This project is co-financed by the European Union and the Republic of Turkey.

DENİZLİ

CLIMATE CHANGE ACTION PLAN

2016 - 2030

CFCU
CENTRAL FINANCE & CONTRACTS UNIT

DENİZLİ
METROPOLITAN
MUNICIPALITY

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Denizli Climate Change Action Plan

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Reminder

This publication has been produced with the financial assistance of the European Union.

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FOREWORD

Climate change is one of the biggest threats our planet faces. If the world's temperature rises more than 2 Celsius degrees compared to pre-industrial revolution, climate change will become irreversible and will have huge impacts in the long term.

With the global temperature rise, increase in the frequency and impact of extreme weather events such as drought, flood, hurricane are observed, human communities are at serious risk as well as plants, animals and ecosystems as a result of factors such as the increase of seawater levels, acidification of oceans and the melting of glaciers. Scientifically obtained concrete data reveal that greenhouse gases created by humans cause global climate change.

Constituting 70% of the global population and 80% of greenhouse gas emissions, cities play an important role in combatting with climate change. Local governments have important means of combating in urban planning, transportation, buildings and waste, which are their main areas of authority and responsibility.

Under the Capacity Building in the Field of Climate Change in Turkey Grant Scheme supported by the EU, we have prepared Denizli Climate Change Action Plan, as one of the main activities of "**Power the Revolution for Climate Action Project**" of which Central Finance and Contracts Unit, is the Contracting Authority, the Ministry of Environment and Urbanization is the beneficiary and Denizli Metropolitan Municipality is the implementing institution.

Denizli Climate Change Action Plan is a plan that sets out the framework for mitigation and adaptation in combatting with climate change. The Climate Change Action Plan prepared at city scale will contribute to achieving the goal of a low-carbon and climate-resilient Denizli.

I would like to express my gratitude to our municipality staff, public institutions and organizations in Denizli, non-governmental organizations, private sector representatives and REC Turkey for their support.

Denizli Climate Change Action Plan will contribute to national, regional and local policies and Turkey's development objectives towards sustainability. I hope that this valuable work will be an example for other projects that will be necessary in this way and will contribute to the development of the capacity of Turkey's mitigation and adaptation.

With deepest regards…

Osman ZOLAN

Mayor of Denizli

SCIENTIFICALLY OBTAINED CONCRETE DATA REVEAL THAT GREENHOUSE GASES CREATED BY HUMANS CAUSE GLOBAL CLIMATE CHANGE.

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EXECUTIVE SUMMARY

Denizli Climate Change Action Plan study has been conducted by REC Turkey under "**Power the Revolution for Climate Action**", supported by the European Union Pre-Accession Assistance (IPA) fund, of which Denizli Metropolitan Municipality is the beneficiary[1].

It is very important to contribute to the national efforts to combat global climate change at the local level. In this respect, Denizli Climate Change Action Plan is of great importance. Target-driven mitigation of greenhouse gas emissions through the implementation of mitigation actions will not remain as a local effort only, but will also support the reduction of total greenhouse gas emissions in Turkey. On the other hand, the implementation of the adaptation actions is largely dependent on local activism although adaptation policy at the national level is important for the general framework and political ownership. In order to mitigate the greenhouse gases that cause climate change and reduce the risks arising from climate change, the actions in the plan are aimed to overlap with the policies and activities in other related areas as much as possible.

The Climate Change Action Plan (CCAP), which will be a milestone in Denizli's struggle with climate change, will serve as a basic source and road map for the officials and specialists of Denizli Metropolitan Municipality and representatives of other related institutions.

THE CLIMATE CHANGE ACTION PLAN (CCAP), WHICH WILL BE A MILESTONE IN DENIZLI'S STRUGGLE WITH CLIMATE CHANGE, WILL SERVE AS A BASIC SOURCE AND ROAD MAP.

A fully participatory process has been followed while preparing the CCAP and all relevant stakeholders have been included in the preparation process. A Advisory Board was formed in the first phase of the study to provide general guidance to the action plan, by bringing together key institutions. CCAP Advisory Board, the members below met three times during the study period. A total of 5 stakeholder workshops, in addition to the steering meetings, have been organized in order to transfer the experience and suggestions of the other stakeholders to the study, and individual and sectoral surveys have been applied to the participants in these workshops. The questionnaires are structured so as to provide a base for mitigation and adaptation actions. In the first workshop, a road map was prepared for data collection. In the second workshop greenhouse gas inventory results and future projections were evaluated and actions were finalized through structured surveys in the third workshop. In the last workshop, adaptation actions were built in the light of identified risks.

The vision of the action plan is defined as "**making Denizli a low carbon, climate change resistant model city"**. In the light of this vision, **21% reduction from increase** was identified **as a realistic goal** covering all emission sources at the provincial level. Taking into account Turkey's Intended Nationally Determined Contribution (INDC), the target year is determined as **2030**, which is the year envisaged in international

[1] Power the Revolution for Climate Action is one of the projects supported under the Capacity Building in the Field of Climate Change in Turkey Grant Scheme by the European Union.

processes. Setting a goal of reduction from increase in parallel with Turkey's national goal and determining the goal as per capita, considering the population increase, was deemed appropriate.

During the preparation of the CCAP, literature survey, stakeholder analysis, desktop analysis, coordination meetings with key institutions / organizations, stakeholder workshops, questionnaire studies and bilateral interviews were conducted and this report herein was prepared.

MITIGATION

Prior to the GHG inventory reporting, the existing national and international sources were scanned in detail, and the relevant data for the year 2016 were systematically collected, classified and analyzed. 2016 was chosen as the inventory year. The main reasons for this are that the most current, holistic and accurate data on the national scale and the Denizli scale can be reached in this year. These data were classified according to the identified methodology.

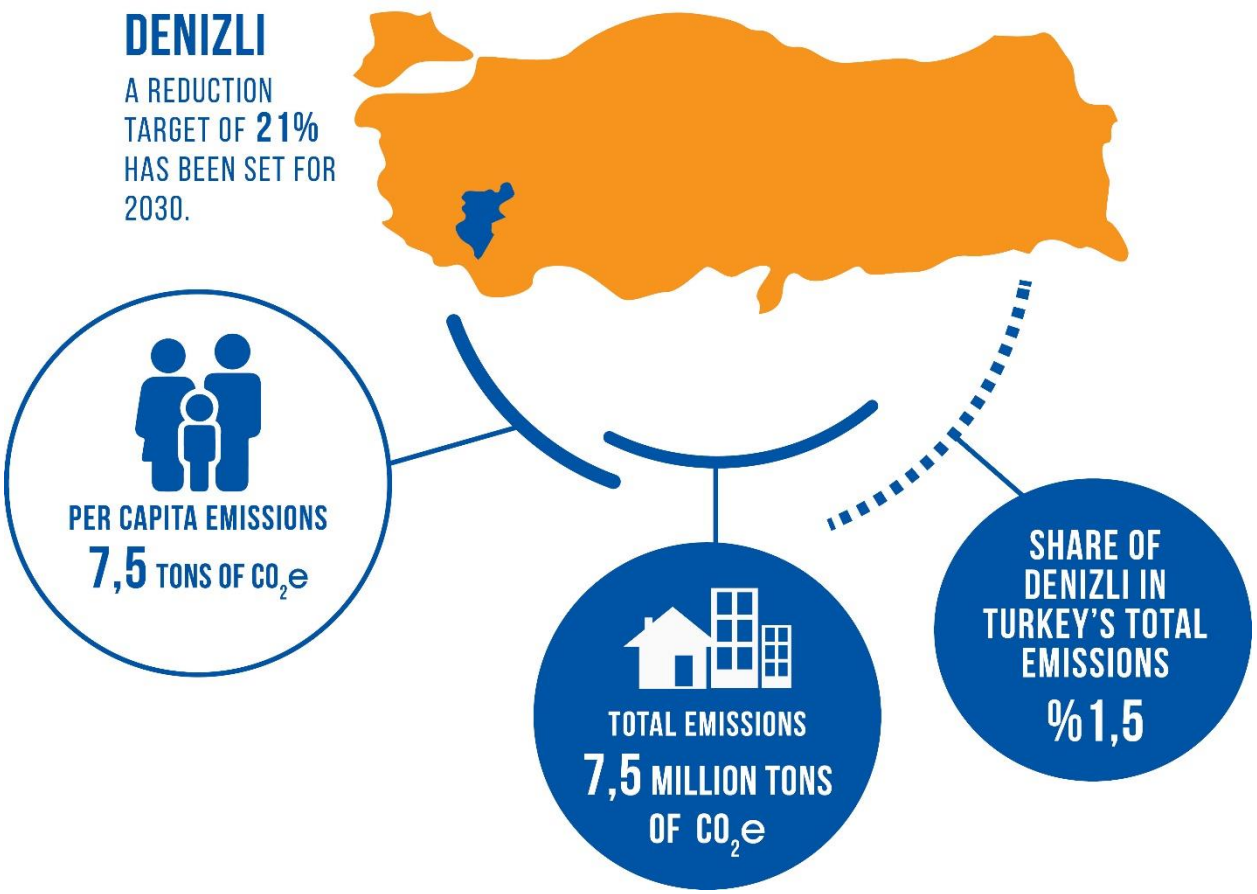
The Denizli Greenhouse Gas Inventory has been prepared in accordance with **Global Protocol for Local GHG Emissions (GPC)** which was prepared in 2014 by C40 Cities Climate Leadership Group (C40), the International Council of Local Environmental Initiatives (ICLEI) and the World Resources Institute (WRI) and which is widely used by local governments. The GPC was prepared on the basis of the IPCC National Greenhouse Gas Inventory Guidelines developed by the Intergovernmental Panel on Climate Change (IPCC) in 2006 and updated periodically. In this way, the results described in the following chapters are intended to be comparable and acceptable on a global scale.

The inventory prepared at the urban scale includes all the emission sources within the realm of authority of Denizli Metropolitan Municipality. The authority of Denizli Metropolitan Municipality covers the provincial boundaries of the province.

