-related emissions.

The high share of fossil fuels in energy production and consumption in Muğla increases the province's carbon intensity and significantly affects greenhouse gas emission levels. Therefore, promoting renewable energy investments and expanding energy efficiency-oriented policies represent critical priorities for supporting Muğla's transition toward a climate-friendly development pathway.

Table 8 2024 Stationary Energy GHG Inventory for Muğla

Sectors	*GHG (tCO_2e)*	*Percentage (%)*
Residential buildings	*1.004.345*	*%40,8*
Commercial and institutional buildings and facilities	*1.133.910*	*%46*
Industral Buildings	*259.338*	*%10,5*
Agricultural Irrigation	*65.239*	*%2,7*
Total	***2.462.832***	***%100***

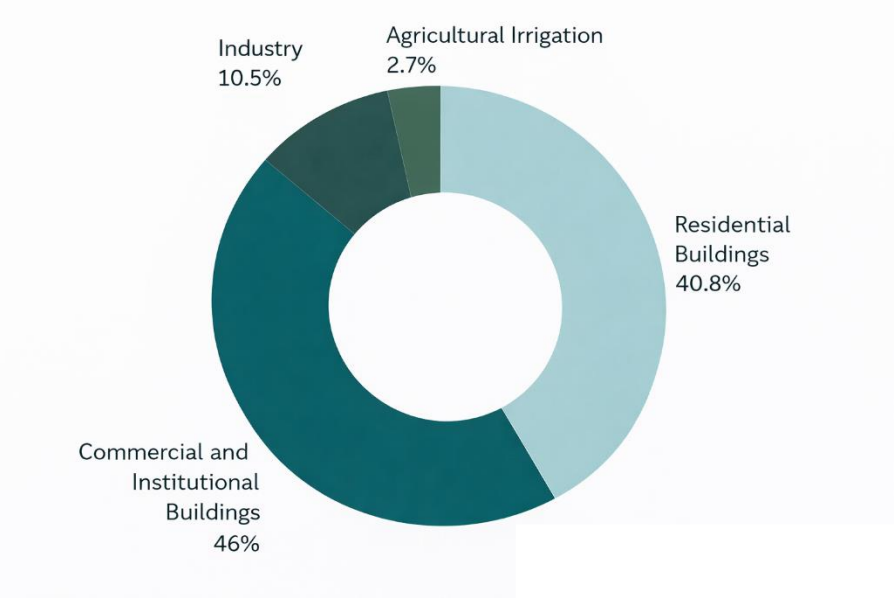


Figure 11 Distribution of Stationary Energy GHG Emissions

When the fuel-based distribution of greenhouse gas emissions in the stationary energy sector in Muğla is examined, electricity consumption is observed to have the largest share. Electricity consumption reaches approximately 2,186,752 tCO_2e, accounting for 88.8% of total emissions in the stationary energy sector. Since 2024 coal consumption data for residential buildings could not be obtained, only coal assistance data were included in the calculations.

Table 9 Stationary Energy GHG Emissions by Energy Source

Stationary Energy Activity Sectors	*GHG Emission (tCO_2e)*	*Percentage (%)*
Natural Gas	207.689	8,4%
Electricity	2.186.752	88,8%
Coal	182	<0,1%
Liqiud Petroleum Gas (LPG)	68.209	2,8%
Total	**2.462.832**	**100%**

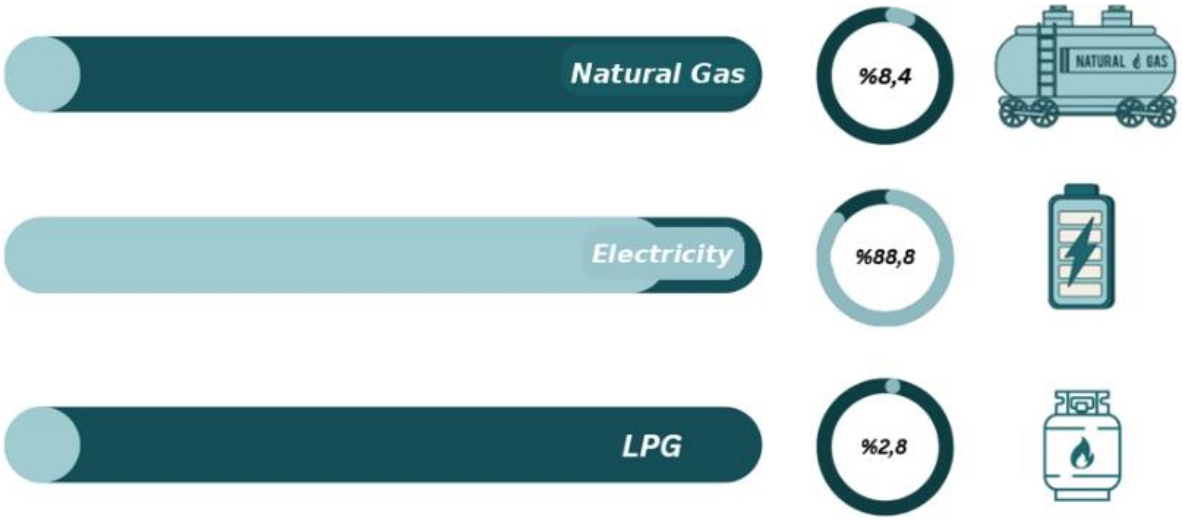


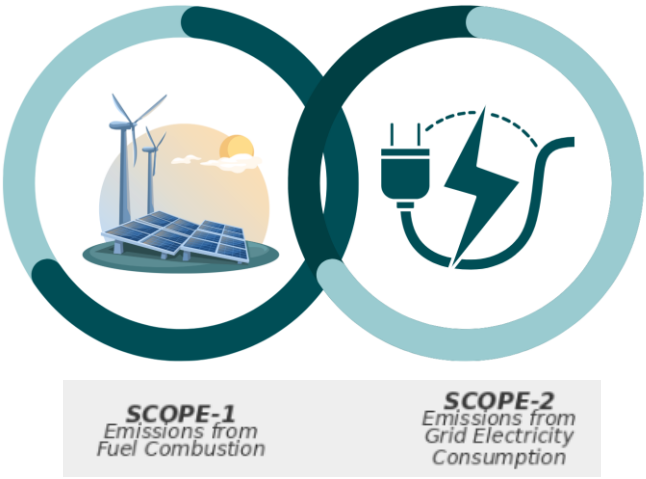
Figure 12 Stationary Energy GHG Emissions by Energy Source Distribution

In Muğla, the high concentration of residential, commercial, and public buildings leads to the prominence of electricity consumption within the stationary energy sector. Across the province, electricity is widely used as a primary energy source for heating, cooling, lighting, appliance use, and production processes.

In particular, improving living standards in residential areas, the increased use of air conditioning during the summer months, and the rise in energy demand during the tourism season significantly increase the share of electricity-related emissions. This situation strengthens the role of the stationary energy sector in Muğla's total greenhouse gas emissions and further highlights the importance of energy efficiency policies.

4.2.2. Transportation

In Muğla, transportation-related greenhouse gas emissions arise from the direct consumption of fuels used in road transport, aviation and public transport vehicles, as well as from the electricity drawn from the grid for electric transportation systems.



The increasing number of vehicles, the transport infrastructure largely dependent on fossil fuels, and the rising traffic density during tourism seasons significantly increase the emission

share of the transportation sector. In addition, the growth in population during the tourism season leads to higher transportation-related energy consumption across the province.

Moreover, the still limited number of electric vehicles indicates that the sector's potential to reduce its carbon footprint has not yet been fully realized.

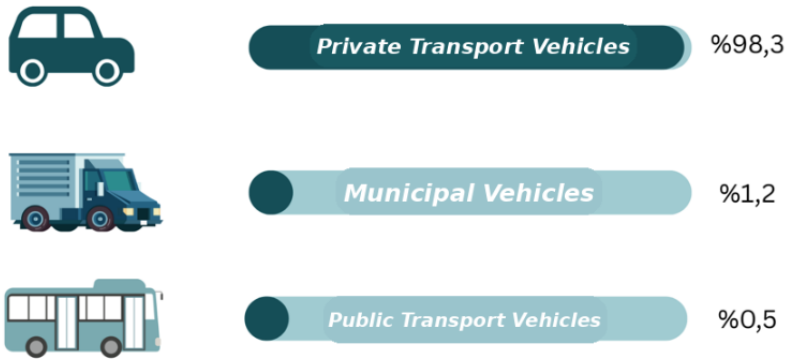


Figure 13 GHG Emissions Inventory Distribution in the Transportation Sector

In Muğla, transportation-related greenhouse gas emissions mainly originate from private vehicles, municipal service vehicles, and public transportation systems operating in road transport, as well as aviation activities.

According to the analyses conducted, the total greenhouse gas emissions from the transportation sector in Muğla are approximately 2,238,322 tCO_2e. Of these emissions, 98.3% originate from private vehicles, 1.2% from municipal vehicles, and 0.5% from public transportation vehicles.

The high level of private vehicle ownership, the increase in tourism-related mobility during the summer months, and the widespread use of fossil fuel-based transportation across the province constitute the main drivers of emissions in this sector. In contrast, the emission share of municipal service vehicles and public transportation fleets remains relatively low. However, it is expected that these emissions will decrease further in the coming years with the integration of electric and low-emission vehicles into the system.

Table 10 Distribution of Transportation-Related GHG Emissions

Transportation Activity Sectors	*GHG Emission (tCO_2e)*	*Percentage (%)*
Private Vehicles	*2.200.680*	*98,3%*
Municipal Fleet Vehicles	*25.860*	*1,2%*
Public Transport Vehicles	*11.782*	*0,5%*
Total	***2.238.322***	***100%***

Table 11 GHG Emissions in the Transportation Sector by Energy Type

Transportation Fuel Source	*GHG Emission (tCO_2e)*	*Percentage (%)*
Diesel	*1.750.689*	*78,1%*
Gasoline	*420.477*	*18,8%*
LPG	*64.980*	*2,9%*
Electricity	*1.205*	*0,1%*
Fuel Oil	*971*	*0,1%*
Total	***2.238.322***	***100%***

When the transportation sector emissions inventory in Muğla is examined, it is observed that the highest level of emissions by fuel type originates from diesel consumption. According to the analysis results, diesel accounts for 78.1% of total emissions, making it the primary source of greenhouse gas emissions in the transportation sector.

While other fuel types such as gasoline and LPG contribute at lower levels, the high number of diesel-powered vehicles and their intensive use constitute the main reasons why diesel remains the dominant emission source in the sector.

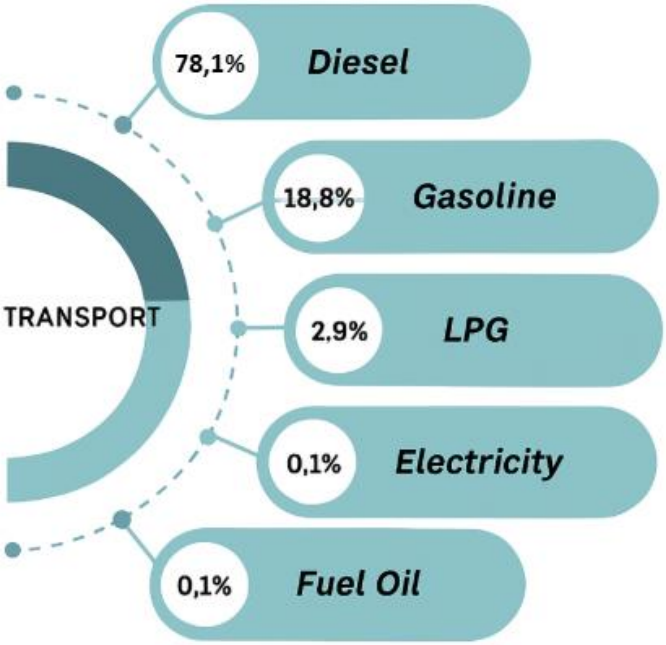


Figure 14 Transportation Sector GHG Emissions by Fuel Type

4.2.3. Waste

Solid waste characterization in Muğla is a comprehensive study carried out to determine the types, quantities, and physical characteristics of the waste generated within the provincial boundaries.

Table 12 Solid Waste Characterization Distribution

Waste Component	*Muğla Overall Winter Average*	*Muğla Overall Summer Average*	*Annual Average*
Kitchen Waste	*50,6%*	*46,5%*	*48,6%*
Paper	*4,9%*	*4,4%*	*4,6%*
Cardboard	*7,0%*	*7,2%*	*7,1%*
Bulky Cardboard	*2,5%*	*3,5%*	*3,0%*
Plastic	*10,8%*	*13,6%*	*12,2%*
Glass	*5,7%*	*5,5%*	*5,6%*
Metal	*3,8%*	*3,4%*	*3,6%*
Bulky Metal	*0,3%*	*0,3%*	*0,3%*
Waste Electrical and Electronic Equipment (WEEE)	*1,2%*	*0,8%*	*1,0%*
Hazardous Waste	*0,0%*	*0,0%*	*0,0%*
Park and Green Waste	*7,1%*	*8,1%*	*7,6%*
Other Non-Combustible Waste	*1,9%*	*1,0%*	*1,5%*
Other Combustible Waste	*4,1%*	*5,7%*	*4,9%*
Other Bulky Combustible Waste	*0,0%*	*0,0%*	*0,0%*
Other Bulky Non-Combustible Waste	*0,0%*	*0,0%*	*0,0%*
Other (Excluding the Above Groups)	*0,0%*	*0,0%*	*0,0%*

This process is of great importance for the development of waste management policies, increasing recycling rates, and reducing environmental impacts. In Muğla, greenhouse gas emissions from the waste sector are evaluated under two main categories: solid waste management and wastewater treatment. A portion of the municipal solid waste generated within the provincial boundaries is disposed of at sanitary landfill sites operated by neighboring municipalities. Similarly, emissions generated during the treatment of wastewater collected within the province are also reported within this scope. Indirect emissions (Scope 3) from these activities are calculated based on disposal and treatment processes occurring outside the provincial boundaries.

According to the calculations, the total greenhouse gas emissions from the waste sector in Muğla are approximately 257,669.52 tCO_2e. Of this amount, approximately 196,295.83 tCO_2e originate from solid waste disposal, while 61,373.69 tCO_2e result from wastewater treatment processes.

Table 13 Distribution of GHG Emissions in the Waste Sector

Waste	*GHG Emission (tCO_2e)*	*Percentage (%)*
Solid Waste Disposal	196.296	76,2%
Wastewater Treatment	61.374	23,8%
Total	**257.670**	**100%**

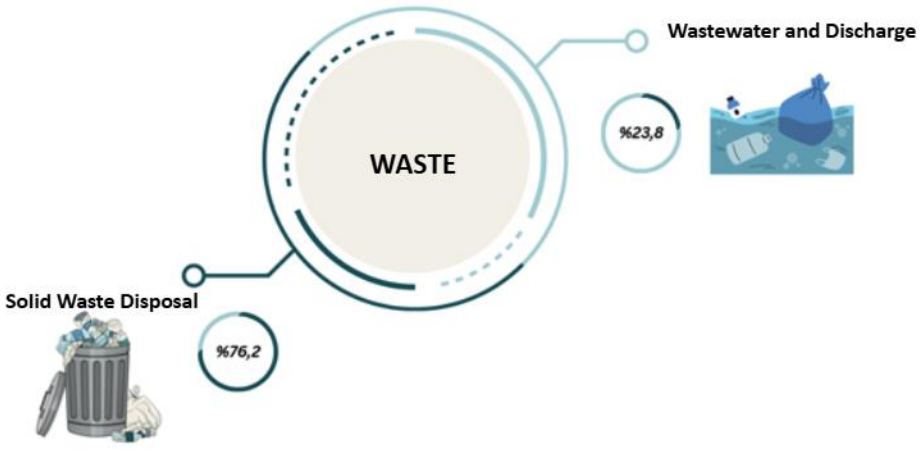


Figure 15 Distribution of GHG Emissions in the Waste Sector

4.2.4. Agriculture and Livestock

Agriculture and livestock activities constitute a critical share of the greenhouse gas inventory, particularly due to emissions of methane (CH_4) and nitrous oxide (N_2O). The inventory study

indicates that the main emission sources in this sector are enteric fermentation, manure management, and the use of chemical fertilizers. In this context, the total emissions from agriculture and livestock in 2024 are calculated as 791,219 tCO_2e.

The emission distribution clearly highlights the dominant role of livestock activities within the sector. Enteric fermentation alone accounts for 69.7% of total emissions, making it the most significant source. This reflects the strong influence of both cattle and small ruminant populations on methane production.

Emissions from manure management processes, including methane and nitrous oxide, contribute 12.4% and 8.5%, respectively. Together, these sources represent approximately 21% of total sectoral emissions, becoming particularly prominent in regions with intensive livestock production. Meanwhile, N_2O emissions from chemical fertilizer use account for 9.4% of total emissions, emphasizing the importance of nitrogen management strategies in agricultural practices.

Table 14 Distribution of GHG Emissions in the Agriculture and Livestock Sector

Agriculture and Livestock	*GHG Emission (tCO_2e)*	*Percentage (%)*
Livestock	**716.806**	**90,6%**
Enteric Fermantation (CH_4)	551.115	69,7%
Manure Management (CH_4)	98.161	12,4%
Manure Management (N_2O)	67.530	8,5%
Agriculture	**74.413**	**9,4%**
Chemical Fertilizers (N_2O)	74.413	9,4%
Total	**791.219**	**100%**

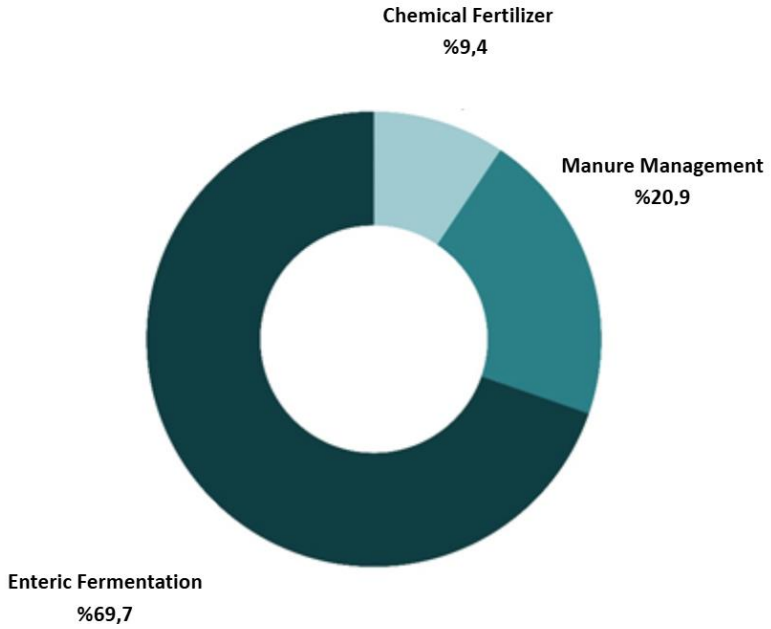


Figure 16 Distribution of GHG Emissions in the Agriculture and Livestock Sector

4.3. Muğla Metropolitan Municipality Corporate Greenhouse Gas Inventory

Within the scope of the Sustainable Energy and Climate Action Plan (SECAP) studies, the Muğla Greenhouse Gas Inventory for 2024 has been prepared; in parallel, the corporate greenhouse gas inventory of Muğla Metropolitan Municipality (MMM) has also been calculated. This study has been conducted in line with corporate greenhouse gas inventory accounting principles and relevant national and international standards, with the aim of identifying Scope 1 and Scope 2 emissions and their sources arising from the activities of Muğla Metropolitan Municipality.

Within the scope of the report, all service units, affiliated organizations, and facilities under the authority and responsibility of Muğla Metropolitan Municipality have been examined, and only emission sources under the direct control of the Municipality have been included in the assessment.

The primary objective of this report is to identify the greenhouse gas emission profile of Muğla Metropolitan Municipality and its affiliated institutions, and to provide a basis for strategic decision-making processes aimed at emission reduction. The results of the study are intended to serve as an input for the Greenhouse Gas Reduction Roadmap and/or Climate Change Strategy Documents to be developed by the Municipality.

Prepared based on 2024 data, this report aims to identify areas with greenhouse gas reduction potential within the Municipality's operations, define priority mitigation actions, and ensure that the results are shared with stakeholders in a transparent, consistent, and comparable manner.

Within the scope of the greenhouse gas inventory study, a methodological approach consistent with previous periods has been adopted to ensure data continuity and comparability, and the results for 2024 have been calculated to reflect the current status of emissions arising from the corporate activities of Muğla Metropolitan Municipality.

Corporate	*Scope 1* *(Direct Greenhouse Gas Emissions)*	*Scope 2* *(Indirect Greenhouse Gas Emissions from Purchased Energy)*
Muğla Metropolitan Municipality	24.398	2.764
Total		**27.192**

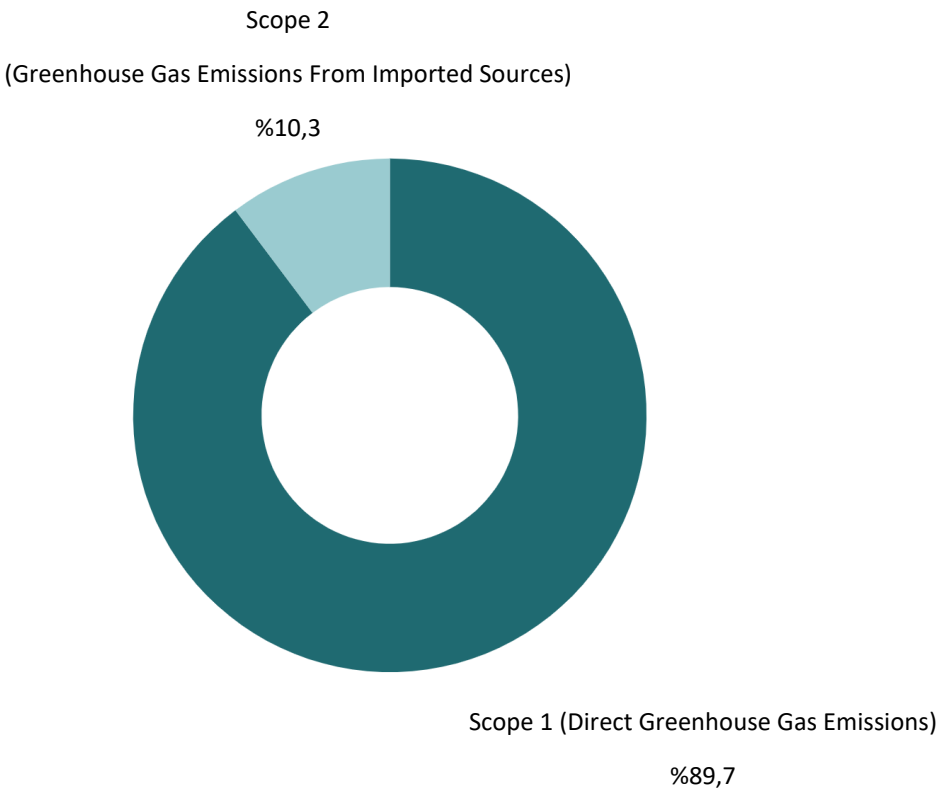


Figure 17 Corporate GHG Emissions Distribution

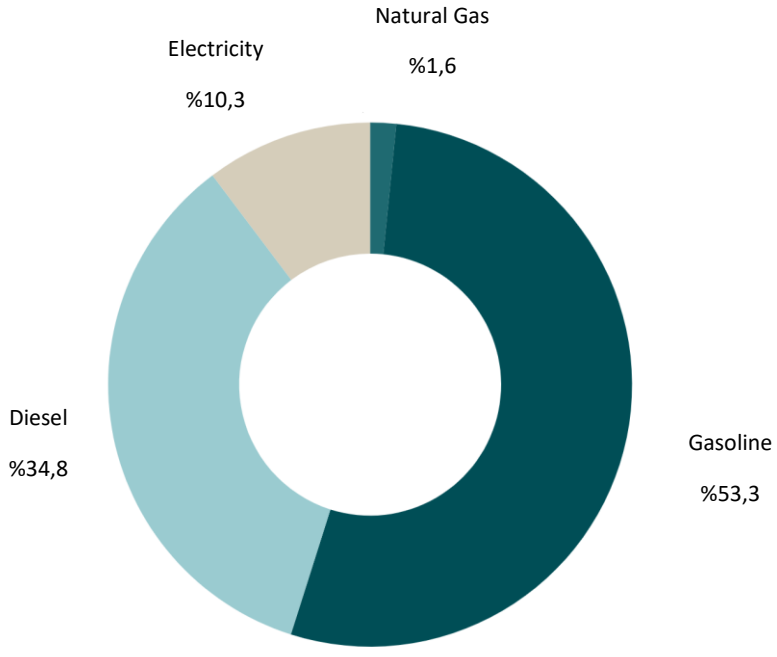


Figure 18 Corporate GHG Emissions by Source

4.4. Annual Comparison of Corporate and Community-Scale Greenhouse Gas Inventories (2013–2024)

The greenhouse gas inventory studies of Muğla provide a fundamental basis for the strategic planning and decision-making processes of local authorities within the scope of climate change mitigation. In this context, city-scale greenhouse gas emissions and those arising from the corporate activities of Muğla Metropolitan Municipality have been evaluated comparatively based on the years 2013 and 2024.

In the 2013 greenhouse gas inventory, a significant share of urban emissions originated from electricity consumption, road transportation, and waste management activities. Corporate greenhouse gas emissions were mainly associated with fuel use in municipal services, energy consumption in municipal facilities, and core service operations.

The 2024 greenhouse gas inventory indicates a notable increase in urban energy demand, driven by both population growth and the intensification of tourism activities in Muğla. However, improvements in waste management infrastructure have played an important role in controlling the rate of emission increase. When the sectoral distribution of emissions at the city scale is examined, it is observed that emissions from transportation and stationary energy have increased, while emissions from waste management have shown a declining trend.

Table 15 Comparison of City-Scale Greenhouse Gas Emissions: 2013–2024

Sectors	GHG Emission (tCO_2e)	
	2013	**2024**
Stationary Energy	1.312.180	2.462.832
Transportation	934.689	2.238.322
Waste	953.468	257.670
Agriculture and Livestock	-	791.219
Energy Production	7.290.532	10.010.415
Total	10.490.869	15.760.458

Table 16 Comparison of Corporate-Scale Greenhouse Gas Emissions: 2013–2024

Sectors	GHG Emission (tCO_2e)	
	2013	**2024**
Scope 1 (Direct Greenhouse Gas Emissions)	442.881	24.398
Scope 2 (Indirect Greenhouse Gas Emissions from Purchased Energy)	789	2.794

In conclusion, the 2013–2024 comparison indicates that greenhouse gas emissions across various sectors in Muğla Province have increased in absolute terms. Conversely, a significant reduction is observed in corporate greenhouse gas emissions. This decrease is attributed to emissions originating from municipal solid waste disposal sites under the Metropolitan Municipality during the inventory year which accounted for 84% of the corporate inventory and the subsequent phased closure of these sites, effectively eliminating a major source of emissions.

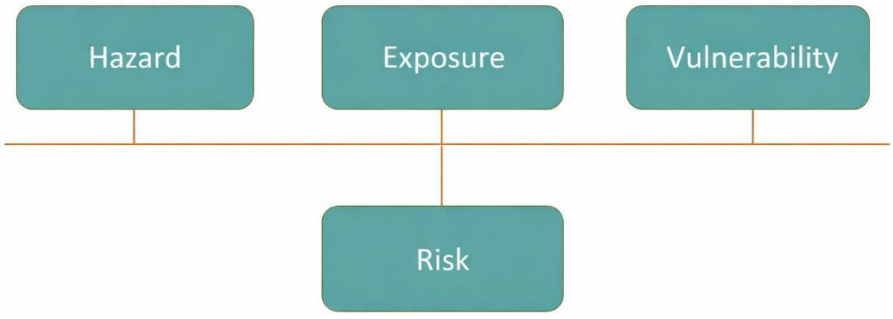
CLIMATE CHANGE ADAPTATION

5

5. Climate Change Adaptation

Climate change today is no longer merely a potential future risk; its impacts are increasingly tangible and demand active management. Events such as intensified heatwaves, concentrated extreme precipitation over shorter periods, prolonged droughts, and a rising frequency of wildfires exert direct pressure on settlements, water resources, agricultural production, and ecosystems. Consequently, climate change adaptation is considered a strategic management approach aimed not at passively observing climate impacts, but at preparing for them, mitigating damage, and safeguarding societal well-being. The Intergovernmental Panel on Climate Change (IPCC) defines adaptation as "adjustments in human or natural systems in response to actual or expected climate stimuli or their effects, aimed at moderating harm or exploiting beneficial opportunities" (IPCC, Sixth Assessment Report – AR6, 2022). The United Nations Framework Convention on Climate Change (UNFCCC) frames adaptation as a core policy component in climate risk management, emphasizing its implementation at both national and local levels (UNFCCC, Adaptation Framework, 2010).

The scientific basis of adaptation efforts relies on the concepts of hazard, exposure, sensitivity, adaptive capacity, and vulnerability. According to the IPCC, a hazard is a potentially damaging physical event or process generated by the climate system (e.g., heatwaves, floods, droughts, wildfires) (IPCC, AR6 Glossary, 2022). Exposure refers to the spatial presence of populations, settlements, agricultural lands, or ecosystems subjected to these hazards. Sensitivity encompasses the characteristics that determine the degree to which exposed assets are affected; for instance, elderly populations exhibit high sensitivity to heatwaves, while irrigated agriculture is particularly vulnerable to drought. Adaptive capacity reflects the ability to cope with and adjust to these impacts (IPCC, AR6 Working Group II, 2022). When considered together, vulnerability increases in contexts where exposure and sensitivity are high and adaptive capacity is limited. Within the IPCC risk framework, climate risk arises from the interaction of hazard × exposure × vulnerability (IPCC, AR6 Risk Assessment Framework, 2022). Thus, risk must be assessed not only in terms of the presence of a hazard but also regarding whom, which sectors, and which geographic areas it affects.



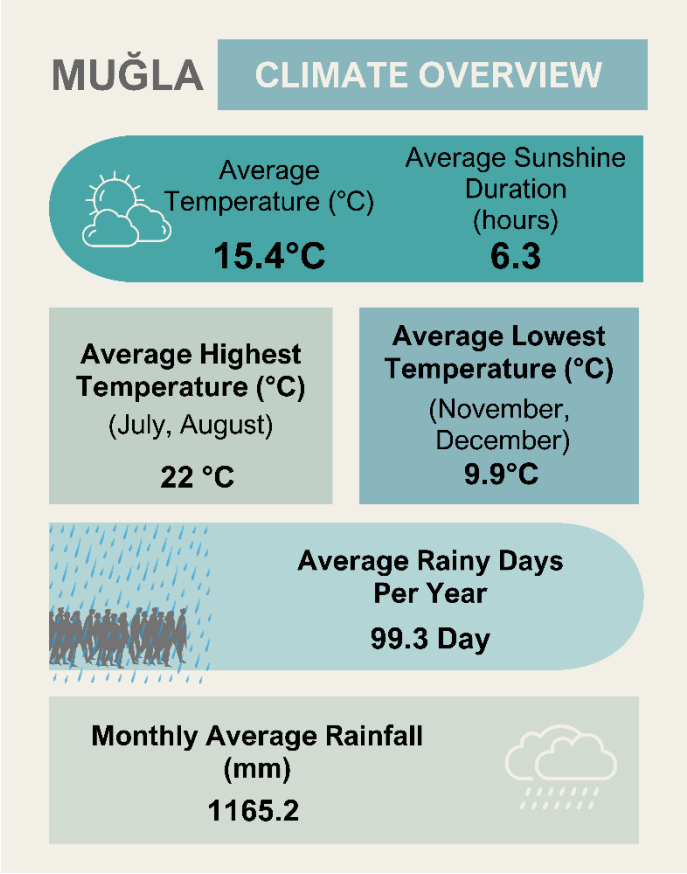
In practice, adaptation encompasses a range of measures aimed at reducing these risk components, including ecosystem-based solutions, water management strategies, enhancing infrastructure resilience, strengthening early warning systems, land-use planning, disaster risk management protocols, and capacity-building initiatives. The World Meteorological Organization (WMO) reported in 2023 that planned adaptation actions can reduce climate-related disaster losses by 50–60% (WMO, State of the Global Climate Report, 2023). In this

regard, adaptation policies play a critical role not only in environmental sustainability but also in ensuring economic and social resilience.

5.1. Muğla Climate Overview

Muğla is located within a climate zone characterized by typical Mediterranean climate conditions, with hot and dry summers and mild, rainy winters. While the coastal areas experience long and hot summer seasons, temperatures decrease in inland regions with increasing elevation, resulting in a cooler climatic character.

High annual sunshine duration, the concentration of precipitation predominantly in the winter months, and the pronounced summer drought are the key factors shaping the city's climate structure. The rapidly varying topography over short distances, comprising coastal plains, valleys, and mountainous areas, enables the formation of diverse microclimatic conditions. These variations directly influence Muğla's natural ecosystems, agricultural patterns, and socio-economic activities.



Muğla's long-term climate characteristics, based on the Turkish State Meteorological Service's 1991–2020 climatological normals, exhibit a typical Mediterranean climate pattern. The annual average temperature is approximately 15.4°C, with temperatures rising significantly during the summer months and reaching peak values in July–August. During the winter season, average temperatures decrease, with November–December standing out as the period with the lowest temperatures. An average sunshine duration of 6.3 hours per day

throughout the year indicates a high solar energy potential for the region, creating a significant advantage for tourism, agriculture, and renewable energy applications.

The precipitation regime shows strong seasonal variability; the annual average total precipitation is nearly 1.165 mm, with the majority occurring during the winter months. In contrast, summers are distinctly dry, which creates critical planning needs in terms of sustainable water resource management, agricultural production, and wildfire risk. These indicators highlight that climate change adaptation efforts in Muğla should particularly focus on rising temperatures, summer drought, and water management.