The inventory content is based on the classification of emission sources set by GPC. When preparing inventory in the framework of GPC, the scope of the inventory was determined depending on the detail, accuracy and reliability of the available data. GPC evaluates greenhouse gas emissions in 3 scopes; Scope 1 - Direct Emissions, Scope 2 - Indirect Emissions and Scope 3 - Indirect (Consumption Based) Emissions. During the preparation of the inventory, all emission sources within the realm of authority of the municipality were scanned and the maximum amount of data was tried to be reached. The emissions under Scope 3 were not included in the inventory due to the fact that it is very difficult to reach related data.

According to the results of the GPC approach, the total greenhouse gas emissions of Denizli province for the year 2016 were estimated to be **7.5 million tons of CO_2e**. This amount refers to **7.5 tons of CO_2e** per capita, which is proportional to the population of Denizli in the same year (1.005.687) and this number is higher than Turkey’s 2016 average calculated as **7.5 tons of CO_2e** per capita. Total emissions of Denizli in **Turkey's total emissions in 2016 constitute 1.5%**.

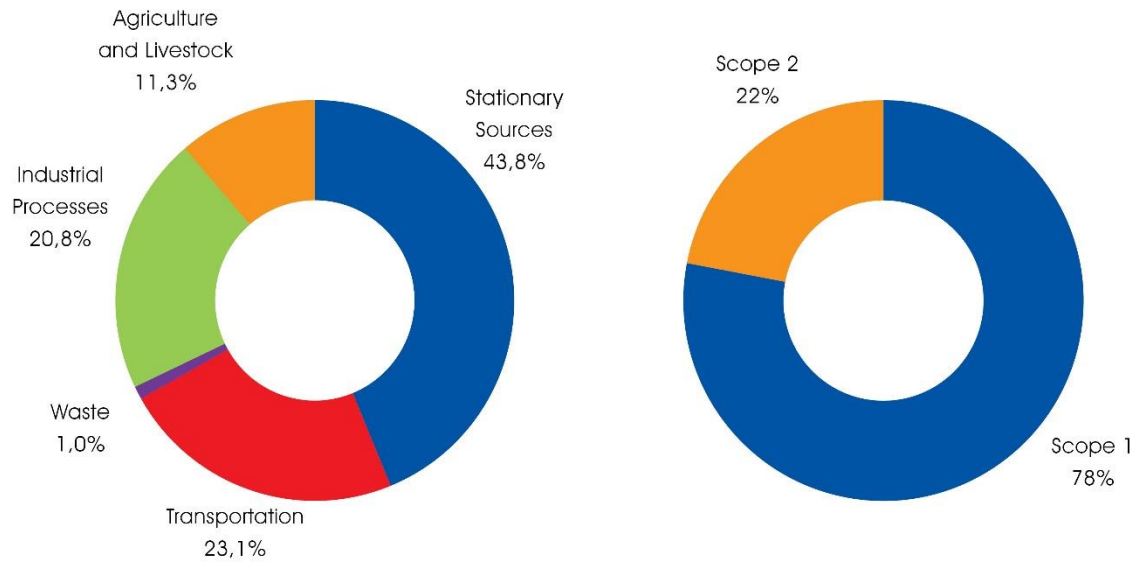
GHG Inventory Summary Results



The following figure shows the scope and sectoral distribution of emissions analyzed in the scope of inventory. 43.8% of total emissions are based on stationary sources, 23.1% transportation, 20.8% industrial processes, 11.3% agriculture and livestock and 1.0% waste management. 78% of these emissions are from Scope 1 - Direct Emissions and 22% from Scope 2 - Indirect Emissions.

Emissions from residential, commercial / institutional buildings, manufacturing industry and construction, energy industry and agricultural activities have been calculated in the stationary sources. Emissions from road transport, railways, waterborne navigation and aviation have been calculated in the transportation sector. Emissions from solid waste disposal (landfill), biological treatment of waste (composting) and wastewater treatment / discharge have been calculated within the scope of the waste sector. Emissions from cement, lime and glass sectors have been calculated within the scope of industrial processes and product use. Lastly, emissions from fertilizer use, manure management and enteric fermentation have been mainly calculated in the scope of agriculture and livestock sector. Details of inventory are presented in the CCAP.

Sectoral Breakdown of GHG Inventory

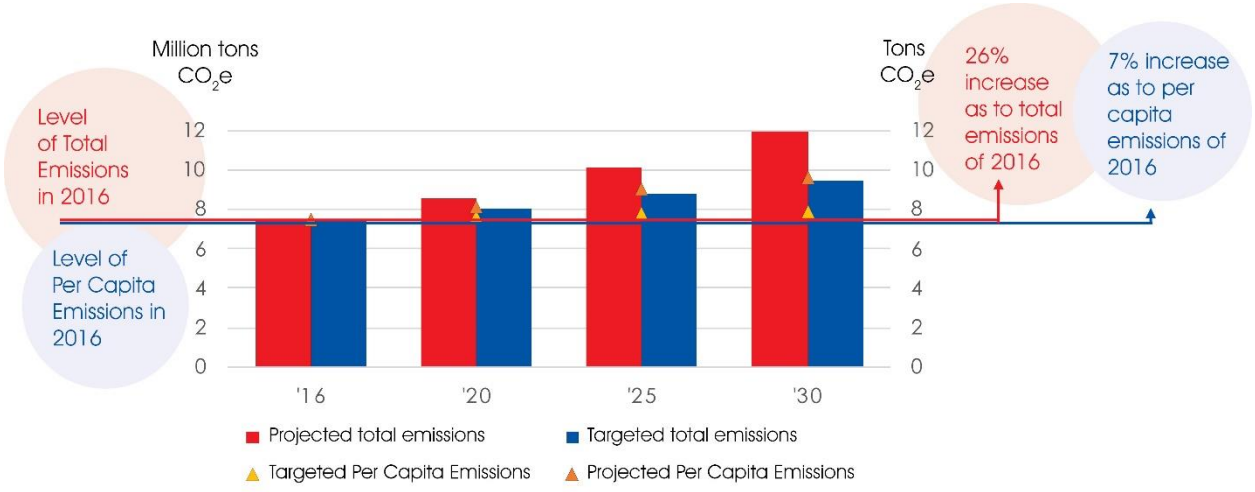


Sector (ton CO_2e)	Scope 1	Scope 2	Sectoral Total
Stationary Sources	1.635.897	1.649.444	3.285.341
Transportation	1.729.770	1.333	1.731.104
Waste	78.092		78.092
Industrial Processes	1.560.472		1.560.472
Agriculture and Livestock	847.659		847.659
Scope Total	5.851.890	1.650.777	**7.502.667**

Denizli is a city which is continuing to expand. The fact that province's population will reach to 1.1 million, which was 1 million in 2016, is present in the reports of TurkStat. In that report, it is anticipated that the population of the province would reach to 1.2 million in 2030. Significant increase is being expected in between 2016 - 2030 in the parameters relevant to greenhouse gas emission as industrial production, vehicle ownership and stock of buildings being in the first place. As per the modelling performed in the study, the emissions of Denizli for the year 2030 have been anticipated as 11.9 million tons of CO_2e. In the same year, the emissions per person are being expected to be 10.1 tons of CO_2e. A reduction target of 21% has been set for 2030. According to that, it is being anticipated to decrease the emissions per person in 2030 in Denizli to 8.0 tons of CO_2e, and to have the total emissions remain as 9.5 million tons of CO_2e.

Total emissions of Denizli and the emissions per person of Denizli are estimated to increase. In case of attaining the goal, it is being expected for Denizli's emissions per person to increase by 7%, while its total emissions would increase by 26% compared to 2016. Attaining this goal will be one of the significant means of making the growth of Denizli sustainable.

Results of 21% Emission Reduction Target for Denizli for 2030



Reduction target is determined as 21% reduction from the projected emissions in 2030, to be compatible with the INDC of Turkey. Following sectoral emission reductions have been projected in 2030 throughout Denizli under the action plan. These emissions should not be considered as sectoral targets but as expected reductions in different sectors.

Sectoral Emission Reduction Projections for 2030

Sector	2030 Projected Emissions (million tons of CO_2e)	Amount of Reduction (million tons of CO_2e)	Estimated Reduction Ratio (%)
Buildings	2.36	0.78	%33
Transportation	2.76	0.49	%18
Waste/Wastewater	0.12	0.07	%54
Industry	5.36	0.98	%18
Land Use	1.35	0.20	%15
Energy**			
TOTAL	11.95	2.51	%21

*Sectoral targets are not foreseen in the CCAP. The given reduction rates indicate the estimated reduction amounts to be achieved as a result of the foreseen actions.

** Reductions in the energy sector are included in other sectors.

ADAPTATION

In some cases, mitigation and adaptation policies to be carried out in cities can be competitive, but in most cases they support each other. For example, thermal insulation in buildings provides energy savings while at the same time it helps less temperature exposure during hot periods. Green infrastructures serve both mitigation and adaptation. Vegetation or green areas reduce the temperature in cities in addition to carbon capture.

Adaptation works should not be considered as a new obligation for municipalities although the studies carried out by the municipalities in Turkey and the measures taken by them in various management areas are not directly addressed under the heading “adaptation”. Municipalities have very significant powers in their areas of responsibility such as "transport, buildings, waste management and spatial planning” in mitigation and adaptation in the fight against climate change in Turkey.

The temperature increase and changes in precipitation regime that occurred in the recent century in Denizli have started to be felt more in the recent past. In the scenario, in which extensive measures and policies cannot be implemented in Denizli that is located within the Mediterranean Basin which will be affected the most from the climate change, it is possible for the significance of negative impacts on social and bio-physical systems to increase.

Denizli Climate Change Risk Analysis verifies also for Denizli the most basic finding determined for the cities in international and national reports:

- Climate change further increases the socio-economic (irregular urbanization, land requirement, food safety, potable water need, water demand management etc.) and environmental (loss of habitat, decrease in biological diversity, forest fires etc.) pressures encountered in the current state.

The information compiled in the Climate Change Risk Analysis Report is presented in related annexes.

- Annex 6 Climate Change Models and Scenarios
- Annex 7 Past and Present Climatic Impacts
- Annex 8 Denizli's Climate Projections
- Annex 9 Climate Change Impact Survey
- Annex 10 Risk Assessment Framework
- Annex 11 Results of Climate Change Risk Analysis

Climate projections of different scenarios for Denizli has been obtained from the database formed by the data generated on the basis of basins within the scope of Impact of Climate Change on Water Resources Project of Ministry of Agriculture and Forestry General Directorate of Water Management (GDWM).

HadGEM2-ES model, and RCP4.5 and RCP8.5 scenarios has been used while obtaining the climate projections of Denizli Province. In the risk analysis study, the results for Büyük Menderes Basin have been taken into account.

Climate change for Denizli will bring along the following changes in temperature and precipitation regimes in the periods of 2015-2044 (near future period) and 2045-2074 (far future period):

- Increase in all the projections regarding the average temperatures of Denizli;
- Increase for all the periods regarding the number of extremely hot days;
- Increase in the number of heat waves;
- Increase in the severity of precipitation;
- Variation of precipitation within the year will be continuing, decrease in precipitation in summer;
- Increase in drought indicators.

It is expected for the semi-arid and semi-humid climate of Denizli to show a change towards arid climate.

In the light of climate projections of two different scenarios for Denizli, the risks arising from climate change have been tried to be assessed for 2015-2044 (near period) and 2045-2074 (distant period) periods.

Within the scope of the climate change risk analysis, prioritization has been made in the light of the available data, expert opinions and stakeholder meetings and it has been decided to evaluate the following headings:

- Agriculture and Ecosystems;
- Water and Wastewater (Infrastructure);
- Transportation;
- Industry;
- Energy;
- Public health.

Exposure to the risks to occur in the specified sectors should be expected to occur differently in different regions of the city. In addition, it should be kept in mind that the impacts of climate change in the same region will vary according to the socio-economic level and the sensitivity of the affected groups.

It is a fact that nobody is exempt from the impacts of climate change, but that poor groups and individuals with low capacity to fight impacts will be more affected. While assessing the risks, it was shared with stakeholders that climate change is a social problem and social justice approach should be seen as a basic principle in the solution of this problem.

In contrast, in the workshops and surveys conducted, the representation of the disadvantaged and vulnerable groups (agricultural workers with disabilities, women and child labour, elderly and needy people) was not at the desired level. It should be emphasized that there is a need for detailed study in all districts in Denizli.

Agriculture and Ecosystems Sector Risk Assessment Table						
Negative Impact	**Risk Level**	**Period of Impact**	**Size of Results**	**Impact's Possibility to Arise**	**Capacity to Struggle**	**Groups / Institutions to be Affected**
1. Decrease in agricultural productivity and production due to extremely hot weather	Very high ☹	2015-2044	Very High	High	Low	Employees of agriculture sector, Factories, Consumers
2. Increase in forest fires affecting large areas along with drought and increasing temperatures	-	-	Lack of detailed data	Lack of detailed data	Lack of detailed data	Lack of detailed data
3. Submerging of fertile agricultural lands as a result of floods	Very high ☹	2015-2044	Very High	High	Low	Agriculture sector, Public, Factories
4. Soil erosion caused by extreme precipitation	Very high ☹	2015-2044	Very High	High	Low	Agriculture sector, Factory, Consumer (Public)
5. Inability to meet the increasing water demand for agricultural irrigation along with increase of drier soils	Very high ☹	2015-2044	Very high	High	Low	Consumer, Factory, Producer
6. Decrease in the efficiency of livestock raising due to temperature stress (decrease in the reproduction efficiency, increasing deaths)	Very high ☹	2015-2044	Very high	High	Low	Consumer, Factory, Producer
7. Decrease in the production of milk and milk products of farm animal due to temperature stress	Very high ☹	2015-2044	Very high	High	Low	Consumer, Factory, Producer
8. Loss of products / decrease of yield as a result of increase of agricultural pests	Very high ☹	2015-2044	Very high	High	Low	Consumer, Factory, Producer
9. Loss of products as a result of increase in agricultural diseases	Very high ☹	2015-2044	Very high	High	Low	Consumer, Factory, Producer
10. Losses at areas where greenhouse cultivation is performed intensely due to sudden and extreme precipitation and hail etc.		No data	No data	No data	No data	No data
11. Migration to city centre from other counties of the province, and from rural areas	Very high ☹	2015-2044	Very high	High	Medium	Consumer, Factory, Producer

Agriculture and Ecosystems Sector Risk Assessment Table						
Negative Impact	**Risk Level**	**Period of Impact**	**Size of Results**	**Impact's Possibility to Arise**	**Capacity to Struggle**	**Groups / Institutions to be Affected**
12. Decrease in the employment of agriculture	Very high ☹	2015-2044	Very high	High	Low	Consumer, Factory, Producer
13. Decrease in the production of agricultural products at processing factories along with the decrease of productivity in agriculture	Very high ☹	2015-2044	Very high	High	Medium (Import)	Consumer, Factory, Producer
14. Decrease in the production of agricultural products at processing factories as a result of decrease in agricultural production due to extreme precipitation, storm and flood incidences	Very high ☹	2015-2044	Very high	High	Low	Consumer, Factory, Producer
15. Increase in food prices	Very high ☹	2015-2044	Very high	High	Low (Medium with Import)	Consumer, Factory, Producer
16. Decrease in the quantity of living things in the forest ecosystems	Very high ☹	2015-2044	Very high	High	No data	Exposure of ecosystem, thus exposure of ecological processes Inability to ensure the sustainability of the natural ecosystem
17. Increase in the pest and invader speciesof forest	-	No data	No data	No data	No data	No data
18. Decrease in the quantity of the living things in water ecosystems, and increase in the invader species	-	No data	No data	No data	No data	No data
19. Decrease in surface and groundwaters due to increasing temperature and drought	Very high ☹	2015-2044	Very high	High	?	Agricultural areas, Public, Production
20. Higher impactiveness of agricultural and industrial contamination along with decreasing amount of water in water resources	Very high ☹	2015-2044	Very high	High	?	Agricultural areas, Forest areas, Public, Production

Water and Waste Water Service Sector Assessment Table						
Negative Impact	**Risk Level**	**Period of Impact**	**Size of Results**	**Impact's Possibility to Arise**	**Capacity to Struggle**	**Groups / Institutions to be Affected**
1. Physical damage on water and sewerage system by the extreme precipitation	Very high ☹	2015-2044	Very high	High	Medium	Citizens, and Public institutions
2. Decrease of the amount of water at dams	Very high ☹	2015-2044	Very high	High	Low	All ecosystems and living beings
3. Damage at urban spaces as a result of floods at urban areas due to sudden and extreme precipitation	High ☹	2015-2044	High	High	Low	All ecosystems
4. Loss property and damages on private property (households, workplaces, and vehicles) at urban areas as a result of extreme wind and twister events	Medium	2045-2074	High	Low	Low	All ecosystems
5. Disruption of clean water service due to drought in some districts	Very high ☹	2015-2044	Very high	Very high	Low	All ecosystems
6. Disruption of clean water service due to drought in the whole province	Very high ☹	2015-2044	Very high	Very high	Low	All ecosystems
7. Damage at historical artworks at antique areas by the extreme temperature	Medium	2045-2074	Medium	Low	Low	Tourism sector's stakeholders
8. Damage at historical artworks at antique areas due to increasing floods	High ☹	2045-2074	High	Medium	Low	Tourism sector's stakeholders

Transportation Sector Risk Assessment Table						
Negative Impact	**Risk Level**	**Period of Impact**	**Size of Results**	**Impact's Possibility to Arise**	**Capacity to Struggle**	**Groups / Institutions to be Affected**
1. Damaged railway transportation infrastructure by the extreme precipitation	Very high ☹	2044-2075	Very high	Low	Medium	Railway, Passengers
2. Damaged road transportation infrastructure by the extreme precipitation	Medium	2015-2044	Medium	Medium	Low	Metr. Mun.-District, Highways, Local public
3. Damaged road lines by the extreme temperatures	Medium	2015-2044	Medium	High	Medium	Metr. Mun.-District, Highways, Local public
4. Disruption of aviaiton by extreme precipitation and storms	Low	2015-2044	Low	Medium	Low	Airways, passengers
5. Accident risk and negative impact on vehicles' traffic by extreme cold weather and icing	High ☹	2015-2044	High Impact	Medium	High	Metropolitan and district municipalities, Local public, Highways
6. Exposure of smart transportation systems to elements such as lightning under extreme precipitation	Medium	2015-2044	Medium Impact	Medium	High	Metropolitan municipalities, Local public, Contractor company (Positive)
7. Disruption of transportation due to extreme precipitation and snow storm, damage at infrastructure by the same	Medium	2015-2044	Medium Impact	Medium	High	Metr. Mun.-District, Highways, Local public, Infrastructure institutions
8. Disruption of transportation as a result of closing of roads under extreme snow, presence of villages that cannot be reached	High ☹	2015-2044	High impact	Low	Medium	Highways, Metr. Mun.-District, Local public, Logistic companies, Infrastructure institutions

Industry Sector Risk Assessment Table						
Negative Impact	**Risk Level**	**Period of Impact**	**Size of Results**	**Impact's Possibility to Arise**	**Capacity to Struggle**	**Groups / Institutions to be Affected**
1. Interruption in production due to scarcity of water in water intense industrial activities	High ☹	2015-2044	High	High	Low	Textile, Marble
2. Decrease in the production of textile industry due to scarcity of raw materials from agriculture	High ☹	2015-2044	High	High	Medium	Agriculture, Textile
3. Loss of productivity in labour due to higher severity of hot weather	Low	2015-2044	Low	High	High	Industrial organizations, Glass, Cement, Textile, Industrial employees
4. Increase of energy consumption cost in value chain	Medium	2015-2044	Medium	High	Medium	Industrial organizations
5. Difficulties in accessing the raw material as a result of negative weather events	Medium	2015-2044	Medium	Medium	High	Industry
6. Decrease in production as a result of disruption of water usage with the purpose of industry due to drought	High ☹	2015-2044	High	High	Low	Textile, Marble
7. Emmigration from the province as a result of decrease in industrial production	Low	2045-2074	Low	Low	Medium	Society
8. Decrease in economic production in the whole province	High ☹	2045-2074	High	Medium	Medium	Industry
9. Damages on factories, and on other fixed assets due to floods	Medium	2015-2044	Medium	High	Low	Industry, Local administration
10. Decrease in the production of food industry due to scarcity of raw materials from agriculture	High ☹	2015-2044	High	High	NA	Society, Agriculture, Food
11. Damages arising from storm, hail, and other similar severe weather conditions	Medium	2015-2044	Medium	High	Low	Industry