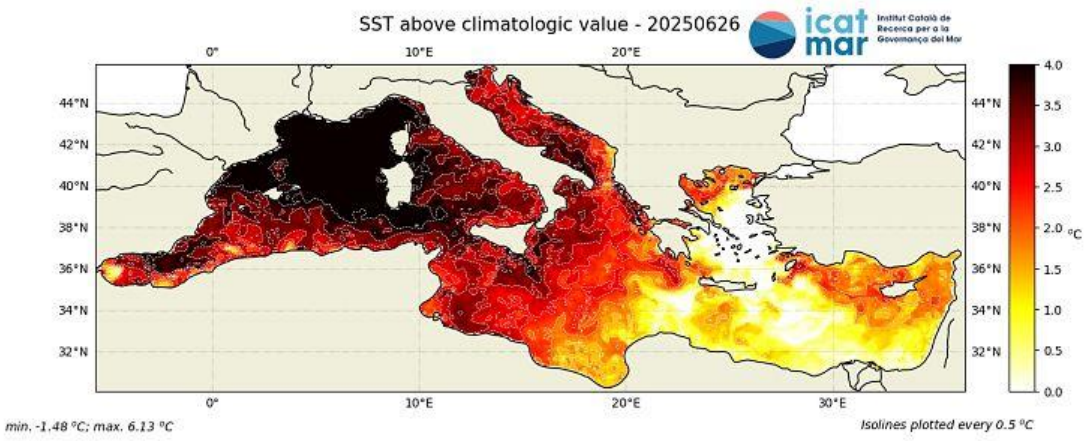
5.2. Climate Change Risks in Muğla

Muğla Province exhibits the characteristic features of a Mediterranean climate due to its geographical location, topographic diversity, and coastal–inland interactions. According to the Turkish State Meteorological Service's 1991–2020 climatological normals, the annual average temperature is 15.4°C, while the annual average total precipitation is approximately 1,165 mm. However, recent observations indicate that temperatures, particularly in coastal areas, are exceeding long-term averages.

Within the scope of this study, coastal-dominated stations with observation periods of 10 years or less show an annual average temperature of 18.7°C. The higher short-term average can be attributed both to the spatial characteristics of these stations, primarily representing low-elevation coastal areas and to the clear warming signal reflected in recent measurements due to increasing temperature trends. The discrepancy between long-term climatological normals and current temperature averages indicates that the impacts of climate change are already being observed in Muğla (MGM Climatological Normals 1991–2020; SECAP study station analysis).

5.2.1. Temperature Rise

One of the most prominent indicators of climate change in the Mediterranean Basin is the increasing frequency and intensity of heatwaves, along with the prolongation of summer droughts. In the IPCC AR6 report, the Mediterranean region is identified as "one of the climate change hotspots with high vulnerability," and it is emphasized that summer temperatures in the region are increasing at a rate above the global average.



Map 7 Mediterranean Sea Surface Temperature Map, 2025 (ICATMAR, 2025)

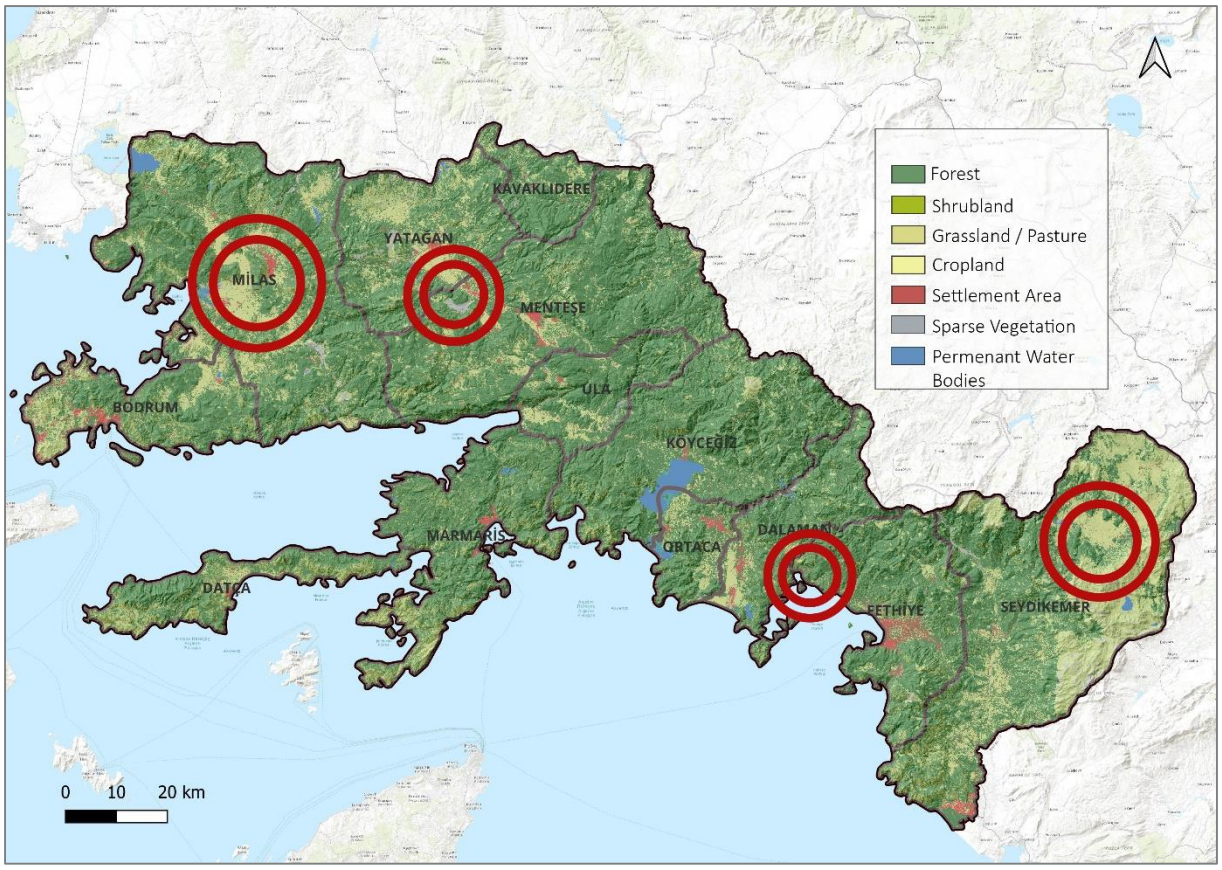
Muğla is among the provinces with high vulnerability to these trends due to its extensive forest cover, long coastline, and complex land-use structure. In particular, average maximum temperatures exceeding 30°C during July-August place significant pressure on agricultural production, tourism intensity, energy demand, and public health.

In urban areas, increasing building density and the expansion of impervious surfaces intensify the local urban heat island effect; this limits nighttime cooling and elevates health risks. As future projections indicate a continued rise in temperatures, adaptation measures such as shading, green infrastructure, permeable surface applications, and behavioral protection strategies are of critical importance.

5.2.2. Water Scarcity and Drought

Another key risk group in Muğla is drought and water scarcity. Precipitation data from the Turkish State Meteorological Service (TSMS) indicate a pronounced seasonal distribution, with the majority of rainfall occurring during the winter months. The near absence of precipitation in summer, combined with population increases during the tourism season, leads to higher drinking water consumption and greater demand for agricultural irrigation.

In the “Muğla Province Vulnerability and Risk Analysis (2022)” report, drought indices were assessed using the ERA5-Land dataset, highlighting an increased likelihood of agricultural water stress across the province, particularly during the summer–autumn period. The Dalaman Plain, Seydikemer, Ortaca, and the Milas region are identified as priority risk areas due to their high irrigation demand. Disruptions in precipitation patterns driven by climate change may lead to impacts such as declining groundwater levels, salinization, and reduced agricultural productivity.



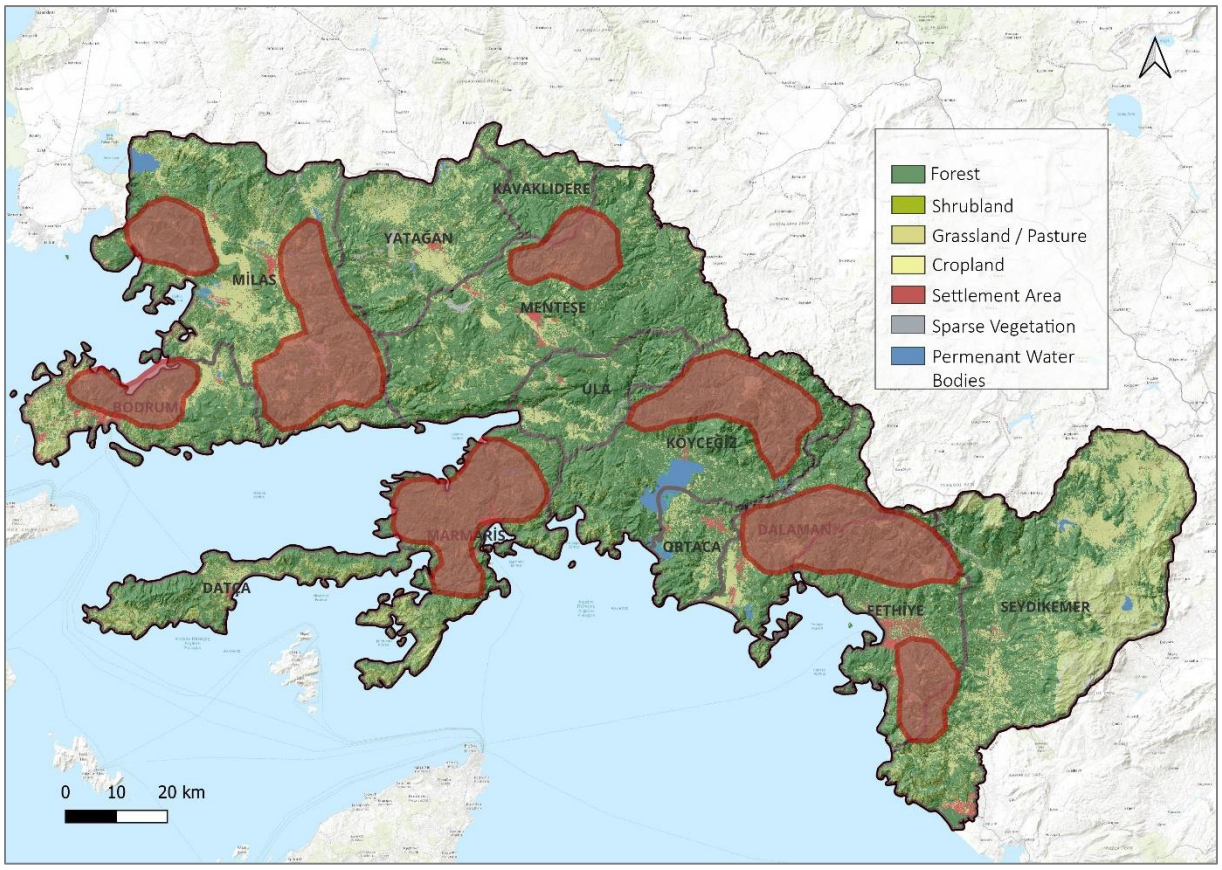
Map 8 Regions at Risk of Water Scarcity and Drought

5.2.3. Wildfires

Wildfires constitute the most critical risk for Muğla. The province is among the highest wildfire-risk regions in Türkiye, and the large-scale fires experienced in 2021 affected extensive areas.

In the risk analysis report, temperature anomaly maps, historical fire occurrences, prevailing wind patterns, and combustible biomass density were evaluated together; as a result, the areas surrounding Marmaris, Köyceğiz, Milas, Bodrum, and Fethiye were identified as highly sensitive to wildfires. The combination of rising temperatures, prolonged dry summer conditions, and strong winds creates a compound hazard cycle that increases both the likelihood of ignition and the rate of fire spread.

Wildfire risk has not only ecological impacts but also economic (loss of tourism revenues), social (settlement safety), and climatic (carbon emissions and loss of carbon sinks) consequences. Therefore, mitigation and adaptation strategies must be addressed in an integrated manner.

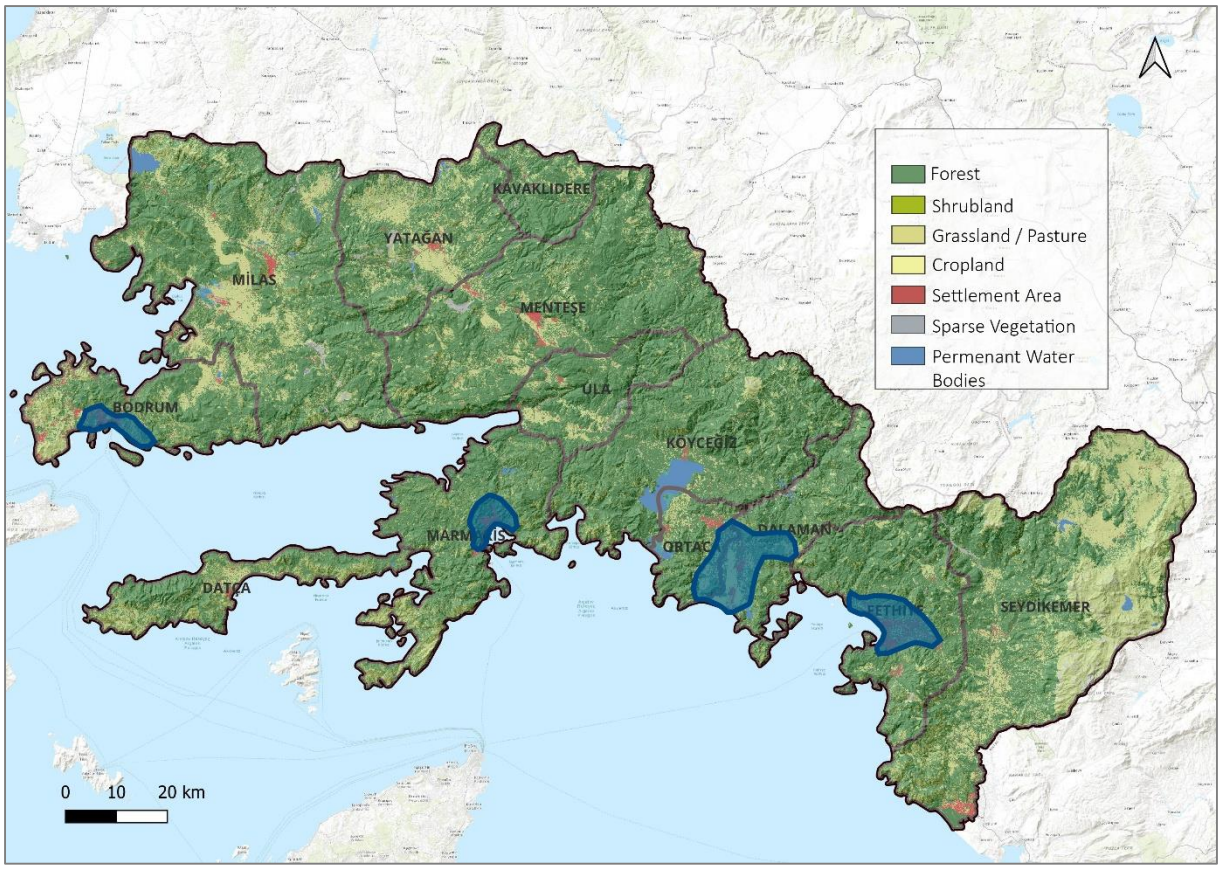


Map 9 Areas with High Wildfire Risk

5.2.4. Extreme Precipition and Floods

Flooding and flash flood events driven by extreme precipitation in Muğla are particularly evident in coastal districts and in areas where stream basins intersect with densely populated settlements. The "Muğla Province Vulnerability and Risk Analysis (2022)" report identifies irregularities in the precipitation regime and the increasing occurrence of high-intensity rainfall over short durations as a critical adaptation issue across the province. In particular, the surroundings of Fethiye, Bodrum, Marmaris, Ortaca, and Dalaman exhibit high flood sensitivity due to past observations and their geographical and topographic characteristics.

Recent events further confirm this risk profile. The Fethiye floods of 2018 and 2020 caused streets and underpasses in the district center to be inundated, disrupted transportation, and led to damage in residential areas. In Bodrum, intense rainfall events in 2019, 2021, and 2023 resulted in stream overflows, demonstrating that flood risk places significant pressure on settlements and tourism facilities, particularly in Konacık, Bitez, and Turgutreis. In Marmaris, following the heavy rainfall event in 2022, flash flooding occurred rapidly in the city center, with increased surface runoff and the expansion of impermeable surfaces placing additional strain on urban infrastructure.