Energy Sector Risk Assessment Table						
Negative Impact	**Risk Level**	**Period of Impact**	**Size of Results**	**Impact's Possibility to Arise**	**Capacity to Struggle**	**Groups / Institutions to be Affected**
1. Decrease in the energy production of hydroelectric power plants	Medium	2045-2074	Medium Level Impact	Medium	Low	All groups having energy requirement
2. Deterioration and damages on transmission lines caused by high temperatures	Medium	2045-2074	High Impact	Low	High	All groups having energy requirement
3. Heavy load imposed on electric grid with the purpose of cooling by the impact of urban weather island to arise due to higher severity of hot weather	Low	2045-2074	Low Impact	Low	High	All groups having energy requirement
4. Occurrence of electricity interruptions as a result of damage on energy infrastructure due to floods	Very high ☹	2015-2044	Very high	Medium	High	All groups having energy requirement
5. Occurrence of damage at energy power plants due to floods, and interruption of energy production	Low	2015-2044	Very Low Impact	Medium	High	All groups having energy requirement
6. Loss of productivity due to permanent damages in information and communication technologies depending on climate change	Very high ☹	2015-2044	Very High Impact	Low	Medium	Everyone using technology and information communication

Implementation period for the following mitigation and adaptation actions determined in line with the vision and objective of the action plan, the emission reduction potential, the estimated costs, the responsible stakeholders, and the risks that may occur in the implementation are presented in detail in CCAP through action fiches.

The city will become more resistant to the impacts of climate change and achieve its emission reduction targets, as a result of DMM's leadership and a high awareness of all stakeholders. It is among the main recommendations that DMM is responsible for monitoring the plan by establishing "Denizli Climate Change Coordination Board (İDDK)" including key stakeholders.

CCAP and reduction target of DMM will increase the opportunities for international co-operation and facilitate the participation of DMM in international local government climate initiatives, such as Covenant of Mayors. CCAP should not only be seen as a study on combating climate change or reducing electricity and fuel consumption, but also as a means of developing local sustainable measures that will enable cities to achieve better urban planning and socio-economic development. In this respect, it is important to coordinate the activities in CCAP with other plans of the municipality.

SUMMARY OF MITIGATION ACTIONS

In the scope of CCAP, a total of **12 objectives and 36 actions** have been created under **6 action areas** in terms of greenhouse gas reduction. Objectives and actions are presented in the table below.

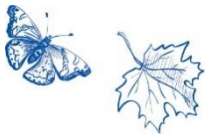
Action Area	Objectives	Actions
Buildings	Objective B1: Reduction of the energy consumption of existing buildings	Action B1.1: Insulation in existing buildings
		Action B1.2: Green roof application in large buildings such as municipal buildings, industrial facilities and shopping centers
		Action B1.3: Ensuring transition to central heating / cooling systems in existing buildings
		Action B1.4: Ensuring transition to smart building systems in large buildings such as municipal buildings, industrial facilities and shopping centers
		Action B1.5: Supporting and creating vertical gardens
	Objective B2: Paying regard to the impacts of climate change on new development activities	Action B2.1: Issuing Metropolitan Municipality Zoning Regulation
		Action B2.2: Designing the buildings built by the municipality as smart and green building systems
		Action B2.3: Encouraging the use of local and renewable materials in buildings
	Objective B3: Redesign of the city to reduce the impact of climate change	Action B3.1: Change in urban plans

Action Area	Objectives	Actions
Energy	Objective E1: Reducing the use of fossil fuels and increasing the use of renewable energy sources and low carbon fuels	Action E1.1: Extension of low-carbon fuel consumption where fossil fuel consumption is mandatory
		Action E1.2: Proliferation of green energy consumption in industrial buildings
		Action E1.3: Renewable energy applications in buildings and areas under municipal responsibility
		Action E1.4: Encouraging the use of geothermal resources for heating purposes (such as greenhouses)
	Objective E2: Increasing energy efficiency practices	Action E2.1: Making lighting systems environmentally friendly
		Action E2.2: Providing non-formal and formal education on energy efficiency to all age groups

Action Area	Objectives	Actions
Transportation	Objective T1: Reduction of urban vehicle traffic	Action T1.1: Increasing public transport
		Action T1.2: Construction of bicycle paths and parks
		Action T1.3: Integration of smart transportation systems
	Objective T2: Increasing alternative fuel and resource efficiency practices in public transport in the province	Action T2.1: Increasing the number of alternative energy vehicles in the DMM public transport fleet
		Action T2.2: Reduction of fuel consumption per vehicle with economical driving techniques
		Action T2.3: Review of lines and reassessment of passenger potential

Action Area	Objectives	Actions
Waste/Wastewater	Objective W1: Improving existing solid waste and waste water services	Action W1.1: Disposal of all domestic solid wastes generated within the provincial boundaries by appropriate methods
		Action W1.2: Providing sewage and waste water treatment plant services to the entire population of the province
	Objective W2: Reducing the amount of landfilled organic waste and recyclable waste	Action W2.1: Increasing the training activities for separation at source and water saving
		Action W2.2: Disposal of a portion of domestic solid waste by an incineration plant to be established
	Objective W3: Increasing renewable energy and energy efficiency practices in solid waste and waste water disposal	Action W3.1: Evaluation of methane gas generated in existing landfill facilities as electrical energy
		Action W3.2: Establishment of biogas production facility (s) for WWTP sewage sludge and animal waste
		Action W3.3: Balancing the electricity consumption of WWTP with the integration of solar power plant
		Action W3.4: Reducing the electricity consumption of WWTP with efficiency applications

Action Area	Objectives	Actions
Industry	Objective I1: Improving processes through resource efficiency applications	Action I1.1: Reduction of business-based electricity consumption
		Action I1.2: Re-use of semi-finished products in the process and recycling of waste
		Action I1.3: Establishment of regional / central heating / cooling centres for industrial heating / cooling needs
		Action I1.4: Reduction of unit/tonne emission of processes



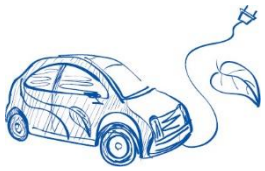
Action Area	Objectives	Actions
Agriculture and Livestock	Objective A1: Improvement of agricultural and animal husbandry processes	Action A1.1: Increasing efficiency by reducing fossil fuel consumption through land consolidation
		Action A1.2: Preventing drought through efficiency practices
		Action A1.3: Reducing the use of chemical fertilizers and pesticides

SUMMARY OF ADAPTATION ACTIONS

In the scope of CCAP, a total of **18 objectives and 36 actions** have been created under **6 action areas** in terms of adaptation to impacts of climate change. Objectives and actions are presented in the table below.

Action Area	Objectives	Actions
Agriculture and Ecosystems	Objective A1: Sustaining agricultural productivity	Action A1.1: Plant selection according to water requirement and rotation of crops
		Action A1.2: Training and support of farmers to promote the use of healthy seedlings, seeds and widespread use of domestic seed
	Objective A2: Prevention of soil erosion	Action A2.1: Changing ploughing technique, terracing and afforestation works
	Objective A3: Protection of agricultural areas from drought and floods	Action A3.1: Implementation of technical and institutional measures in the fight against agricultural drought
		Action A3.2: Preservation of the natural form of Büyük Menderes river through reclamation canal works
	Objective A4: Reduction of water consumption and improvement of water quality in agricultural irrigation	Action A4.1: Changing irrigation methods and agricultural pattern
		Action A4.2: Increasing storage facilities and improving existing facilities
		Action A4.3: Increasing control of point and non-point pollution
		Action A4.4: Institutional and technical measures to reduce water consumption
	Objective A5: Making livestock activities resistant to changing climate	Action A5.1: Locally appropriate animal husbandry
	Objective A6: Strengthening of other economic sectors in the rural areas with agriculture-based economy	Action A6.1: Improving economic diversity in rural areas, improving superstructure and infrastructure and social structure
	Objective A7: Conservation of biological diversity	Action A7.1: To include climate change adaptation measures in the planning, management and implementation of protected areas
		Action A7.2: Biological control (fauna production), fight against invasive species and prevention of hunting

Action Area	Objectives	Actions
Water and Wastewater	Objective W1: To increase the resistance of existing water and sewerage infrastructure	Action W1.1: Regular maintenance of infrastructure and sewerage systems
		Action W1.2: Increasing the effectiveness of Infrastructure Coordination Centre (AYKOME)
		Action W1.3: Making the canal systems more technological
		Action W1.4: Informing the public about wastewater and rain water
		Action W1.5: Separation of storm water and sewerage infrastructures
		Action W1.6: Revision of infrastructure systems to reduce losses in drinking water networks
	Objective W2: Preventing floods in urban areas	Action W2.1: Completion of stream improvement without damaging natural ecosystems
		Action W2.2: Preventing filling of developed parts of creeks
		Action W2.3: Determination of the impacts of climate change on the ruins
	Objective W3: Reduction of water consumption	Action W3.1: Carrying out training and awareness-raising activities related to water saving



Action Area	Objectives	Actions
Transportation	Objective T1: Preventing excessive rainfall from damaging the railway and road transport network infrastructure	Action T1.1: Increasing inspections and maintenance according to meteorological data
		Action T1.2: Increasing the number of vehicles and personnel employed in responses
	Objective T2: Design of highways in accordance with extreme hot and cold climate conditions	Action T2.1: To use materials suitable for extreme hot and cold climates on highways
	Objective T3: Personnel and vehicles in public transport system on roads are resistant to climate change	Action T3.1: Reducing the impact on public transport drivers and public transport users
		Action T3.2: Regular maintenance and inspection of public transport vehicles

Action Area	Objectives	Actions
Industry	Objective I1: Ensuring efficient water use in industry	Action I1.1: Increasing investments in new technologies enabling the use of rain water, reuse of wastewater and saving water
	Objective I2: Ensuring sustainability in industrial production	Action I2.1: Conducting projects that support production in agricultural areas that provide raw materials to industry
		Action I2.2: Taking measures to increase industrial employment

Action Area	Objectives	Actions
Energy	Objective E1: Protection of power infrastructure against climatic hazards	Action E1.1: Taking measures for the climatic hazards to which the energy infrastructure will be exposed
	Objective E2: Reduction of overloads on the power grid	Action E2.1: Enabling energy saving and energy optimization applications

Action Area	Objectives	Actions
Public Health	Objective P1: Making people more resistant to the impacts of climate change	Action P1.1: Organizing training and awareness-raising activities for adaptation to climate change
		Action P1.2: Taking measures for public health
		Action P1.3: Implementation of urban planning and green space management practices

1. INTRODUCTION

1.1. AIM OF THIS STUDY

Denizli Climate Change Action Plan preparation study has been conducted by REC Turkey under "**Power the Revolution for Climate Action**", supported by the European Union Pre-Accession Assistance (IPA) fund, of which Denizli Metropolitan Municipality is the beneficiary[2].

It is very important to contribute to the national efforts to combat global climate change at the local level. In this respect, Denizli Climate Change Action Plan is of great importance. Target-driven mitigation of greenhouse gas emissions through the implementation of mitigation actions will not remain as a local effort only, but will also support the reduction of total greenhouse gas emissions in Turkey. On the other hand, the implementation of the adaptation actions is largely dependent on local activism although adaptation policy at the national level is important for the general framework and political ownership. In order to mitigate the greenhouse gases that cause climate change and reduce the risks arising from climate change, the actions in the plan are aimed to overlap with the policies and activities in other related areas as much as possible.

The Climate Change Action Plan (CCAP), which will be a milestone in Denizli's struggle with climate change, will serve as a basic source and road map for the officials and specialists of Denizli Metropolitan Municipality and representatives of other related institutions.

The vision of the action plan is defined as "**making Denizli a low carbon, climate change resistant model city"**. In the light of this vision, **21% reduction from increase** was identified **as a realistic goal** covering all emission sources at the provincial level. Taking into account Turkey's Intended Nationally Determined Contribution (INDC), the target year is determined as **2030**, which is the year envisaged in international processes. Setting a goal of reduction from increase in parallel with Turkey's national goal and determining the goal as per capita, considering the population increase, was deemed appropriate.

1.2. KEY STAKEHOLDERS AND CONSULTING PROCESS

A fully participatory process has been followed while preparing the CCAP and all relevant stakeholders have been included in the preparation process. A Advisory Board was formed in the first phase of the

[2] Power the Revolution for Climate Action is one of the projects supported under the Capacity Building in the Field of Climate Change in Turkey Grant Scheme by the European Union.

study to provide general guidance to the action plan, by bringing together key institutions. CCAP Advisory Board, the members of which are listed in

Table 1, met three times during the study period.

Table 1 - Members of CCAP Advisory Board

	Denizli Metropolitan Municipality		Governorate of Denizli Provincial Directorate of Environment and Urbanization
	Denizli Metropolitan Municipality Water and Sewerage Administration		Governorate of Denizli Provincial Directorate of Industry and Technology
	Governorate of Denizli Provincial Directorate of Agriculture and Forestry		Governorate of Denizli Provincial Directorate of National Education
	Pamukkale Municipality		Turkish Statistical Institute Denizli Regional Directorate
	Merkezefendi Municipality		State Hydraulic Works Branch Office 212
	Pamukkale University		Denizli Chamber of Industry

A total of 5 stakeholder workshops, in addition to the Advisory Board meetings, have been organized in order to transfer the experience and suggestions of the other stakeholders to the study, and individual and sectoral surveys have been applied to the participants in these workshops. The questionnaires are structured so as to provide a base for mitigation and adaptation actions. Apart from the meetings, a comprehensive literature research, one-to-one interviews and data requests have been conducted and the opinions and suggestions of the stakeholders have been transferred to the study in full. The table below summarizes the activities under the consultation process.

Table 2 - Consultation Process Activities

Level	Activity	Date	Participation
Local	1st Advisory Board	06/06/2018	18 representatives from 13 institutions
Local	2nd Advisory Board	01/10/2018	20 representatives from 12 institutions
Local	3rd Advisory Board	06/02/2019	20 representatives from 12 institutions
Local	1st Workshop: Inventory Data Collection	07/06/2018	57 representatives from 24 institutions
Local	2nd Workshop: Sharing and Verifying Inventory Results	02/10/2018	44 representatives from 20 institutions
Local	3rd Workshop: Mitigation Actions	21/11/2018	45 representatives from 29 institutions
Local	4th Workshop: Risk Analysis	21/11/2018	51 representatives from 25 institutions
Local	5th Workshop: Adaptation Actions	27/12/2018	46 representatives from 24 institutions
Local	Mitigation Target and Actions Survey Studies	02/10/2018 21/11/2018	Participants of Stakeholder Workshop
Local	Risk Analysis and Adaptation Actions Survey Studies	19/11/2018 27/12/2018	Denizli Province and Participants of Stakeholders Workshop
National, Local	One-to-One Interviews and Data Requests	20/03/2018 31/12/2018	MoIT, MoEU, EMRA, TURKSTAT, DMM
International, National, Local	Literature Review	20/03/2018 31/12/2018	Desk Work (REC, DMM)

During the study, the key stakeholders, who have been in contact, especially in accessing the data, are presented below.

Figure 1 - Key Stakeholders

1.3. THE SCIENTIFIC BASIS OF CLIMATE CHANGE AND EFFORTS OF STRUGGLE

Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period. It can be defined as a significant increase in severity and number of extreme weather events that are not frequently observed in certain regions. Climate change is a result of both natural processes and human activities.

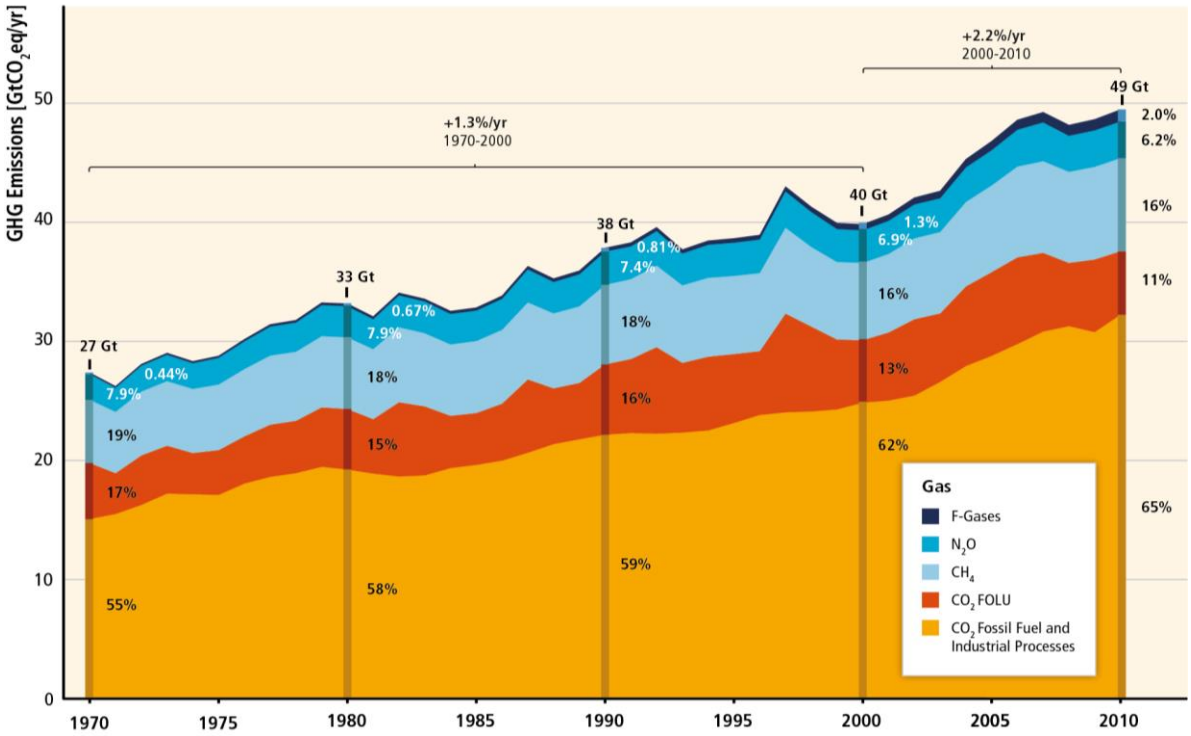
During climate change, significant changes are observed in average surface temperature of land/ocean, rainfall averages, and glacial regions. These changes present a picture that shows that global warming is increasing and shakes the world's energy balance; In the last 150 years, the global average temperature has increased by about 1°C, and 2015, 2016 and 2017 have been the hottest three years ever recorded.

Due to global warming, the temperature of the seas and land increases while the glaciers shrink and the sea level rises. Increases have been experienced in extreme weather events with devastating impacts all over the world. Accordingly, the habitats of many species living in land, freshwater and seas are negatively and permanently affected by climate change.

> As part of global change, temperatures have increased in the last 42 years everywhere in Turkey. The increase in summer temperatures has been higher than in other seasons. According to Turkey's 1981-2010 averages, summer and winter average temperatures were 23,5 °C and 3,7 °C while the average summer temperature of 2014 was 24,4 °C and the average temperature of the winter season in 2013-2014 was 4,6 °C, which was 0,9 °C over seasonal averages (REC Turkey 2017).

The United Nations Framework Convention on Climate Change (UNFCCC) regime adopted 1990 as the base year for measuring greenhouse gas emissions. Calculations for 1990 showed that global emissions were 38 billion tons CO_2e. Significant progress has been made in implementing innovative and sustainable approaches with the development, use and expansion of energy saving and renewable energy technologies, which have been the cornerstones of the low-carbon economy in the past 26 years. The international agreements that will support the implementation of these technological developments have not been able to provide the necessary level of binding. Greenhouse gas emissions, and therefore the warming of the earth, continued to increase, gathering speed.