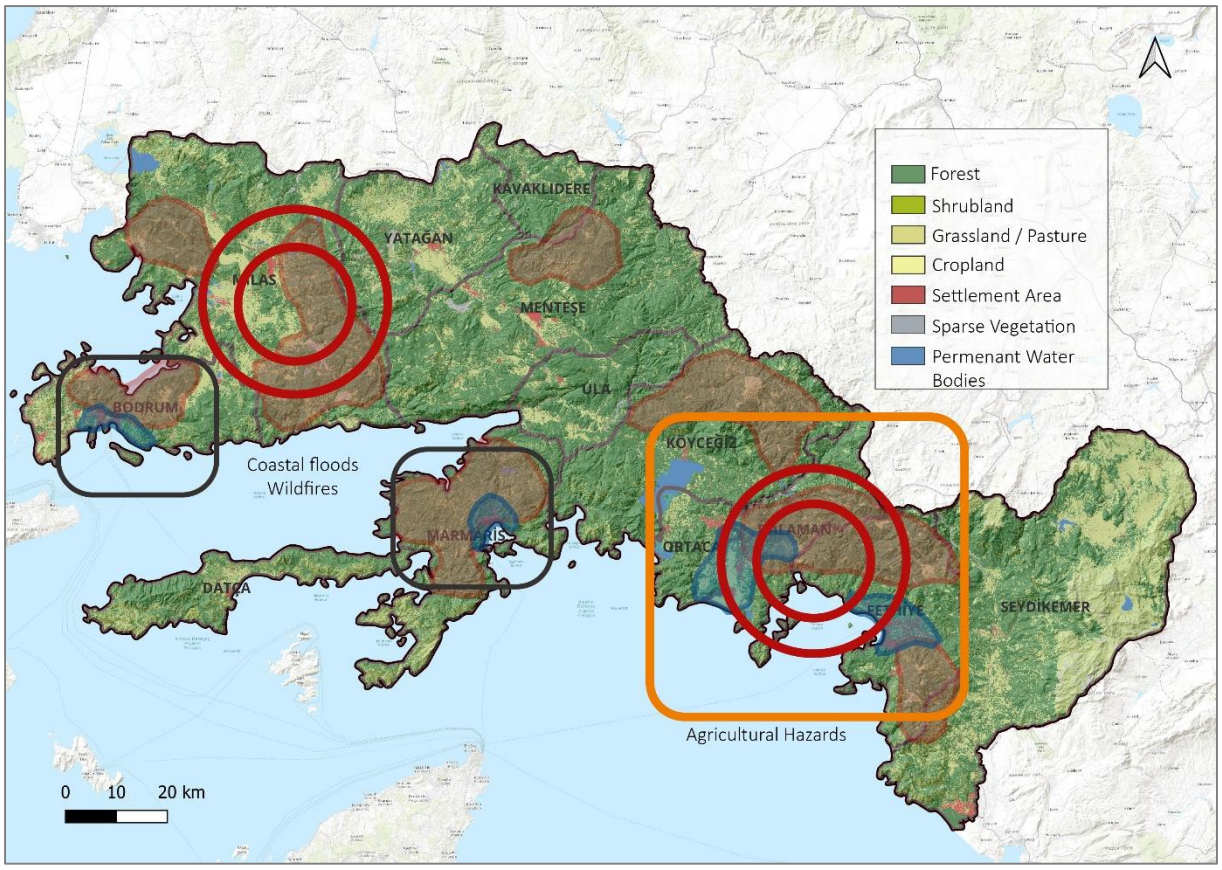
Map 10 Areas with High Flood and Flash Flood Risk

The Dalaman and Ortaca plains are among the areas prone to water accumulation following rainfall due to their flat terrain morphology. The extensive presence of agricultural production areas means that floods have the potential to affect not only urban settlements but also citrus groves and greenhouse cultivation zones.

5.3. Vulnerability Synthesis to Climate Change Impacts in Muğla

Muğla Province, with its coastal zones, forested areas, and agricultural basins characterized by diverse topographic and microclimatic conditions, is among the regions in Türkiye most vulnerable to climate change. As illustrated in the map analysis, climate impacts are not spatially homogeneous; coastal areas, forest-dense regions, and agricultural plains emerge as zones where climate-related risks are particularly concentrated. This situation directly affects not only the physical environment but also the region's economic activities and social vulnerability.

The Bodrum–Marmaris–Datça corridor is a region dominated by coastal settlements with high tourism intensity. Recent extreme rainfall events and coastal flooding have demonstrated that infrastructure capacity in these areas is under significant pressure. As a large portion of settlements are located in low-lying areas with a high proportion of impermeable surfaces, even short-duration rainfall leads to increased surface runoff and difficulties in drainage. Considering the significant share of tourism revenues in the provincial economy, coastal flooding not only causes physical damage but also has the potential to generate economic losses by disrupting accommodation facilities, transportation flows, and seasonal activities.



Map 11 Vulnerability Synthesis to Climate Change

The Marmaris, Köyceğiz, Ortaca, Dalaman, and Seydikemer region is primarily characterized by agricultural production. Citrus cultivation, greenhouse farming, olive groves, and vegetable production are common in the area. Prolonged drought periods, irregular precipitation patterns, and rising summer temperatures due to climate change have begun to put pressure on crop yields. In particular, fluctuating rainfall disrupts soil moisture continuity, while high evaporation during summer increases irrigation needs, imposing additional costs on producers. Considering the share of the agricultural sector in regional employment, these dynamics directly contribute to socio-economic vulnerability. Milas and its surroundings stand out for a high risk of forest fires due to extensive forest cover and dense maquis vegetation. Rising temperatures, decreasing soil moisture, and periodic increases in wind speed significantly amplify fire potential. Following the 2021 fires, this vulnerability became visible at both ecological and societal levels, resulting in biodiversity loss, destruction of carbon sink areas, and temporary disruptions in the local economy. The long-term nature of post-fire regrowth processes indicates that these areas will require priority adaptation measures in the future. Overall, climate-related risks in Muğla are not confined solely to the natural environment. Losses in agricultural production affect social structures through food security and income fluctuations; coastal flooding pressures tourism and infrastructure resilience; and forest fires reduce ecosystem services and carbon sequestration capacity. Therefore, it is critical that climate adaptation policies in Muğla are addressed in an integrated manner across agriculture-water management, coastal settlement planning, early warning systems for disasters, and forest fire risk reduction.

ENERGY POVERTY

6

6. Energy Poverty

Energy is recognized in modern societies not only as essential for sustaining economic activities but also as a fundamental requirement for ensuring a standard of living that respects human dignity. Basic needs such as heating, lighting, cooking, cooling, access to clean water, and communication are directly dependent on energy use. Accordingly, energy access is addressed under the United Nations Sustainable Development Goal 7, which emphasizes "affordable, reliable, sustainable, and modern energy" (UN, 2015).

While the concept of energy poverty is defined in various ways in the literature, the common approach focuses on households' inability to access basic energy services in an adequate, safe, and affordable manner. Boardman (2010) defines energy poverty as a household's inability to adequately heat its dwelling and meet basic energy needs. Bouzarovski (2014), on the other hand, views energy poverty not merely as a lack of income but as a multidimensional social issue encompassing energy prices, the physical condition of dwellings, infrastructure, and spatial inequalities.

Contemporary definitions used by international organizations also emphasize this multidimensional nature. According to the European Commission, energy poverty occurs when households cannot access adequate heating, cooling, lighting, and other essential energy services, or when they face excessive financial burdens to obtain these services (European Commission, 2023). The World Bank and the International Energy Agency define energy poverty as the lack of access to modern energy services or the unavailability of reliable and economically affordable energy (IEA & World Bank, 2024).

In this context, energy poverty is not merely an issue of energy infrastructure access; it is a structural problem directly linked to income distribution, housing quality, energy efficiency, and deficiencies in social policies.

6.1. Measuring Energy Poverty and the Global Overview

Different indicators are used in the literature to measure energy poverty. One of the most common approaches is the ratio of a household's total energy expenditures (electricity, heating, and other fuels) to household income. In the classical approach developed by Boardman (2010), energy expenditures exceeding 10% of household income are considered a risk of energy poverty, while some studies raise this threshold to 20–25% for low-income countries. These threshold values vary depending on countries' socioeconomic structures and energy prices.

The global dimension of energy poverty remains a serious issue according to current statistics. According to the 2024 Tracking SDG 7 report by the IEA and World Bank, approximately 666–675 million people worldwide still lack access to electricity. The majority of this population is concentrated in sub-Saharan Africa, where in many countries more than half of the population lacks reliable electricity services (IEA & World Bank, 2024).

In addition, around 2.1–2.3 billion people lack access to clean and modern cooking technologies and rely on wood, coal, and other traditional biomass fuels. According to the World Health Organization, this situation causes millions of premature deaths annually, primarily due to indoor air pollution (WHO, 2023). These figures demonstrate that energy poverty is not only an economic issue but also a significant public health concern.

Energy poverty is not limited to developing countries. The recent global energy crisis and rising energy prices have made energy poverty increasingly visible in developed countries as well. In European Union countries, millions of households reportedly struggle to adequately heat their homes or pay their energy bills due to rising energy costs (European Commission, 2023). This situation positions energy poverty as a critical issue at the intersection of social justice, energy policy, and climate change mitigation on a global scale.

6.2. Energy Poverty in Muğla

One of the commonly used indicators for assessing energy poverty in Turkey and globally is the provision of fuel assistance, such as firewood and coal, by public institutions and local authorities. Such support is considered an important parameter, as it indirectly reveals the constraints households face in accessing clean, reliable, and sustainable energy sources. In this context, data on fuel assistance provided by district municipalities across Muğla province were compiled and analyzed to reveal the spatial distribution of energy poverty within the region.

DISTRICT	*YEAR*	*TOTAL (TONNES)*
Bodrum	2024	275
Fethiye	2024	106
Marmaris	2024	9,63
Menteşe	2024	170
Yatağan	2024	35,2
Datça	2024	22,5
Milas	2024	17,25
Dalaman	2024	Not granted.
Köyceğiz	2024	Not granted.
Seydikemer	2024	Not granted.
Ula	2024	Not granted.
Ortaca	2024	No data.
Kavaklıdere	2024	No data.

The data indicate that fuel assistance in Muğla province varies by district and is concentrated in specific areas. In particular, the districts of Bodrum, Menteşe, and Fethiye stand out in terms of the total amount of fuel support provided. This suggests that certain households in these districts face difficulties accessing modern and clean heating systems due to economic constraints, remaining dependent on traditional fuel types.

The fact that a significant portion of fuel assistance consists of fossil fuels such as firewood and coal indicates that energy poverty is not limited to income insufficiency, but also involves

challenges in accessing clean energy. The provision of fossil fuel-based heating sources through social assistance suggests that households have limited opportunities to transition to more efficient and environmentally sustainable heating solutions. This situation not only increases the energy burden on household budgets but also leads to negative impacts in terms of local air pollution and greenhouse gas emissions.

Energy poverty is a multidimensional concept, and assessing it solely based on the amount of fuel assistance provides a limited perspective. Therefore, the analysis also incorporates the 2022 Socio-Economic Development Index (SEGE) published by the Ministry of Industry and Technology. SEGE is a composite indicator that includes a wide range of variables such as income level, employment structure, education level, demographic characteristics, infrastructure availability, and economic diversity. These variables are directly related to households' capacity to access energy, their ability to transition to modern and clean energy systems, and their capacity to meet energy expenditures. Accordingly, SEGE data serve as an indirect yet strong indicator for evaluating the socioeconomic dimension of energy poverty.

Table 17 Socio-Economic Development Ranking of Muğla Districts (Republic of Türkiye Ministry of Industry and Technology, 2022)

DISTRICT	*CATEGORY*	*RANKING (TÜRKİYE)*
Bodrum	1	25
Marmaris	1	65
Menteşe	2	72
Fethiye	2	78
Datça	2	140
Ortaca	2	148
Milas	2	184
Dalaman	2	212
Ula	3	247
Köyceğiz	3	275
Yatağan	3	282
Kavaklıdere	4	518
Seydikemer	5	635

According to the 2022 SEGE data, the districts of Muğla province differ in terms of their levels of socio-economic development. Bodrum and Marmaris, classified as first-tier districts, have the highest level of socio-economic development. Menteşe, Fethiye, Datça, Ortaca, Milas, and Dalaman are categorized as second-tier districts, exhibiting relatively high but more limited levels of development compared to first-tier districts. Ula, Köyceğiz, and Yatağan are considered third-tier districts and are evaluated as having a lower-middle level of development. Kavaklıdere is classified as a fourth-tier district, while Seydikemer is a fifth-tier district, standing out as the least developed areas in the province in terms of socio-economic indicators. This distribution indicates that access to energy and household welfare capacity are not homogeneous across Muğla province, and that the potential vulnerability risk is higher, particularly in lower-tier districts.

Table 18 Energy Poverty Vulnerability Assessment of Muğla Districts

Low Vulnerability
Marmaris
Bodrum
Menteşe
Dalaman
Mid-Level Vulnerability
Ortaca
Datça
Milas
Fethiye
High Vulnerability
Köyceğiz
Ula
Yatağan
Very High Vulnerability
Kavaklıdere
Seydikemer

The assessment of energy poverty was conducted through a relative vulnerability classification, taking into account both fuel assistance data and the SEGE 2022 indicators reflecting the socio-economic development levels of districts. Structural advantages such as being the provincial center, having greater access to public services, and the availability of natural gas infrastructure have led to Menteşe being classified within the low-vulnerability group. Similarly, first-tier districts such as Marmaris and Bodrum are also positioned in the lower risk category due to their higher levels of structural development.

In contrast, districts with lower SEGE rankings and limited socio-economic capacity, such as Kavaklıdere and Seydikemer, stand out as priority vulnerable areas in terms of energy poverty. This classification demonstrates that energy poverty has been addressed through a multidimensional evaluation approach based not only on the amount of assistance provided, but also on underlying structural socio-economic conditions.

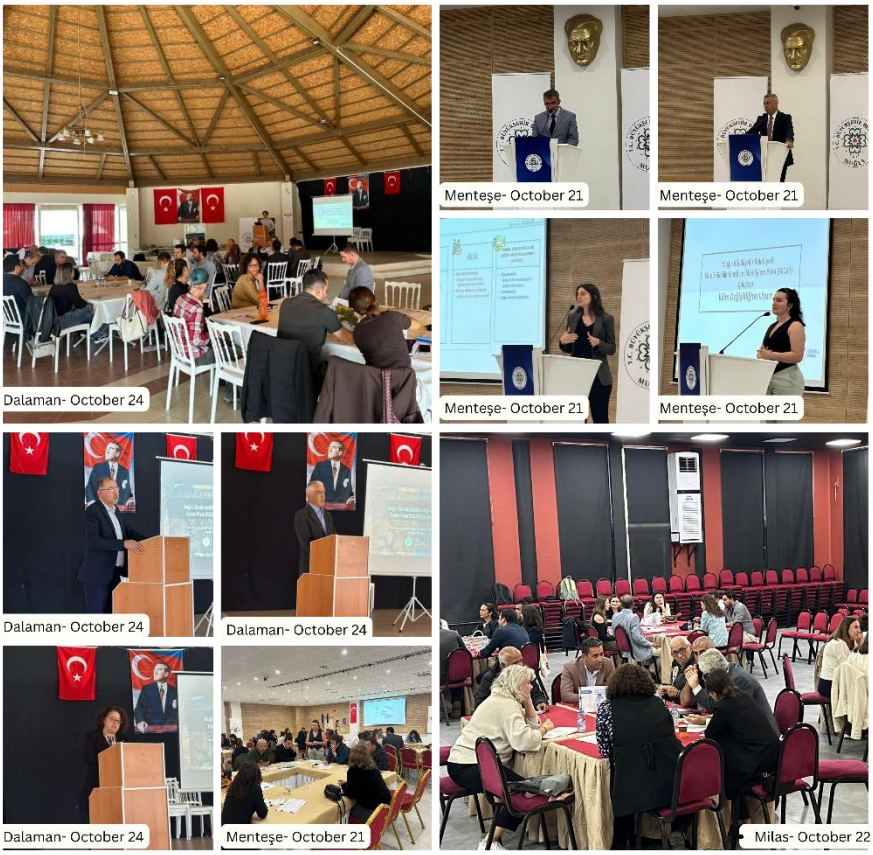
GOALS AND ACTIONS

7

7. Goals and Actions

7.1. Muğla Stakeholder Workshop Outcomes

Within the scope of the preparation of the "Muğla Sustainable Energy and Climate Action Plan (SECAP)" carried out by Muğla Metropolitan Municipality, "Greenhouse Gas Emissions and Climate Adaptation Stakeholder Workshops" were held in the districts of Menteşe on October 21, 2025, Milas on October 22, 2025, and Dalaman on October 24, 2025.



Photograph 1 Muğla Greenhouse Gas Emission Reduction and Climate Adaptation Stakeholder Workshops

The workshops began with opening remarks by the mayors and the General Manager of İstanbul Enerji, followed by technical presentations on the Muğla Greenhouse Gas Inventory, Climate Change Adaptation, and Muğla Climate Risk and Vulnerability Analyses. The Technical Briefing Presentations, which formed the first part of the workshops, were structured to provide the scientific basis for the Sustainable Energy and Climate Action Plan prepared for Muğla and to ensure that all participating stakeholders could conduct evaluations on a common knowledge foundation. In this context, the presentations included datasets based on international methodologies as well as emission and risk analyses conducted at the district level.