Figure 2 - Greenhouse Gas Emissions 1970 - 2010 (IPCC, 2014)

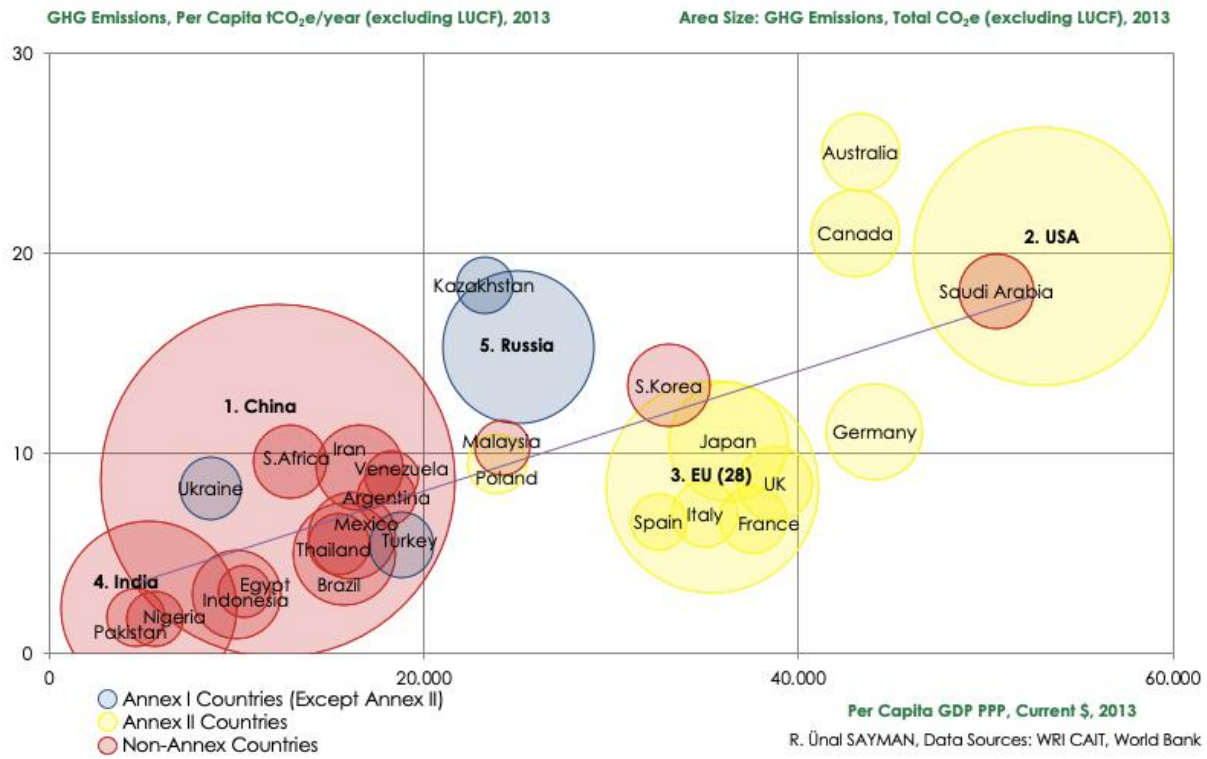


By 2010, global emissions increased by 30% reaching 49 billion tons of CO_2e. Scientific models clearly show that the amount of emissions will continue to increase with the current policies. According to the IPCC studies, greenhouse gas emissions increased, despite all efforts, by an average of 1,3% per year in the period from 1970 to 1990. This rate rose to 2,2% between 2000 and 2010, particularly as a result of the increased emissions of developing countries (see Figure 2).

Looking at the global scale emissions in the states, we see that the 30 countries with the highest emissions release 80% of the total emissions. According to 2013 data, these 30 countries account for 80% of total emissions, 83% of the total global economy and 72% of the total population (see Figure 3).

The persisting increase in greenhouse gas emissions helped the issue of climate change remain on the agenda. The Paris Agreement, which came into force in 2016, has created a new implementation structure that all counties would contribute to combating climate change, especially the developed countries.

Figure 3 - Top 30 Countries with Highest Emissions in 2013



Note: The horizontal axis shows the per capita GDP data according to the purchasing power of the countries, and the vertical axis shows the greenhouse gas emission per capita. The size of the country's circles also increases according to the ratio of total emissions.

1.3.1. ADAPTATION IN COMBATING CLIMATE CHANGE IMPACTS

Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period. It can be defined as a significant increase in severity and number of extreme weather events that are not frequently observed in certain regions. Climate change is a result of both natural processes and human activities. Scientists agree that the change we are experiencing is people-driven. Greenhouse gases resulting from human activities and released in quantities exceeding the carbon holding capacity of natural sinks have changed the climate balance of the planet.

During climate change, significant changes are observed in average surface temperature of land/ocean, rainfall averages, and glacial regions. These changes present a picture that shows that global warming is increasing and shakes the world's energy balance; In the last 150 years, the global average temperature has increased by about 1°C, and 2015, 2016 and 2017 have been the hottest three years ever recorded.

Due to global warming, the temperature of the seas and land increases while the glaciers shrink and the sea level rises. Increases have been experienced in extreme weather events with devastating impacts all over the world. Accordingly, the habitats of many species living in land, freshwater and seas are negatively and permanently affected by climate change.

The rapid increase in atmospheric greenhouse gas accumulation due to human-induced activities, compared to natural processes, has triggered a number of chained bio-physical and human events. It causes various changes in the global climate system (atmosphere, oceans and glacial regions), especially in global temperature averages and irregularities in precipitation regimes; these changes affect the

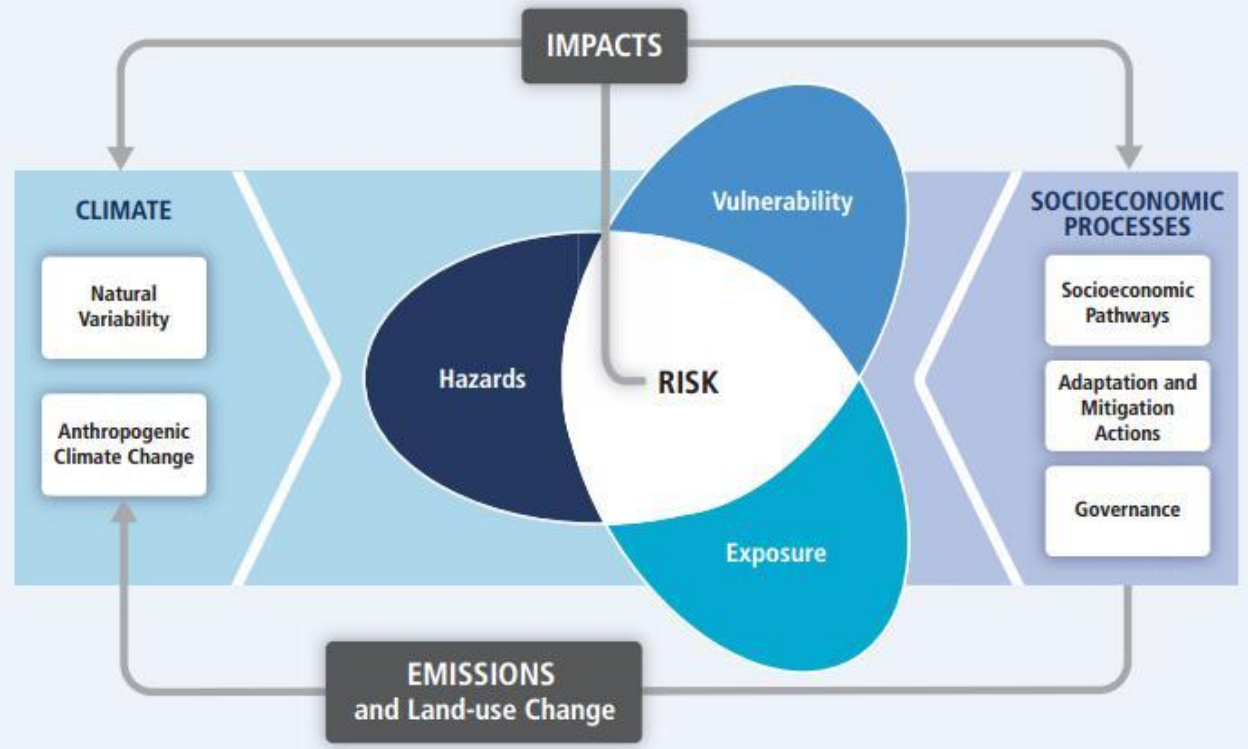
existence and distribution of natural resources and this irregularity, which is reflected in socio-economic structures again.[3]

Figure 4 - Components of Climate Change Risk

In the assessment of risks arising from climate change, the IPCC's 5th Assessment Report (AR5) consists of the components of the risk: “climatic hazards,” “exposure” and “vulnerability”.

In order to support these impacts, the “Climate Change Risk Assessment” approach has been included in the policy-making processes as an important tool to take into account the current and future risks and uncertainties of climate change. Risk assessment in the context of climate change adaptation not only takes into account negative impacts but also ensures that “opportunities” are taken into account.

IPCC Risk Assessment Framework



Even if all human induced emissions are eliminated in the fight against climate change, changes in the climate system (increase in frequency and intensity of extreme weather events) will continue to be observed for decades with the cumulative impact of greenhouse gases emitted to the atmosphere in the past and present.

[3] A to Z Reference Guide to Climate Change (2015), REC Turkey

In this context, in order to minimize potential adverse impacts, societies need to maintain efforts to mitigate greenhouse gas emissions in parallel with adaptation works to potential impacts.

Adaptation according to UNFCCC is defined as “readjustment of natural or human systems to mitigate the damage that may arise from current or expected climatic impacts (hazards) or to benefit from the opportunities resulting from these impacts “.