The stakeholder composition of the workshops indicates that local governments, public institutions, the private sector, academia, and civil society actively participated in all three districts. In Menteşe and Milas, the high proportion of municipal representatives (around 45%) reflects strong engagement of local decision-making bodies, whereas in the Dalaman workshop, participation from the private sector (21%) and municipalities outside the district was notably higher. In all three districts, the significant representation of provincial directorates ensured that the workshop outcomes were developed based on sectoral and institutional collaboration. Overall, the distribution demonstrates that climate change adaptation and mitigation efforts are being conducted on a multi-stakeholder, inclusive, and inter-institutionally coordinated platform.

Figure 19 Stakeholder Distribution in the Menteşe, Milas, and Dalaman Greenhouse Gas Emission Reduction and Climate Adaptation Workshops

The data recorded by the participants on the workshop forms were grouped at the district level, and common as well as diverging trends were then identified using thematic analysis.

7.1.1. Mitigation

In the workshops, the greenhouse gas emission reduction priorities identified by the participants were shaped around renewable energy production, increased energy efficiency, low-emission transportation, circular economy practices, and emission reduction in agriculture and livestock. Based on these themes, district-specific project proposals were developed for Menteşe, Milas, and Dalaman, taking into account local conditions, sectoral needs, and the existing energy profile of Muğla. These projects, developed with the contributions of participants, aim to strengthen the districts' capacity to address climate change and support long-term sustainability goals. As a result of the workshops and stakeholder feedback collected across the three districts, the common greenhouse gas emission reduction themes were shaped as follows:

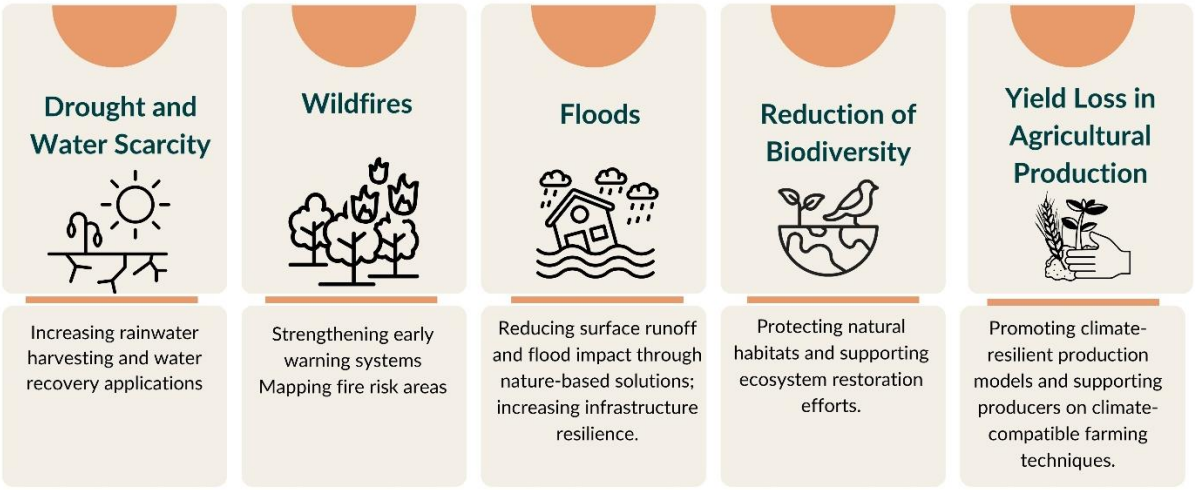
Scaling up renewable energy generation	Enhancing energy efficiency applications	Low Carbon Transportation	Waste management and circular economy	Reducing emissions from the agricultural and livestock sectors
Expanding the use of Solar Power Plants (SPP) Rooftop solar solutions for rural residences and enterprises Supporting heat pumps and clean energy technologies	Strengthening energy management and efficiency practices in public and private administrative buildings, educational and health facilities, agricultural infrastructure systems (irrigation, etc.), cold storage facilities, and small-scale industrial sites.	Improving public transport, transitioning to electric vehicles and electric public transport, promoting bicycle use, and supporting low-carbon models in rural transportation.	Composting of organic waste, source separation, and expanding recovery systems (waste markets, card-based collection, sorting).	Reducing energy consumption in agricultural production, livestock enterprises, and rural infrastructure facilities; promoting irrigation and modern production techniques that ensure water-energy efficiency.

Key Project Topics Emerging from the Three Workshops:

Menteşe	Milas	Dalaman
• Strengthening energy efficiency and renewable energy applications in public buildings, schools, and campuses, considering the urban center, university, and service-sector-oriented structure. • Developing cycling infrastructure in urban areas and installing shaded, solar-powered micro-mobility stations. • Expanding the use of energy efficiency practices in small-scale industrial enterprises.	• Accelerating the widespread adoption of SPP and heat pump applications in rural housing and agricultural enterprises. • Strengthening renewable energy alternatives to reduce emissions from thermal power plants. • Increasing energy efficiency in agricultural cold storage facilities and irrigation plants.	• Green transformation in the tourism sector, implementation of sustainable business models and energy efficiency activities. • Strengthening electric lines, charging stations, and low-emission transport links, considering the high traffic load between the airport, district centers, and tourism zones.

7.1.2. Climate Change Risks and Vulnerabilities

In the workshops, the common climate change risk themes for the three districts were identified under the headings of drought and water scarcity, forest fires, floods, biodiversity loss, and reduced agricultural productivity. Participants assessed the increasing regional impacts of these risks and developed actionable solutions focused on water management, ecosystem protection, infrastructure resilience, and climate-smart agriculture. These proposals offer a holistic perspective aimed at reducing the districts' vulnerabilities and enhancing their resilience to changing climate conditions. The common risk themes and key proposed solutions for the three districts are summarized as follows:



Key Project Themes from the Three Workshops:

Dalaman

- Reducing flood, overflow, and surface runoff risks through nature-based solutions.
- Adaptation practices focused on heat stress and water management in tourism regions.

Menteşe

- Specific measures and early warning systems against fire risk in forest-slope settlements.
- Strengthening water harvesting and storage infrastructure in urban areas.
- Expanding agrovoltaic and water efficiency techniques in rural production.

Milas

- Adaptation plans against climate risks in coastal erosion and port-shipyard zones.
- Circular systems for drought and models for waste reuse.
- Deepening regional risk analyses in collaboration with Muğla Sıtkı Koçman University.

7.2. Actions

The fight against the climate crisis is built on two complementary policy axes: mitigating greenhouse gas emissions and strengthening adaptation to climate change. While mitigation policies aim to target the root causes of climate change by reducing emissions and limiting negative impacts, adaptation-oriented approaches focus on increasing resilience against the effects of changing climatic conditions on social, environmental, and economic structures.

The strategies developed in this direction are designed not only to address local priorities but also to align with global climate and sustainability goals. In the action cards within the scope of the Bayrampaşa SECAP, the relationship established with the Sustainable Development Goals is clearly defined, demonstrating the plan's integration with national and international policy frameworks.

Figure 20 Sustainable Development Goals

The **Muğla Sustainable Energy and Climate Action Plan (SECAP)** provides a holistic and applicable set of actions to reduce greenhouse gas emissions and ensure adaptation to climate change. The action proposals are structured to be transformed into concrete projects at the local level.

Under the "Strengthening Climate Change Adaptation Action in Turkey Project," the **Muğla Local Climate Change Adaptation Strategy and Action Plan (LCCAAP 2025-2030)** was prepared, identifying 12 strategic goals and 107 adaptation actions. These actions cover the following thematic areas: Urban Areas, Water Resources Management, Agriculture and Food Security, Biodiversity and Ecosystem Services, Public Health, Energy, Tourism and Cultural Heritage, Industry, Transportation and Communication, Social Development, Disaster Risk Reduction, and Cross-cutting Issues.

Within the scope of SECAP activities, mitigation actions to reduce greenhouse gas emissions were consulted with stakeholders alongside climate risks and vulnerability areas specific to Muğla. As a result of the workshops and meetings conducted, adaptation action proposals were developed for the energy, transportation, waste, agriculture, and livestock sectors. By

taking into account the adaptation actions specified in the Muğla LCCAAP, priority actions aimed at increasing the city's climate resilience have been integrated into the actions within this report.

To establish a strategic vision for combating the climate crisis in Muğla, two main objectives have been set, under which a total of 10 targets have been defined.

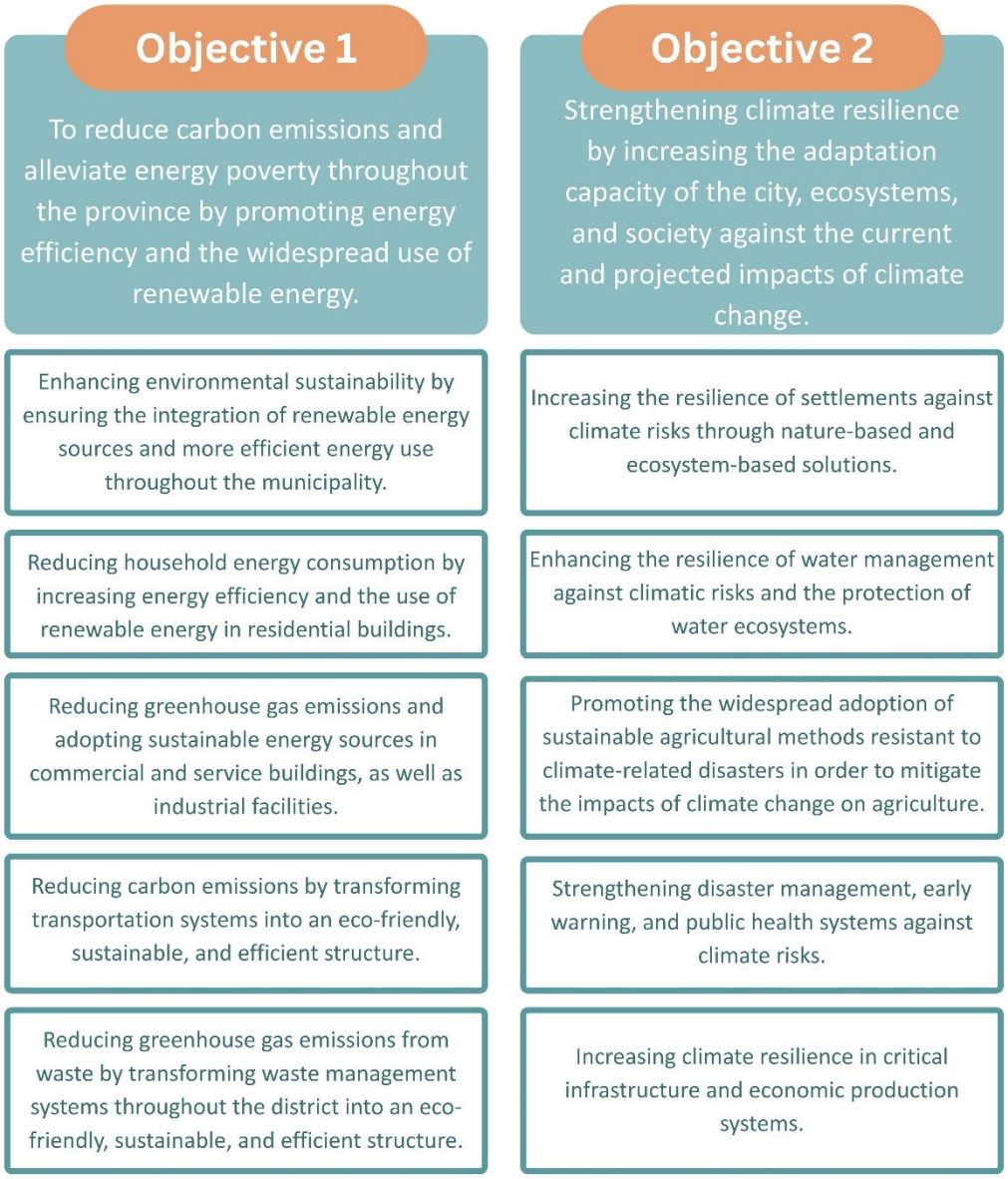


Figure 21 Objectives and Targets

To ensure the realization of the established **objectives** and **targets**, greenhouse gas mitigation and climate change adaptation **actions** have been defined specifically for the relevant sub-

sectors. These actions are structured within a sector-based framework, and the following section presents the action cards for both mitigation and adaptation.

Figure 22 Mitigation Sectors

Figure 23 Adaptation Sectors

Sub-sectors under the mitigation and adaptation axes have been defined by considering Muğla's climate vulnerabilities and emission sources. Under adaptation, sectors directly exposed to climate impacts, such as water management, disaster management, tourism, land use, public health, biodiversity, agriculture and food security, and infrastructure management, are addressed. In the mitigation axis, priority is given to housing, municipal services, industry, tertiary buildings, transportation, agricultural irrigation, and waste sectors. These sectors are detailed in the action cards provided below, presenting the mitigation and adaptation actions defined for each sub-sector alongside responsible units and expected impacts.

The emission reduction targets and associated actions established under Objective 1 are detailed through the action cards below. Subsequently, the adaptation targets and related actions defined under Objective 2 are presented via the adaptation action cards.

ACTION CARD

A.1. H.1.1. SPP (SOLAR POWER PLANT) INTEGRATION IN MUNICIPAL FACILITIES

MUNICIPALITY

Action Description

The installation and integration of rooftop and ground-mounted solar energy systems are targeted to reduce energy costs in municipal buildings and facilities, increase the share of renewable energy, and minimize the institution's carbon footprint.

Sub Actions

- Conducting feasibility studies for the installation of solar power plants (SPP) in municipal facilities.
- Installation and operation of solar power plants in municipal facilities.

Target Year

2030 - 2040 (Short-Medium Term)

Priority

High

Estimated Cost

500 €/kWp

Implementation Risks/Challenges

- Barriers and constraints encountered in licensing processes.
- Lack of suitable land for ground-mounted SPP (Solar Power Plant) installations.

Mitigation Impact

%0,1

Reduction Amount

2.169 tCO_2e

Stakeholders

- Ministry of Energy and Natural Resources
- Product Suppliers
- Consultancy Firms
- Energy Companies

Performance Indicators

- Number of Implemented SPP Projects (Unit/Year)
- Amount of Electricity Generated from SPPs (kWh/Year)
- Number of Feasibility Reports Prepared (Unit/Year)

Responsible Body

Muğla Metropolitan Municipality
MUSKİ (Muğla Water and Sewerage Administration) General Directorate

SDG

ACTION CARD

A.1. H.1.2.	SUSTAINABLE URBAN LIFE AWARENESS PROGRAM	MUNICIPALITY

Action Description

Through training programs, information campaigns, field events, digital content production, and stakeholder collaborations, these efforts aim to encourage citizens to adopt sustainable living habits and to improve urban environmental quality.

Target Year

2030 - 2040 (Short-Medium Term)

Cost and Mitigation Not Estimated.

Stakeholders

- Consultancy Firms
- Trainers

Performance Indicators

- Number of Participants in the Training Program (people/year)
- Number of Training Sessions Conducted (unit/year)

Responsible Body

Muğla Metropolitan Municipality Department of Climate Change and Zero Waste / District Municipalities
Non-Governmental Organizations (NGOs)

SDG

ACTION CARD

A.1. H.1.3.	SOLAR-POWERED LED LIGHTING SYSTEMS	MUNICIPALITY

Action Description

The project aims to replace the existing street lighting systems throughout the province with energy-efficient and environmentally friendly solar-powered lighting units. With the new system to be installed, it is intended to reduce energy consumption and maintenance costs while providing uninterrupted and sustainable lighting.

Sub Actions

- Switching to solar LED systems for the perimeter lighting of municipal buildings.
- Switching to solar LED systems for municipal roads.
- Switching to solar LED systems for municipal parks and green spaces.
- Switching to solar LED systems for district municipality roads.

Priority	Estimated Cost
High	500 €/kWp

Mitigation Impact	Reduction Amount
%0,9	49.758 tCO_2e

Target Year

2030 (Short Term)

Stakeholders

- Relevant Electricity Distribution Company
- Contractors / Implementing Firms
- District Municipalities
- General Directorate of Highways

Performance Indicators

- Number of solar-powered LED lighting systems installed province-wide (unit/year)
- Reduction in the municipality's electricity consumption for lighting (%)

Responsible Body	Muğla Metropolitan Municipality Department of Survey and Projects Muğla Metropolitan Municipality Department of Public Works

SDG

ACTION CARD

A.1. H.1.4. ENERGY EFFICIENCY IN MUNICIPAL FACILITIES

MUNICIPALITY

Action Description

The project aims to implement and disseminate design, transformation, and digitalization (smart buildings, etc.) applications to increase energy efficiency in municipal buildings and facilities. An emission reduction of 3,948.6 tCO2e per building is estimated.

Target Year

2030 - 2040 (Short and Medium Term)

Implementation Risks/Challenges

- High Investment Costs

Stakeholders

- District Municipalities
- Public Institutions
- Homeowners
- Business Owners

Priority

High

Estimated Cost

500 €/kWp

Performance Indicators

- Sustainability and Circularity Compliant Infrastructure and Building Design Guide (Yes/No)
- Number of infrastructure/building projects designed and/or constructed according to the Sustainability and Circularity Compliant Guide (unit/year)

Sub Actions

- Preparation of the "Sustainability and Circularity Compliant Infrastructure and Building Design Guide." (2030)
- Implementation of the "Sustainability and Circularity Compliant Infrastructure and Building Design Guide" in infrastructure and building projects to be carried out by Muğla Metropolitan Municipality. (2040)
- Installation of a digital electricity consumption measurement and monitoring system to increase energy efficiency in municipal buildings and facilities. (2050)
- Implementation of the "Circularity Compliant Infrastructure and Building Design Guide" in infrastructure and building projects to be carried out by Muğla Metropolitan Municipality. (2040)
- Integration of the "Sustainability and Circularity Compliant Infrastructure and Building Design Guide" into the building permit processes of District Municipalities to ensure province-wide implementation and dissemination. (2050)

Responsible Body

Muğla Metropolitan Municipality Department of Survey and Projects

SDG

ACTION CARD

A.1. H.2.1. ENERGY EFFICIENCY IN RESIDENTIAL AND COMMERCIAL BUILDINGS

RESIDENTIAL BUILDINGS

Action Description

The project aims to disseminate energy efficiency practices in residential buildings to reduce energy consumption and ensure more efficient resource use throughout the city. Within this scope, it is planned to increase the level of awareness across the province through organized training programs and events.

Sub Actions

- Organization of awareness training, workshops, and similar events by the Municipality regarding energy efficiency practices in residential buildings.
- Organization of awareness training, workshops, and similar events by the Municipality regarding energy efficiency practices in commercial buildings and workplaces.

Priority

High

Estimated Cost

400 €/resident

Target Year

2030 (Short Term)

Mitigation Impact	Reduction Amount
%2	113.677 tCO_2e

Stakeholders

- Relevant Electricity Distribution Company
- Implementing Firms
- District Municipalities
- TMMOB (Union of Chambers of Turkish Engineers and Architects)
- Neighborhood Representatives

Performance Indicators

- Number of events and/or training sessions organized (unit/year)
- Reduction in residential electricity consumption per capita (%)
- Reduction in residential natural gas consumption per capita (%)

Responsible Body

Muğla Metropolitan Municipality Department of Climate Change and Zero Waste / District Municipalities
Non-Governmental Organizations (NGOs)

SDG

ACTION CARD

A.1. H.2.2. RENEWABLE ENERGY APPLICATIONS IN RESIDENTIAL BUILDINGS

RESIDENTIAL BUILDINGS

Action Description

The transition of households to renewable energy will be accelerated by encouraging the installation of rooftop solar energy systems in residential buildings. Thus, it is aimed both to reduce the energy expenses of households and to strengthen environmental sustainability throughout the city.

Sub Actions

- Development of incentive mechanisms for renewable energy system applications in residential buildings.
- Dissemination of renewable energy system applications in residential buildings.

Mitigation Impact	Reduction Amount
%12,6	703.912 tCO_2e

Priority

Medium

Estimated Cost

500 €/kWp

Target Year

2040 (Medium Term)

Performance Indicators

- Number of events and/or training sessions organized (unit/year)
- Reduction in residential electricity consumption per capita (%)
- Number of incentives provided (unit/year)

Stakeholders

- Relevant Ministries
- Muğla Metropolitan Municipality
- Electricity Distribution Company
- Implementing Firms
- District Municipalities

Implementation Risks/Challenges

- Inadequate Legislation and Regulatory Framework

Responsible Body	Ministry of Energy and Natural Resources Homeowners

SDG

ACTION CARD

A.1. H.2.3. THERMAL INSULATION AND ISOLATION IMPROVEMENTS IN RESIDENTIAL BUILDINGS

RESIDENTIAL BUILDINGS

Action Description

The energy efficiency of households will be increased by encouraging exterior thermal insulation (sheathing), roof and floor insulation, and applications that reduce thermal bridges; by providing technical information and guidance services to households, it is aimed to reduce heat losses and achieve a decrease in energy consumption.

Sub Actions

- Development of incentive mechanisms for energy efficiency applications in residential buildings.
- Dissemination of energy efficiency applications in residential buildings.

Mitigation Impact	Reduction Amount
%0,5	26.689 tCO_2e

Priority

Medium

Estimated Cost

1.400 €/Resident

Target Year

2040 (Medium Term)

Performance Indicators

- Number of incentives provided (unit/year)
- Number of buildings undergoing urban transformation (unit/year)
- Number of households benefiting from incentives (unit/year)

Stakeholders

- Relevant Ministries
- Muğla Metropolitan Municipality
- District Municipalities
- Implementing Firms
- NGOs

Implementation Risks/Challenges

- Inadequate Legislation and Regulatory Framework

Responsible Body	Homeowners District Municipalities

SDG

ACTION CARD

A.1. H.2.4. IMPROVING AND MONITORING URBAN AIR QUALITY

Action Description

The transition to natural gas as a clean fuel is aimed at replacing the use of fuels with high environmental impacts for heating and cooking purposes in households. This action will contribute to reducing air pollution and alleviating energy poverty.

RESIDENTIAL BUILDINGS

Mitigation Impact	Reduction Amount
-	-

Target Year
2050
Long Term

Estimated Cost
-

Stakeholders

- Ministry of Energy and Natural Resources Ministry of Environment, Urbanization and Climate Change
- Muğla Sıtkı Koçman University

Performance Indicators

- Length of Added Natural Gas Infrastructure (km/year)
- Increase in the Number of Households Using Natural Gas (%)
- Amount of Incentive/Support Provided for Natural Gas Conversion (TL/year)
- Number of Air Quality Monitoring Stations

Responsible Body: Muğla Governorship (YİKOB) / Muğla Provincial Directorate of Environment, Urbanization and Climate Change / Muğla Department of Climate Change and Zero Waste / Natural Gas Distribution Companies / Homeowners

SDG

ACTION CARD

A.1. H.2.5. HEAT PUMP APPLICATIONS IN RESIDENTIAL BUILDINGS

RESIDENTIAL BUILDINGS

Action Description

The aim is to disseminate air, water, and ground-source heat pump systems in order to reduce fossil fuel use in households and increase renewable heat production. By conducting technical feasibility assessments in suitable buildings, it is intended to carry out information and guidance activities regarding efficiency advantages.

Sub Actions

- Dissemination of heat pump system applications in residential buildings.

Mitigation Impact	Reduction Amount
%1	59.746 tCO_2e

Performance Indicators

- Reduction in residential electricity consumption per capita (%)
- Reduction in residential natural gas consumption per capita (%)

Priority

Medium

Estimated Cost

3.500 €/Resident

Target Year

2040 (Medium Term)

Implementation Risks/Challenges

- Lack of Consumer Awareness
- Inadequacy of Incentive Mechanisms
- High Cost

Stakeholders

- Relevant Ministries
- Muğla Metropolitan Municipality
- NGOs
- District Municipalities

Responsible Body

Homeowners

SDG

ACTION CARD

A.1. H.3.1. ENERGY EFFICIENCY STUDIES IN COMMERCIAL AND INSTITUTIONAL BUILDINGS

Action Description

Within the scope of this action, it is aimed to replace lighting systems with efficient technologies, optimize HVAC (heating-cooling-ventilation) systems, develop energy management practices, and conduct energy audits in order to reduce energy consumption in commercial and institutional buildings.

TERTIARY BUILDINGS

Mitigation Impact	Reduction Amount
%6,4	359.326 tCO_2e

Target Year
2050
Long Term

Estimated Cost
13.000 €/Building

Stakeholders

- Muğla Metropolitan Municipality
- District Municipalities
- NGOs
- Relevant Distribution Companies

Performance Indicators

- Number of energy efficiency projects implemented in commercial and industrial areas
- Number of businesses meeting energy efficiency standards and receiving certification

Responsible Body	Building/Facility Managers District Municipalities

SDG

ACTION CARD

A.1. H.3.2. RENEWABLE ENERGY APPLICATIONS IN COMMERCIAL AND INSTITUTIONAL BUILDINGS

Action Description

It is aimed to accelerate the transition of households to renewable energy use and thereby reduce energy expenses by encouraging the installation of rooftop solar energy systems in residential buildings.

TERTIARY BUILDINGS

Mitigation Impact	Reduction Amount
%11,4	635.673 tCO_2e

Target Year
2050
Long Term

Estimated Cost
500 €/kWp

Stakeholders

- Relevant Ministries
- Muğla Metropolitan Municipality
- Relevant Electricity Distribution Company
- Implementing Firms

Performance Indicators

- Installed Solar PV Capacity (kWp)
- Annual Amount of Energy Produced (kWh)

Responsible Body	Building/Facility Managers District Municipalities

SDG

ACTION CARD

A.1. H.3.3. HEAT PUMP IN COMMERCIAL AND PUBLIC BUILDINGS

TERTIARY BUILDINGS

Action Description

In order to increase energy efficiency and reduce fossil fuel use in commercial and institutional buildings, it is aimed to encourage the transformation of existing heating-cooling systems with high-efficiency heat pumps and to disseminate low-carbon air conditioning solutions by conducting technical analysis and guidance studies in suitable facilities.

Sub Actions

- Development of incentive mechanisms for energy efficiency applications in commercial and public buildings.
- Dissemination of energy efficiency applications in commercial and public buildings.

Mitigation Impact	Reduction Amount
%1,1	60.652 tCO_2e

Priority

Medium

Estimated Cost

18.000 €/Building

Performance Indicators

- Reduction in residential electricity consumption per capita (%)
- Reduction in residential natural gas consumption per capita (%)

Target Year

2040 (Medium Term)

Stakeholders

- Relevant Ministries
- Muğla Metropolitan Municipality
- Electricity Distribution Company
- Implementing Firms
- District Municipalities

Implementation Risks/Challenges

- Inadequacy of incentive mechanisms.
- High cost.

Responsible Body	Building/Facility Managers District Municipalities

SDG

ACTION CARD

A.1. H.3.4. ENERGY EFFICIENCY STUDIES IN INDUSTRIAL FACILITIES

Action Description

In order to reduce energy costs and increase efficiency in production processes within industrial facilities, the modernization of equipment, process improvements, and the implementation of energy management systems will be supported; furthermore, efficiency opportunities will be identified through energy audits, aiming for businesses to transition to low-carbon production.

INDUSTRY

Mitigation Impact	Reduction Amount
%1	56.210 tCO_2e

Target Year
2050
Long Term

Estimated Cost
45.000 €/Building

Stakeholders

- Product Suppliers
- Energy Consultants

Performance Indicators

- Energy Saving Ratio (%)

Responsible Body	Industrial Facilities Muğla Provincial Directorate of Industry and Technology

SDG

ACTION CARD

A.1. H.3.5.	RENEWABLE ENERGY APPLICATIONS IN INDUSTRIAL FACILITIES

Action Description

In order to reduce energy costs in industrial facilities, the implementation of renewable energy solutions such as rooftop solar PV, land-mounted solar PV, and waste heat recovery will be supported; furthermore, technical feasibility analyses will be conducted to increase the clean energy utilization rates of these enterprises.

INDUSTRY

Mitigation Impact	Reduction Amount	Target Year	Estimated Cost
%2,7	149.550 tCO_2e	2050 Long Term	500 €/kWp

Stakeholders

- Relevant Ministries
- Muğla Metropolitan Municipality
- Relevant Electricity Distribution Company
- Implementing Firms

Performance Indicators

- Number of Installed Systems
- Total Energy Production (kWh)

Responsible Body	Industrial Facility Managers Muğla Provincial Directorate of Industry and Technology

SDG

ACTION CARD

A.1. H.3.6. WATER EFFICIENCY STRATEGY IN AGRICULTURAL IRRIGATION SYSTEMS

IRRIGATION

Action Description

It is aimed to increase irrigation efficiency in agricultural irrigation systems to reduce water and energy consumption per unit of production. In this way, by decreasing pump operating times, the objective is to reduce indirect greenhouse gas emissions resulting from agricultural irrigation and to ensure the sustainable use of water resources.

Priority

High

Estimated Cost

200 €/hectar

Target Year

2030 (Short Term)

Paydaşlar

- NGOs
- Relevant Electricity Distribution Company
- District Municipalities

Mitigation Impact

%0,4

Reduction Amount

22.814 tCO e

Sub Actions

- Dissemination of solar PV applications in agricultural irrigation systems and development of incentive mechanisms for producers.
- Prevention of flood irrigation in agriculture; implementation and dissemination of smart and drip irrigation systems.
- Implementation of smart irrigation systems for the watering of green spaces.
- Dissemination of water-efficient landscaping practices in urban green areas.
- Dissemination of soilless agriculture applications.
- Training and awareness campaigns to increase awareness regarding energy and water efficiency in agriculture.

Performance Indicators

- Reduction in electricity consumption caused by agricultural irrigation (%)
- Amount of incentives provided for smart irrigation systems (TL/year)
- Size of areas where urban xeriscaping is applied (m2/year)
- Number of people trained

Responsible Body

Ministry of Agriculture and Forestry (Muğla Provincial Directorate of Agriculture and Forestry) / Muğla Metropolitan Municipality Department of Agricultural Services / State Hydraulic Works (DSİ)

SDG

ACTION CARD

A.1. H.4.1. DEVELOPMENT OF ELECTRIC VEHICLE INFRASTRUCTURE

TRANSPORTATION

Action Description

In order to encourage the use of electric vehicles throughout Muğla province, it is aimed to expand the charging infrastructure. In this context, the objective is to reduce greenhouse gas emissions from transportation, increase energy efficiency, and support the transition to low-carbon transportation systems in line with SECAP targets.

Sub Actions

- Installation of electric vehicle charging stations in existing and planned parking lots, buildings, and/or facilities belonging to the municipality.
- Establishment of charging stations in newly developed residential areas and common use areas (shopping malls, etc.) throughout the province.
- Implementation of regulations by District Municipalities to mandate charging stations in new buildings during the building permit process.

Priority

High

Estimated Cost

600-10.000 €/AC-DC

Target Year

2030 (Short Term)

Mitigation Impact	Reduction Amount
%39,2	2.191.972 tCO_2e

Stakeholders

- Relevant Ministries
- Muğla Metropolitan Municipality
- Electricity Distribution Company
- NGOs
- District Municipalities

Performance Indicators

- Number of installed electric vehicle charging stations (units/year)

Responsible Body

Muğla Metropolitan Municipality Department of Survey and Projects
Muğla Metropolitan Municipality Department of Transportation
District Municipalities
Implementing Firms

SDG

ACTION CARD

A.1. H.4.2. DEVELOPMENT OF LOW-CARBON AND INTEGRATED PUBLIC TRANSPORTATION SYSTEMS

TRANSPORTATION

Action Description

Within the scope of this action, the objective is to popularize the use of public transportation and develop smart transportation applications in order to increase the accessibility of public transport systems in the city and reduce carbon emissions originating from transportation.

Sub Actions

- Encouraging public transportation (road and maritime), while increasing its accessibility and comfort levels.
- Expanding the bicycle path network and planning routes in a safe and climate-resilient manner.
- Making urban pedestrian paths safer and more comfortable, and creating pedestrianized zones.
- Updating the Transportation Master Plan to include actions aimed at popularizing low-carbon transportation modes.

Priority

High

Estimated Cost

200.000 €/km

Target Year

2030 (Short Term)

Performance Indicators

- Number of people benefiting from public transportation (people/year)
- Amount of incentives provided for public transportation (TL/year)
- Length of additional bicycle paths (km/year)
- Number of additional maritime transport lines (units/year)
- Number of implemented practices aimed at popularizing pedestrian transportation (units/year)

Stakeholders

- Relevant Ministries
- NGOs (Non-Governmental Organizations)

Mitigation Impact	Reduction Amount
%2	110.471 tCO_2e

Responsible Body

Muğla Metropolitan Municipality Department of Transportation
District Municipalities
MUTTAŞ (Muğla City Services Inc.)

SDG

ACTION CARD

A.1. H.4.3. GREEN TRANSFORMATION OF PUBLIC TRANSPORTATION AND MUNICIPAL VEHICLE FLEET

TRANSPORTATION

Action Description

The objective is to gradually convert the vehicles used in public transportation and municipal services into electric models.

Sub Actions

- Gradual conversion of urban public transportation vehicles to electric models.
- Gradual conversion of inter-district public transportation vehicles to electric models.
- Gradual conversion of service vehicles used by the municipality in its own operations to electric models.

Priority

Medium

Estimated Cost

500.000 €/Amount

Target Year

2050 (Long Term)

Stakeholders

- Electricity Distribution Company
- Implementing Firms
- District Municipalities

Implementation Risks/Challenges

- High initial investment cost of electric vehicles.
- Long charging times for electric buses.
- Short driving ranges of electric buses.
- Insufficiency of charging stations throughout the province.
- Narrow and/or rugged urban roads throughout the province.

Mitigation Impact	Reduction Amount
%0,4	22.136 tCO_2e

Performance Indicators

- Number of electric vehicles used in public transportation (units/year)
- Number of electric vehicles in the municipal vehicle fleet (units/year)

Responsible Body

Muğla Metropolitan Municipality Department of Transportation
MUTTAŞ (Muğla City Services Inc.)