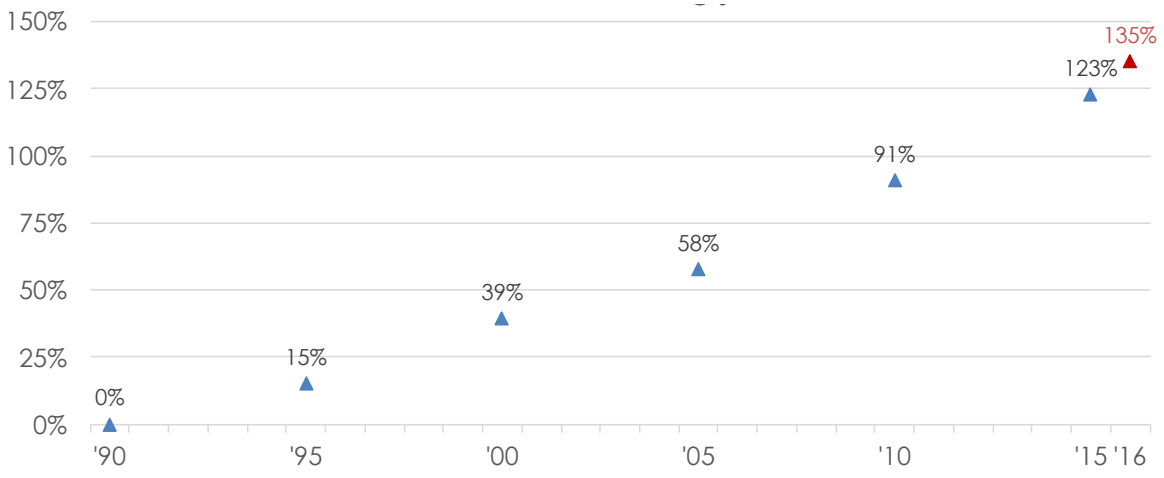
In other words, Adaptation is a set of activities, plans and/or programs implemented in biophysical or human systems (eg. in urban areas) in response to current or expected climatic impacts. Adaptation aims to reduce the potential negative consequences of climate change or benefit from opportunities. Adaptation can be predictable, autonomous or planned. In general, activities that are not implemented directly to adapt to climate change can also be considered within the scope of adaptation.

1.4. NATIONAL CLIMATE CHANGE POLICIES

Taking the base year as 1990, Turkey's total greenhouse gas emissions increased from 208.000 tons to 496.000 tons in 2016 by an increase of 135% (see Figure 5). When evaluating Turkey's total greenhouse gas emissions on a global scale, it is seen that the country rose from the 25th place in 1990 to 19th place in 2012. Turkey's emissions are at the level of 0,9% of the total emissions on a global scale for 2012.

Figure 5 - Turkey's Total Greenhouse Gas Emissions Growth Rate (CO_2e)

Between the Years 1990 - 2016



(Data Source: TURKSTAT, 2018)

Energy sector in Turkey's total greenhouse gas emissions now ranks the highest with 73%. Energy includes emissions of 29% electricity generation, 16% transport, 13% buildings and 12% fuel used in industry. Energy sector is followed by industrial activities with 13%, agriculture with 11% and waste sectors with 3%.

Figure 6 - Detailed Sectoral Breakdown of Greenhouse Gas Emissions (CO_2e) in Turkey for the Year 2016

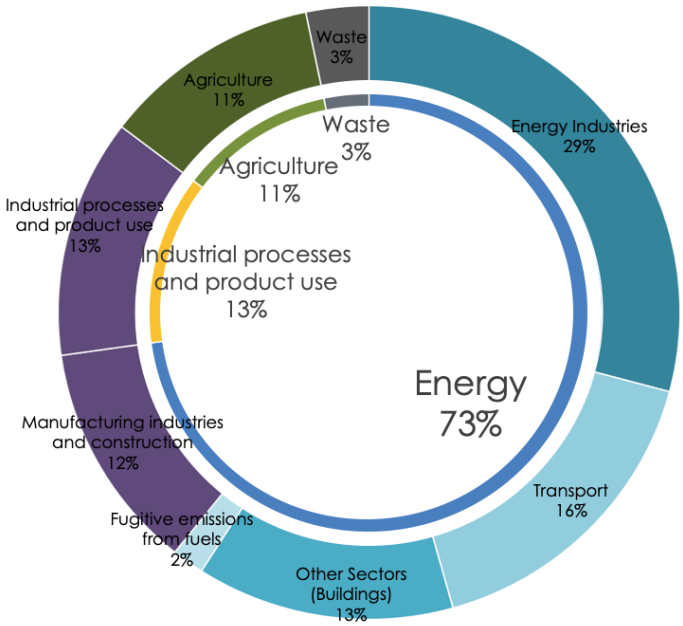
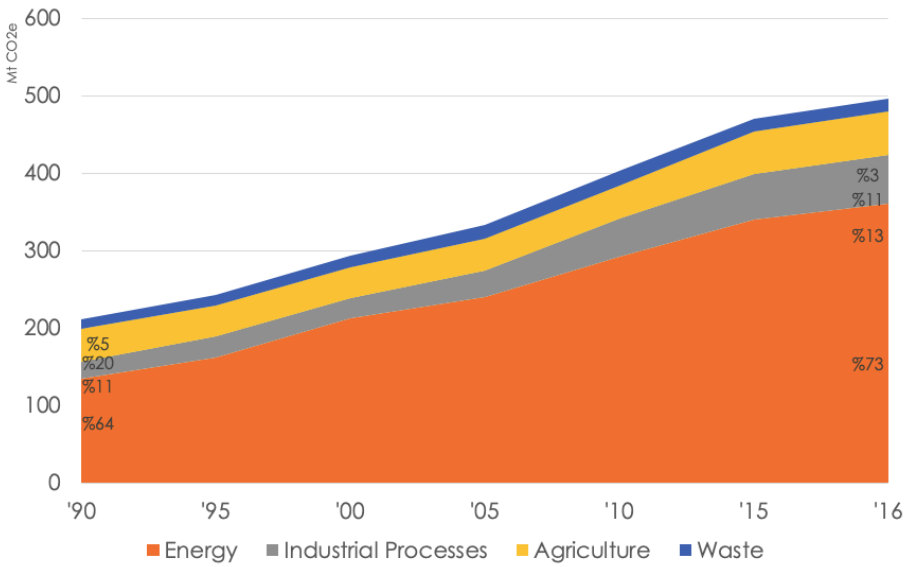


Figure 7, shows the sectoral breakdown of Turkey's emissions and change in the years. The share of the energy sector in total emissions increased from 64% in 1990 to 73% in 2016.

Figure 7 - Sectoral Breakdown of GHG emissions (CO_2e) Between the Years 1990 - 2016 in Turkey



(Data Source: TURKSTAT, 2018)

There are 3 basic documents which aim to draw the frames of mitigation and adaptation policies in combating climate change in Turkey and implement related actions.

- National Climate Change Strategy Document (2010-2020),
- National Climate Change Action Plan (2011-2023) and
- Climate Change Adaptation Strategy and Action Plan (2011).

The "National Climate Change Strategy 2010-2020", prepared by the repealed Ministry of Environment and Forestry and approved on May 3, 2010, was the first official strategy document on climate change at the national level.[4] The Strategy was published again under the name "Turkey Climate Change Strategy 2010-2023".[5] In Chapter 8 "Adaptation to Climate Change" of the Strategy, the objectives related to compliance are listed in the short, medium and long term. Activities such as physical investments, capacity building, R&D, legislation and policy development are proposed to identify and combat such issues as agricultural drought and floods caused by climate change, water scarcity, food safety, habitat deterioration and loss, flora and fauna impacts, desertification and erosion accelerating impacts, forest fires, forest pests, public health impacts, animal diseases and plant pests and so on.

"The **National Action Plan on Climate Change (CCNAP) (2011-2020)**" published in July 2011 by the Ministry of Environment and Urbanization was the first official document to include comprehensive actions on direct adaptation policies at the national level.[6] A total of 44 targets and 159 actions were identified under the 17 main objectives for Adaptation to Climate Change.[7] The relevant action plan defines 5 areas of action for adaptation to climate change, including Water Resources Management, Agriculture Sector and Food Security, Ecosystem Services, Biological Diversity and Forestry, Natural Disaster Risk Management, and Cross-sectoral Common Issues in the Context of Human Health and Adaptation. The NAPCC document has been re-published as "National Action Plan on Climate Change (NAPCC) (2011-2023)"with the extension of 2023. However, adaptation actions and durations have not changed.[8]

"**Turkey's Climate Change Adaptation Strategy and Action Plan**" was prepared by the Ministry of Environment and Urbanism in 2011.[9] Almost all of the actions in this document are the same as those in the CCAP document. Some new actions have been added and the implementation times of the actions in the CCAP document have been updated. This document, was republished in 2012 by the Ministry of

[4] Turkey Climate Change Strategy 2010-2020 URL:
http://iklim.cob.gov.tr/iklim/Files/Stratejiler/strateji%20kitapcik_turkce_pdf.pdf
[5] Turkey Climate Change Strategy 2010-2023 URL:
http://webdosya.csb.gov.tr/db/iklim/banner/banner592.pdf
[6] Republic of Turkey National Action Plan on Climate Change 2011-2020, July 2011, URL:
http://iklim.tarim.gov.tr/dosya/idep.pdf
[7] Climate Change Action Plan Evaluation Report, URL:
https://tr.boell.org/sites/default/files/tipig_idep_raporu.pdf
[8] Republic of Turkey National Action Plan on Climate Change 2011-2020,
URL:http://webdosya.csb.gov.tr/db/iklim/banner/banner591.pdf
[9] Turkey's Climate Change Adaptation Strategy and Action Plan, URL:.
http://www.dsi.gov.tr/docs/iklim-degisikligi/t%C3%BCrkiyenin-iklim-de%C4%9Fi%C5%9Fikli%C4%9Fi-uyum-stratejisi-ve-eylem-plan%C4%B1.pdf?sfvrsn=2

Environment and Urbanism under title "**Turkey's Climate Change Adaptation Strategy and Action Plan 2011-2023**"[10]

Published in 2011, "**Turkey's Climate Change Adaptation Strategy and Action Plan**" includes assessment on impacts induced by climate change in Turkey and sub-regions in particular, the severity of these impacts and the affected sectors.