SDG

ACTION CARD

A.1. H.5.1.	CIRCULAR RESOURCE MANAGEMENT AND RECOVERY PROGRAM

Action Description

With the aim of reducing urban waste generation and increasing recovery capacity, the goal is to popularize source separation practices, strengthen recycling infrastructure, and increase awareness of the circular economy across society.

WASTE

Mitigation Impact	Reduction Amount
%3	16.098 tCO_2e

Target Year
2050
Long Term

Estimated Cost
80 €/House

Stakeholders

- Muğla Provincial Directorate of Environment, Urbanization and Climate Change
- Muğla Provincial Directorate of National Education

Performance Indicators

- Total Number of Waste Collection Centers Throughout the Province (units/year)
- Amount of Recyclable Waste Collected Separately at the Source (tons/year)
- Improvement in Recycling Rate (%)

Responsible Body	District Municipalities / Muğla Metropolitan Municipality Department of Environmental Protection and Control / Muğla Metropolitan Municipality Department of Climate Change and Zero Waste

SDG

ACTION CARD

A.1. H.5.2. CARBON SINK CAPACITY ENHANCEMENT PROJECT

Action Description

The goal is to protect, strengthen, and sustainably manage forests, which hold significant importance as carbon sink areas. This action will contribute both to mitigating the effects of climate change and to increasing the environmental resilience of the city.

LAND USE

Mitigation Impact	Reduction Amount
%18,1	1.012.860 tCO_2e

Target Year
2050
Long Term

Estimated Cost
-

Stakeholders

- District Municipalities
- Ministry of Environment, Urbanization and Climate Change
- Non-Governmental Organizations (NGOs)
- Provincial Directorate of Agriculture and Forestry

Performance Indicators

- Increase in the ratio of forest land in the province (%)
- Number of action plans prepared for the protection of SEPA (Specially Environmental Protection Areas) (units/year)
- Number of action plans for the protection of wetlands (units/year)
- Increase in the presence of urban green spaces (%)

Responsible Body

Muğla Regional Directorate of Forestry / Muğla Directorate of Nature Conservation and National Parks / Muğla Provincial Directorate of Environment, Urbanization and Climate Change / Muğla Metropolitan Municipality Department of Reconstruction and Urbanism / Muğla Metropolitan Municipality Department of Climate Change and Zero Waste

SDG

ACTION CARD

A.1. H.5.3.	SUSTAINABLE WASTE AWARENESS AND EDUCATION PROGRAM

Action Description

Comprehensive waste management training sessions will be organized to encourage individuals and institutions to reduce waste generation, separate waste correctly, and ensure active participation in recycling processes. By increasing the awareness levels of participants regarding waste management, the aim is to both strengthen environmental sustainability and support a more efficient waste collection and recovery system throughout the city.

WASTE

Mitigation Impact	Reduction Amount
-	-

Target Year
2050
Long Term

Estimated Cost
-

Stakeholders

- Ministry of Environment, Urbanization and Climate Change
- Muğla Provincial Directorate of National Education
- Muğla Sıtkı Koçman University

Performance Indicators

- Number of Participants in Organized Trainings, Workshops, etc.

Responsible Body	Muğla Provincial Directorate of Environment, Urbanization and Climate Change / Muğla Metropolitan Municipality Department of Climate Change and Zero Waste / District Municipalities

SDG

ACTION CARD

A.1. H.5.4. RECOVERY OF BIODEGRADABLE WASTE THROUGH ALTERNATIVE METHODS

WASTE

Action Description

The goal is to ensure circularity by transforming biodegradable waste, originating from various activities such as agriculture, tourism, and wastewater treatment throughout the province, on-site through alternative recovery methods, thereby reducing carbon emissions resulting from waste disposal.

Sub Actions

- Development of projects for the recovery of vineyard, garden, and pruning waste originating from pruning, landscaping, and similar activities in the agriculture and tourism sectors, instead of disposal in sanitary landfills.
- Development of R&D projects for the recovery (use in agriculture, etc.) of sewage sludge generated at MUSKİ urban wastewater treatment plants within the provincial borders.
- Increasing energy production capacity from waste by establishing biomass energy plants at additional solid waste sanitary landfills to be constructed.

Priority

Medium

Estimated Cost

-

Target Year

2040 (Medium Term)

Stakeholders

- District Municipalities
- Waste Producers
- Muğla Sıtkı Koçman University

Performance Indicators

- Amount of recovered biodegradable waste (tons/year)
- Installed biomass energy plant capacity (MW)
- Increase in installed biomass energy plant capacity (%)

Implementation Risks/Challenges

- Infrastructural deficiencies regarding the separation of waste at the source
- Legislative constraints regarding the use of treatment sludge in agriculture

Responsible Body

Muğla Metropolitan Municipality Department of Environmental Protection and Control / Muğla Metropolitan Municipality Department of Climate Change and Zero Waste / MUSKİ (Muğla Water and Sewerage Administration) General Directorate / District Municipalities

SDG

ACTION CARD

A.2. H.1.1. MAINSTREAMING CLIMATE CHANGE ADAPTATION INTO URBAN PLANNING PROCESSES

Action Description

This action encompasses making land use and urban planning decisions in Muğla compatible with climate risks, strengthening green and blue infrastructure, and applying climate adaptation criteria in new development areas. It is planned to incorporate these adaptation measures into municipal zoning regulations and project specifications.

Related LCCAAP Target: The adaptation capacity and resilience of Muğla city and its residents will be increased, and nature-balanced, climate-resilient, and sustainable urbanization will be ensured.

LAND USE

Target Year

2030 Short Term

Stakeholders

- District Municipalities
- Provincial Directorate of Environment, Urbanization and Climate Change
- Universities

Performance Indicators

- Ratio of spatial/zoning plans integrated with climate adaptation criteria (%)

Responsible Body

Provincial Directorate of Environment, Urbanization and Climate Change / Muğla Metropolitan Municipality Department of Reconstruction and Urbanism / District Municipalities

SDG

ACTION CARD

A.2. H.1.2. REDUCING FLOOD AND OVERFLOW RISKS THROUGH NATURE-BASED SOLUTIONS

LAND USE

Action Description

This action involves increasing green spaces that allow for natural water retention to reduce pressure from floods and overflows, and implementing nature-based landscaping arrangements that mitigate flood spread. Within this scope, it is planned to increase permeable surfaces and implement ecological designs that support natural water retention capacity.

Related LCCAAP Target: The adaptation capacity and resilience of Muğla city and its residents will be increased, and nature-balanced, climate-resilient, and sustainable urbanization will be ensured.

Sub Actions

- Implementation of sponge city concepts, artificial streams, and similar applications in parks, gardens, and green spaces.
- Increasing the amount of permeable surface areas within the city.
- Increasing the total amount of urban green space.
- Afforestation in both urban and rural areas.
- Expanding the use of water-wise landscaping in urban green spaces.

Target Year

2040 Medium Term

Stakeholders

- State Hydraulic Works (DSİ)
- District Municipalities
- Provincial Directorate of Environment, Urbanization and Climate Change

Performance Indicators

- Increase in urban green space area (%)
- Size of urban areas where xeriscaping (water-wise landscaping) is applied (m2/year)
- Number of afforestation efforts and/or seedling/tree supports provided (count/year)
- Number of experimental gardens established (count/year)

Responsible Body

Muğla Metropolitan Municipality Department of Agricultural Services
District Municipalities
MUSKİ (Muğla Water and Sewerage Administration)

SDG

Priority

Medium

ACTION CARD

A.2. H.1.3. ENHANCING THE RESILIENCE OF SETTLEMENTS ADJACENT TO FOREST AREAS AGAINST FOREST FIRES

Action Description

This action aims to enhance the resilience of rural and forest-fringe settlements against increasing forest fire risks. It covers the identification of high-risk areas, the creation of defensible spaces around settlements, and targeted vegetation management practices. Additionally, it aims to reduce loss of life, property, and ecosystems through core preparedness and awareness measures.

Related LCCAAP Target: Measures to prevent forest fires in Muğla province will be taken, and the adaptation of biodiversity and ecosystem services to climate change will be ensured.

LAND USE

Target Year

2030 Short Term

Stakeholders

- Muğla Metropolitan Municipality
- District Municipalities
- Provincial/District Directorates of Environment, Urbanization and Climate Change
- AFAD (Disaster and Emergency Management Authority)

Performance Indicators

- Number of rural / forest-fringe settlements where fire risk reduction measures are implemented (count/year)
- Number of community preparedness and evacuation training sessions conducted (count/year)

Responsible Body

Regional Directorate of Forestry

SDG

ACTION CARD

A.2. H.1.4. PROTECTION OF BIODIVERSITY AND MONITORING OF CLIMATE-SENSITIVE SPECIES

Action Description

This action plans for the monitoring of species and ecosystems endemic to Muğla against the impacts of climate change, the inventorying of sensitive species, and the protection of critical habitats.

Related LCCAAP Target: Measures to prevent forest fires in Muğla province will be taken, and the adaptation of biodiversity and ecosystem services to climate change will be ensured.

BIODIVERSITY

Target Year

2030 Short Term

Stakeholders

- Regional Directorate of Forestry
- Special Environmental Protection Areas (SEPA)
- Provincial and District Municipalities
- Universities (Biology, Ecology departments)
- NGOs

Performance Indicators

- Number of sensitive species monitored (count/year)
- Number of habitats / areas placed under protection (count/year)

Responsible Body

Directorate of Nature Conservation and National Parks

SDG

ACTION CARD

A.2. H.2.1. INSTALLATION OF RAINWATER HARVESTING AND STORAGE SYSTEMS

WATER

Action Description

This action encompasses the installation, promotion, and establishment of technical standards for rainwater harvesting and storage systems. It is planned to recover rainwater from roofs, hard surfaces, and suitable collection areas to be redirected for use.

Related LCCAAP Target: The adaptation capacity and resilience of Muğla and its citizens will be increased; climate-resilient, sustainable urbanization in balance with nature will be ensured.

Sub Actions

- Installation of rainwater harvesting and storage systems in buildings and facilities to be constructed by the Municipality.
- Installation of rainwater harvesting and storage systems in parks and green areas.
- Implementation and expansion of rainwater harvesting practices in the agricultural sector, primarily for irrigation.
- Development of pilot projects by MUSKİ for the separate collection, storage, and utilization of rainwater to ensure urban water efficiency.

Target Year 2050 Long Term

Implementation Risks/ Challenges

- Requirement for large areas for rainwater storage systems.

Stakeholders

- State Hydraulic Works (DSİ)
- District Municipalities
- Provincial Directorate of Environment, Urbanization and Climate Change
- Irrigation Cooperatives

Performance Indicators

- Number of public buildings with rainwater harvesting systems (count/year)
- Amount of rainwater harvested in parks and green areas (m3/year)
- Amount of rainwater used in agricultural irrigation (m3/year)
- Amount of recovered rainwater in urban water efficiency (m3/year)

Responsible Body Muğla Metropolitan Municipality Department of Agricultural Service / MUSKİ

SDG

Priority

Low

ACTION CARD

A.2. H.2.2.	ENHANCING AND IMPROVING THE CLIMATE RESILIENCE OF WATER ECOSYSTEMS AND BASINS	WATER

Action Description

This action encompasses the protection of fragile aquatic ecosystems (lakes, rivers, wetlands), the restoration of degraded water areas using ecological methods, the strengthening of basin protection efforts, and the reduction of pressures affecting water quality.

Related LCCAAP Target: Water resource management in Muğla will be strengthened; efficiency in urban, industrial, and especially agricultural water use will be increased; and efforts will be made to protect and monitor the quality of the province's water resources.

Sub Actions

- Implementing practices and improvements for the protection of aquatic ecosystems.
- Preparing Basin Protection Plans.

Target Year 2040 Medium Term

Implementation Risks / Challenges

- Inability to prepare basin protection plans holistically due to property ownership issues.

Stakeholders

- State Hydraulic Works (DSİ)
- District Municipalities
- Provincial Directorate of Environment, Urbanization and Climate Change
- Universities

Performance Indicators

- Number of projects implemented for the protection of aquatic ecosystems (count/year)
- Number of Basin Protection Plans prepared on a provincial basis (count/year)
- Number of Basin Protection Plans approved on a provincial basis (count/year)
- MUSKİ Basin Protection Regulation (exists/does not exist)

Responsible Body MUSKİ / State Hydraulic Works (DSİ)
General Directorate for Preservation of Natural Heritage

SDG

Priority

Medium

ACTION CARD

A.2. H.2.3. ESTABLISHING PROTECTION ZONES AROUND STREAM BEDS

WATER

Action Description

This action encompasses designating development-free protection zones around stream beds to reduce risks from floods, storm surges, and heavy precipitation, integrating these areas into spatial plans, and managing stream corridors to preserve natural flow capacity.

Related LCCAAP Target: The adaptation capacity and resilience of Muğla and its citizens will be increased; climate-resilient, sustainable urbanization in balance with nature will be ensured.

Sub Actions

- Designating protection zones around stream beds.
- Integrating protection zones into spatial plans.
- Regularly cleaning stream beds to ensure unobstructed natural flow.

Target Year 2050 Long Term

Implementation Risks / Challenges

- Requirement for expropriation.

Stakeholders

- District Municipalities
- Universities

Performance Indicators

- Length of stream lines with designated protection zones (km/year)
- Number of improvement interventions implemented in high flood-risk areas (count/year)

Responsible Body Ministry of Environment, Urbanization and Climate Change
MUSKİ / State Hydraulic Works (DSİ)

SDG

Priority

Medium

ACTION CARD

A.2. H.2.4. MONITORING, PROTECTION, AND EFFICIENT USE OF WATER RESOURCES

WATER

Action Description

This action encompasses strengthening monitoring systems to protect surface and groundwater, reducing water loss and leakage rates, increasing the use of alternative water sources, and expanding their application.

Related LCCAAP Target: Water resource management in Muğla will be strengthened; efficiency in urban, industrial, and especially agricultural water use will be increased; and efforts will be made to protect and monitor the quality of the province's water resources.

Sub Actions

- Reducing loss and leakage rates in drinking water lines.
- Expanding the reuse of treated urban wastewater and increasing the amount of reclaimed water.
- Implementing projects and investments for alternative water sources, especially in districts with high water scarcity and drought risk (e.g., regional desalination, industrial wastewater recovery).
- Preparing Water Management Master Plans to create a roadmap for the integrated and efficient management of water resources province-wide.

Target Year: 2050 Long Term

Stakeholders

- District Municipalities
- Universities

Performance Indicators

- Reduction in drinking water loss and leakage rate (%)
- Amount of reclaimed wastewater throughout the province (m3/year)
- Number of implemented projects regarding the provision of alternative water sources (count/year)

Responsible Body: MUSKİ / State Hydraulic Works (DSİ)

SDG

Priority

Medium

ACTION CARD

A.2. H.3.1. EXPANDING DROUGHT-RESISTANT CROP PATTERNS

FOOD SECURITY

Action Description

It encompasses identifying drought-resistant crop varieties, expanding them to suitable agricultural areas, planning crop patterns, and increasing producer access to technical information for adaptation. The goal is to establish a high-productivity production model with low water consumption that is resilient to climate risks.

Related LCCAAP Target: To ensure Muğla maintains its status as a significant agricultural city in Türkiye, its agricultural structure will be protected and developed.

Sub Actions

- Developing pilot applications and projects to expand drought-resistant crop patterns.
- Providing consultancy on fertilization and irrigation based on the specific crop at the Soil, Plant, and Irrigation Water Laboratory established in cooperation with the University.
- Developing R&D projects to enhance climate resilience in crop patterns and ensure food security.
- Training producers on climate crisis impacts and the selection of climate-resilient crops.
- Creating GIS-based mapping of the province's crop patterns.

Target Year 2040 Medium Term

Stakeholders

- District Municipalities
- Universities
- Non-Governmental Organizations (NGOs)
- Farmers

Performance Indicators

- Number of drought-resistant seedlings provided to the producer
- Number of medicinal-aromatic plants produced
- Number of soil, plant, and irrigation water analyses
- Number of developed projects
- Number of seeds distributed at the Local Seed Center
- Number of people trained (people/year)

Responsible Body Muğla Metropolitan Municipality Department of Agricultural Services / Muğla Provincial Directorate of Agriculture and Forestry

SDG

Priority

Medium

ACTION CARD

A.2. H.3.2. STRENGTHENING THE ADAPTATION CAPACITY OF AGRICULTURAL PRODUCERS TO CLIMATE CHANGE

FOOD SECURITY

Action Description

This action encompasses the development of training, consultancy, cooperative formation, insurance applications, digital information networks, and support mechanisms specifically for women and young producers to increase their capacity to adapt to climate change. In doing so, the sustainability of the rural economy and the resilience of producers against climate-induced risks will be enhanced.

Related LCCAAP Target: To ensure that Muğla, a significant agricultural city in Türkiye, maintains this status, its agricultural structure will be protected and developed.

Sub Actions

- Supporting the formation of cooperatives by the municipality and conducting projects for this purpose.
- Establishing new facilities for locally specific products through municipal support to strengthen local agricultural production capacity.
- Providing training to producers on the impacts of the climate crisis on agricultural production and the selection of climate-resilient, appropriate crops.

Target Year 2030 Short Term

Stakeholders

- District Municipalities
- Universities
- Non-Governmental Organizations (NGOs)
- Producers
- Agricultural Cooperatives

Performans Indicators

- Number of agricultural cooperatives throughout the province (count/year)
- Number of supports and incentives provided by the municipality to producers and agricultural cooperatives (count/year)
- Number of established production facilities (count/year)
- Number of people trained (people/year)

Responsible Body Muğla Metropolitan Municipality Department of Agricultural Services / Muğla Provincial Directorate of Agriculture and Forestry

SDG

Priority

High

ACTION CARD

A.2. H.4.1. ESTABLISHING EARLY WARNING SYSTEMS FOR THE CLIMATE-RELATED DISASTERS

Action Description

It encompasses the establishment of sensor-based measurement networks, meteorological monitoring stations, mobile warning systems, and data analysis infrastructures for the early detection of climate-induced disasters. The plan aims to reduce disaster risks and support rapid decision-making processes by delivering early warning notifications to producers, local governments, and relevant institutions.

Related LCCAAP Target: Disaster risk reduction activities related to climate change will be carried out in Muğla.

DISASTER MANAGEMENT

Target Year

2030 Short Term

Stakeholders

- Muğla Metropolitan Municipality
- District Municipalities
- State Hydraulic Works (DSİ)
- Regional Directorate of Forestry
- Provincial Directorate of Meteorology

Performance Indicators

- Number of established early warning stations / sensors
- Number of users / institutions registered in the warning system

Responsible Body Provincial Directorate of AFAD (Disaster and Emergency Management Authority)

SDG

ACTION CARD

A.2. H.4.2. MONITORING CLIMATE-SENSITIVE DISEASES AND STRENGTHENING PUBLIC HEALTH RISK MANAGEMENT

Action Description

It encompasses the strengthening of data collection and early warning mechanisms for monitoring health risks related to heatwaves, vector-borne diseases, water-borne illnesses, and air quality. There are plans to create a provincial-level list of climate-sensitive diseases and to enhance monitoring, evaluation, and integration with health centers.

Related LCCAAP Target: The infrastructure for climate change adaptation in the health sector within Muğla province will be strengthened.

PUBLIC HEALTH

Target Year

2030 Short Term

Stakeholders

- Provincial Directorate of Meteorology
- Provincial Directorate of Environment, Urbanization and Climate Change
- Provincial and District Municipalities

Performance Indicators

- Number of monitored climate-sensitive disease types
- Number of training sessions conducted against diseases caused by climate change

Responsible Body

Muğla Provincial Directorate of Health

SDG

ACTION CARD

A.2. H.5.1. ENHANCING THE ADAPTATION CAPACITY OF TOURISM INFRASTRUCTURE AGAINST CLIMATE RISKS

Action Description

This encompasses the protection of cultural heritage and natural areas, enhancing the resilience of tourism facilities and infrastructure against climate risks, strengthening sustainable tourism practices, and developing the adaptation capacity of sector stakeholders. These efforts are planned to be carried out through a holistic approach.

Related LCCAAP Target: The adaptation capacity and resilience of existing tourism activities, facilities providing tourism services, and infrastructure in Muğla against climate risks will be increased.

TOURISM

Target Year

2030 Short Term

Paydaşlar

- Tourism Facility Operators
- Ministry of Culture and Tourism
- District Municipalities
- Non-Governmental Organizations (NGOs)
- Universities

Performans Göstergeleri

- Number of facilities and infrastructure elements where climate adaptation measures are implemented
- Rate of change in cultural heritage and natural protected areas (%)

Responsible Body Muğla Provincial Directorate of Culture and Tourism, Muğla Metropolitan Municipality Department of Urban History and Tourism

SDG

ACTION CARD

A.2. H.5.2 ENHANCING THE RESILIENCE OF ENERGY INFRASTRUCTURE AGAINST CLIMATIC RISKS

Action Description

It encompasses the strengthening of energy transmission and distribution lines, as well as HEPP (Hydroelectric Power Plants) and biomass/biogas facilities, against climate risks and the implementation of protective structural measures in renewable energy plants.

Related LCCAAP Target: The impacts of climate hazards on Muğla's energy system will be reduced; water management will be improved to increase the resilience of thermal and hydroelectric power plants against climate change; and improvement and adaptation projects will be implemented to maintain the efficiency of all power plants against extreme weather conditions.

INFRASTRUCTURE MANAGEMENT

Target Year

2030 Short Term

Stakeholders

- TEİAŞ (Turkish Electricity Transmission Corporation)
- EPDK (EMRA - Energy Market Regulatory Authority)
- Contractor Firms / Implementing Companies
- Municipalities

Performance Indicators

- Number of energy facilities (units) and line length (km) with climate risk resilience enhancements
- Reduction in energy outage duration due to extreme weather events (%)

Responsible Body Relevant Distribution Company

SDG

ACTION CARD

A.2. H.5.3. STRENGTHENING TRANSPORTATION AND COMMUNICATION INFRASTRUCTURE AGAINST THE IMPACTS OF CLIMATE CHANGE

TRANSPORTATION

Action Description

Strengthening the transportation infrastructure against climate risks, making improvements in public transport infrastructure, and developing smart transportation applications are planned.

Related LCCAAP Target: The climate resilience of critical transportation and communication infrastructures in Muğla province will be increased; transportation and passenger safety will be ensured by reducing vulnerability levels; planning and emergency management capacity will be enhanced; and a flexible transportation system with high adaptation capacity will be established by developing high-quality alternatives instead of the current trend based on individual and motorized vehicle transportation.

Sub Actions

- Strengthening urban transportation infrastructure through smart city applications.
- Strengthening urban communication infrastructure.

Target Year 2050 - Long Term

Stakeholders

- District Municipalities
- 2nd Regional Directorate of Highways
- AFAD
- UKOME
- MUTTAŞ

Performance Indicators

- Length of newly constructed and/or improved highways (km)
- Length of newly constructed and/or improved bicycle paths (km)
- Length of newly constructed and/or improved pedestrian paths (km)

Responsible Body Muğla Metropolitan Municipality Department of Smart City and Urban Information Systems / Muğla Metropolitan Municipality Department of Transportation

SDG

Priority

Medium

ACTION CARD

A.2. H.5.4. CLIMATE RISK MANAGEMENT AND STRENGTHENING RESILIENCE IN INDUSTRIAL FACILITIES

Action Description

This encompasses identifying the vulnerabilities of industrial facilities to climate-related risks, establishing facility-based risk management and early warning systems, and implementing adaptation measures to increase resilience, particularly in agriculture-based small and micro-scale enterprises.

Related LCCAAP Target: The impacts of climate change on the industrial sector and the adaptation approach will be planned with a specific focus on small and micro-scale enterprises operating in the agro-based industrial field.

INDUSTRY

Target Year

2030 - Short Term

Stakeholders

- OIZ Directorates (Organized Industrial Zone Directorates)
- Chambers of Commerce and Industry
- Small Industrial Estates
- KOSGEB (Small and Medium Enterprises Development Organization of Türkiye)

Performance Indicators

- Number of industrial facilities with completed risk assessments
- Number of facility-based risk management systems established or strengthened

Responsible Body

Muğla Provincial Directorate of Industry and Technology
Industrial Facilities

SDG

OVERALL ASSESSMENT

8

8. Overall Assessment

Within the scope of the Muğla Sustainable Energy and Climate Action Plan (SECAP), a holistic approach to combating the climate crisis has been adopted, defining a total of 10 goals and 38 actions under two main objectives: mitigation and adaptation.

In this framework, 22 mitigation actions have been developed to reduce greenhouse gas emissions, aiming to reach a carbon-neutral target by achieving an 80% reduction in emissions by 2050. To increase the city's resilience against the current and projected impacts of climate change, 16 adaptation actions have been planned, covering critical areas such as water management, agriculture, tourism, disaster risk, ecosystems, and infrastructure.

The identified actions have been prioritized by considering Muğla's spatial, environmental, and socio-economic characteristics and structured in line with the criteria of feasibility, impact, and sustainability. In this regard, SECAP presents a strategic roadmap that supports Muğla's vision for a low-carbon and climate-resilient future with a concrete, traceable, and applicable set of actions.

Objective 1: To reduce carbon emissions and alleviate energy poverty throughout the province by promoting energy efficiency and the widespread use of renewable energy.			
Target 1: Enhancing environmental sustainability by ensuring the integration of renewable energy sources and more efficient energy use throughout the municipality.			
Action Code	**Action**	**Emission Reduction (tCO_2e)**	**Mitigation Impact (%)**
A.1 H.1.1	SPP (SOLAR POWER PLANT) INTEGRATION IN MUNICIPAL FACILITIES	2.169	%0,1
A.1 H.1.2	SUSTAINABLE URBAN LIFE AWARENESS PROGRAM	-	-
A.1 H.1.3	SOLAR POWERED LED LIGHTING SYSTEMS	49.758	%0,9
A.1 H.1.4	ENERGY EFFICIENCY IN MUNICIPAL FACILITIES	-	-

Objective 1: To reduce carbon emissions and alleviate energy poverty throughout the province by promoting energy efficiency and the widespread use of renewable energy.			
Target 2: Reducing household energy consumption by increasing energy efficiency and the use of renewable energy in residential buildings.			
Action Code	**Action**	**Emission Reduction (tCO_2e)**	**Mitigation Impact (%)**
A.1 H.2.1	ENERGY EFFICIENCY IN RESIDENTIAL AND COMMERCIAL BUILDINGD	113.677	%2
A.1 H.2.2	RENEWABLE ENERGY APPLICATIONS IN RESIDENTIAL BUILDINGS	703.912	%12,6
A.1 H.2.3	THERMAL INSULATION AND ISOLATION IMPROVEMENTS IN RESIDENTIAL BUILDINGS	26.689	%0,5
A.1 H.2.4	IMPROVING AND MONITORING URBAN AIR QUALITY	-	-
A.1 H.2.5	HEAT PUMP APPLICATIONS IN RESIDENTIAL BUILDINGS	59.746	%1

Objective 1: To reduce carbon emissions and alleviate energy poverty throughout the province by promoting energy efficiency and the widespread use of renewable energy.			
Target 3: Reducing greenhouse gas emissions and adopting sustainable energy sources in commercial and service buildings, as well as industrial facilities.			
Action Code	**Action**	**Emission Reduction (tCO_2e)**	**Mitigation Impact (%)**
A.1 H.3.1	ENERGY EFFICIENCY STUDIES IN COMMERCIAL AND INSTITUTIONAL BUILDINGS	359.326	%6,4
A.1 H.3.2	RENEWABLE ENERGY APPLICATIONS IN COMMERCIAL AND INSTITUTIONAL BUILDIGNS	635.673	%11,4
A.1 H.3.3	HEAT PUMP IN COMMERCIAL AND PUBLIC BUILDINGS	60.652	%1,1
A.1 H.3.4	ENERGY EFFICIENCY STUDIES IN INDUSTRIAL FACILITIES	56.210	%1
A.1 H.3.5	RENEWABLE ENERGY APPLICATIONS IN INDUSTRIAL FACILITIES	149.550	%2,7
A.1 H.3.6.	WATER EFFICIENCY STRATEGY IN AGRICULTURAL IRRIGATION SYSTEMS	22.814	%0,4

Objective 1: To reduce carbon emissions and alleviate energy poverty throughout the province by promoting energy efficiency and the widespread use of renewable energy.			
Target 4: Reducing carbon emissions by transforming transportation systems into an eco-friendly, sustainable, and efficient structure.			
Action Code	**Action**	**Emission Reduction (tCO_2e)**	**Mitigation Impact (%)**
A.1 H.4.1	DEVELOPMENT OF ELECTRIC VEHICLE INFRASTRUCTURE	2.191.972	%39,2
A.1 H.4.2	DEVELOPMENT OF LOW CARBON AND INTEGRATED PUBLIC TRANSPORTATION SYSTEMS	110.471	%2
A.1 H.4.3	GREEN TRANSFORMATION OF PUBLIC TRANSPORTATION AND MUNICIPAL VEHICLE FLEET	22.136	%0,4

Objective 1: To reduce carbon emissions and alleviate energy poverty throughout the province by promoting energy efficiency and the widespread use of renewable energy.			
Target 5: Reducing greenhouse gas emissions from waste by transforming waste management systems throughout the district into an eco-friendly, sustainable, and efficient structure.			
Action Code	**Action**	**Emission Reduction (tCO_2e)**	**Mitigation Impact (%)**
A.1 H.5.1	CIRCULAR RESOURCE MANAGEMENT AND RECOVERY PROGRAM	16.098	%3
A.1 H.5.2	CARBON SINK CAPACITY ENHANCEMENT PROJECT	1.012.860	%18,1
A.1 H.5.3	SUSTAINABLE WASTE AWARENESS AND EDUCATION PROGRAM	-	-
A.1 H.5.4	RECOVERY OF BIODEGRADABLE WASTE THROUGH ALTERNATIVE METHODS	-	-

Objective 2: Strengthening climate resilience by increasing the adaptation capacity of the city, ecosystems, and society against the current and projected impacts of climate change.	
Target 1: Increasing the resilience of settlements against climate risks through nature-based and ecosystem-based solutions.	
Action Code	**Action**
A.2 H1.1	MAINSTREAMING CLIMATE CHANGE ADAPTATION INTO URBAN PLANNING PROCESSES
A.2 H1.2	REDUCING FLOOD AND OVERFLOW RISKS THROUGH NATURE-BASED SOLUTIONS
A.2 H1.3	ENHANCING THE RESILIENCE OF SETTLEMENTS ADJACENT TO FOREST AREAS AGAINST FOREST FIRES
A.2. H.1.4	PROTECTION OF BIODIVERSITY AND MONITORING OF CLIMATE-SENSITIVE SPECIES

Objective 2: Strengthening climate resilience by increasing the adaptation capacity of the city, ecosystems, and society against the current and projected impacts of climate change.	
Target 2: Enhancing the resilience of water management against climatic risks and the protection of water ecosystems.	
Action Code	**Action**
A.2 H2.1.	INSTALLATION OF RAINWATER HARVESTING AND STORAGE SYSTEMS
A.2 H2.2.	ENHANCING AND IMPROVING THE CLIMATE RESILIENCE OF WATER ECOSYSTEMS AND BASINS
A.2 H2.3.	ESTABLISHING PROTECTION ZONES AROUND STREAM BEDS
A.2 H2.4.	MONITORING, PROTECTION, AND EFFICIENT USE OF WATER RESOURCES

Objective 2: Strengthening climate resilience by increasing the adaptation capacity of the city, ecosystems, and society against the current and projected impacts of climate change.	
Target 3: Promoting the widespread adoption of sustainable agricultural methods resistant to climate-related disasters in order to mitigate the impacts of climate change on agriculture.	
Action Code	**Action**
A.2 H3.1	EXPANDING DROUGHT-RESISTANT CROP PATTERNS
A.2 H3.2	STRENGTHENING THE ADAPTATION CAPACITY OF AGRICULTURAL PRODUCERS TO CLIMATE CHANGE

Objective 2: Strengthening climate resilience by increasing the adaptation capacity of the city, ecosystems, and society against the current and projected impacts of climate change.	
Target 4: Strengthening disaster management, early warning, and public health systems against climate risks.	
Action Code	**Action**
A.2 H4.1.	ESTABLISHING EARLY WARNING SYSTEMS FOR THE CLIMATE-RELATED DISASTERS
A.2 H4.2.	MONITORING CLIMATE-SENSITIVE DISEASES AND STRENGTHENING PUBLIC HEALTH RISK MANAGEMENT

Objective 2: Strengthening climate resilience by increasing the adaptation capacity of the city, ecosystems, and society against the current and projected impacts of climate change.	
Target 5: Increasing climate resilience in critical infrastructure and economic production systems.	
Action Code	**Action**
A.2 H5.1	ENHANCING THE ADAPTATION CAPACITY OF TOURISM INFRASTRUCTURE AGAINST CLIMATE RISKS
A.2 H5.2	ENHANCING THE RESILIENCE OF ENERGY INFRASTRUCTURE AGAINST CLIMATIC RISKS
A.2 H5.3	STRENGTHENING TRANSPORTATION AND COMMUNICATION INFRASTRUCTURE AGAINST THE IMPACTS OF CLIMATE CHANGE
A.2 H5.4	CLIMATE RISK MANAGEMENT AND STRENGTHENING RESILIENCE IN INDUSTRIAL FACILITIES

To successfully implement climate change mitigation and adaptation policies and activities, it is essential to develop clearly defined evaluation and reporting requirements and monitoring methods that provide performance assessments.

In this regard, action owners, targeted implementation years, and performance indicators have been determined for all actions included in the SECAP Report. A Monitoring and Evaluation System will be established under the coordination of the Department of Climate Change and Zero Waste. Through this system, the implementation status of mitigation and adaptation actions will be monitored and reported in 6-month periods, and an annual evaluation report based on concrete, measurable data derived from performance indicators will be prepared and shared with relevant stakeholders.

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