1.4.1. TURKEY'S POSITION IN CLIMATE CHANGE NEGOTIATIONS

Turkey was included as an OECD country in both Annex I and Annex II lists during the establishment of the UNFCCC. As an Annex I country, it has been under the obligation to make emission reductions and to undertake financial support to developing countries as an Annex II country. Therefore Turkey has not ratified the UNFCCC for a long time. Turkey was excluded from Annex II in COP7 held in Marrakech in 2001. Although not excluded from Annex I, its special conditions have been accepted. Following this development, Turkey became a party to the Convention in 2004 after Grand National Assembly of Turkey (Parliament) ratified the law on Turkey's accession to the UNFCCC. Turkey adopted the Kyoto Protocol in 2009. Because it was not a member of the UNFCCC during the signing of the Protocol Turkey did not assume any reduction commitment.

Although Turkey signed the Treaty of Paris, which came into force in 2016, it has not ratified the Treaty in parliament yet. Until this process is completed, Turkey is not a party to the agreement. Turkey's being a party to the agreement is expected to take shape according to the results of Turkey's accession negotiations to the Green Climate Fund.

Other relevant basic information and documents on Turkey's climate policy can also be reached via links included in Annex 2.

1.4.2. TURKEY'S CLIMATE CHANGE TARGETS

In the process leading to the Paris Treaty, Turkey submitted its Intended Nationally Determined Contribution (INDC) to the UNFCCC Secretariat in 2015. With its national contribution, Turkey committed 21% reduction of greenhouse gas emissions compared to the usual scenario in 2030, if it becomes a party to the treaty. Accordingly, if no measures are taken, the amount of emission in Turkey in 2030 is targeted to increase to 1.175 million tons of CO_2e; this figure is intended to be 929 million tons of CO_2e if the measures specified in the declaration of intent are taken [11] (see Figure 8).

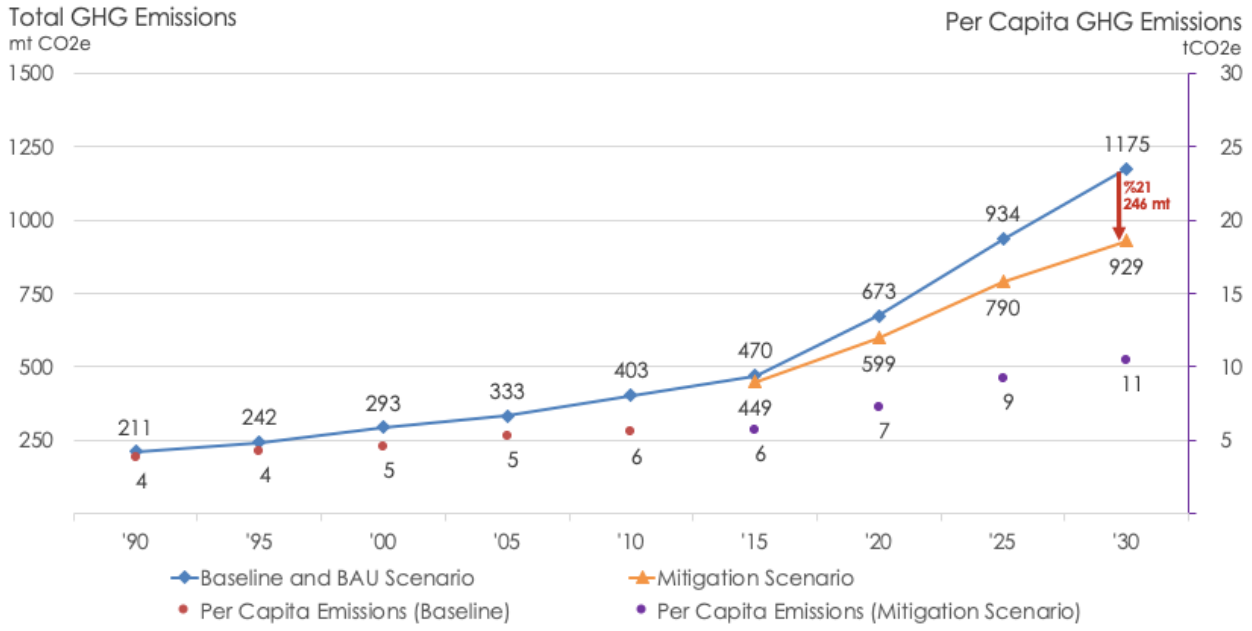
Turkey committed to increase the capacity to produce electricity from solar power and wind power by 2030 to 10 GW and 16 GW respectively, to use full of hydroelectric capacity, to commission 1 nuclear power plant and to reduce the loss rate in the electricity generation and grid to 15%.

[10] Turkey's Climate Change Adaptation Strategy and Action Plan 2011-2023, URL:. https://webdosya.csb.gov.tr/db/iklim/editordosya/uyum_stratejisi_eylem_plani_TR.pdf

[11] This target includes emissions from land use, land use change and forestry activities (LULUCF).

Figure 8 - Turkey's Intended Nationally Determined Contribution (2015-2030)

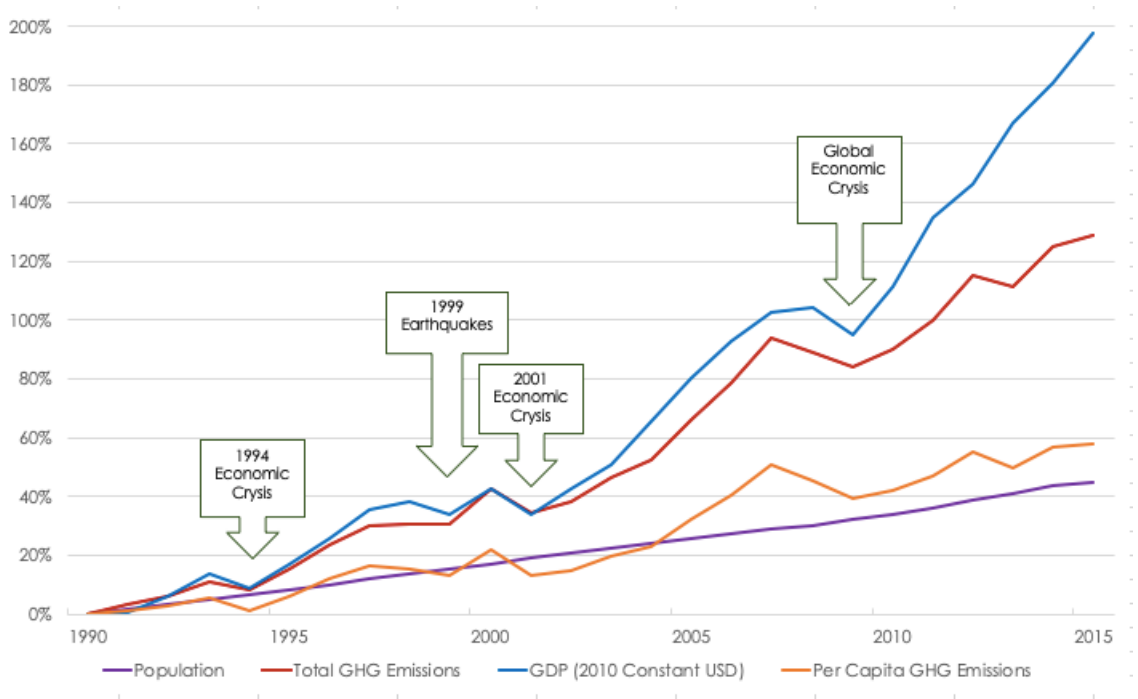
(MoEU, 2015; Turkstat, 2018)



1.4.3. KEY INDICATORS

It is very clear that Turkey's greenhouse gas emissions will increase in the short and medium term. The increase in greenhouse gas emissions is expected to continue considering the key indicators such as population, GDP per capita, number of vehicles per thousand people and the size of households. Turkey's national income increased around 200% between in 1990 - 2015 (in $ price of the year 2010), while the population increased by over 40% (see Figure 9).

Figure 9 - Cumulative Change in Selected Key Indicators (1990-2014) (TURKSTAT, 2018; World Bank, 2014)



Units: 1 - Population,% change compared to 1990; 2 - Total Greenhouse Gas Emissions, CO2e % change compared to 1990; 3 - National Income,% change in 2010 $ prices compared to 1990; 4 - Per Capita Greenhouse Gas Emissions, CO_2e change compared to 1990

2. CURRENT SITUATION:

CLIMATE CHANGE AND CITIES

The fact that the cities with high population, production and consumption have high pollutants causes impacts and vulnerability to climate change to become high. Moreover, cities are not only influencing their borders but also a large area where they interact with instruments such as trade and transportation. The population of cities continues to grow rapidly and the urban population is estimated to be 6,4 billion in the year 2050, consisting of more than 70% of the total population (OECD, 2014). The increase in the urban population in Turkey is similar to that in the world. While the total population increased by 4,5 times between the years of 1940-2016, the population living in cities increased by 11,5 times until 2007, which was before the Law No. 5747.[12] Turkey has a total of 1.397 municipalities, including 30 metropolitan municipalities (Ministry of Interior, 2018). In 2016, 75 million people, 94% of the total population, lived within municipal boundaries and 77% lived within the borders of metropolitan municipalities (TURKSTAT, 2016a).

The close relationship of cities with climate change also indicates that they can be a solution to this problem. New York and London, the major metropolises of the world, committed 80% reduction by 2050 and 60% reduction in greenhouse gas emissions by 2040, respectively, while Seoul, the capital of South Korea, with a population of 10 million, committed a 25% reduction by 2020. It has been proved by the European cities that not only the big cities but also small-scale cities can make a great contribution to the fight against climate change. Copenhagen, a medium-sized city, aims to reduce greenhouse gas emissions by 100% until 2025 (REC Turkey, 2016).

In some cases, mitigation and adaptation policies to be carried out in cities can be competitive, but in most cases they support each other. For example, thermal insulation in buildings provides energy savings while at the same time it helps less temperature exposure during hot periods. Green infrastructures serve both mitigation and adaptation. Vegetation or green areas reduce the temperature in cities in addition to carbon capture.

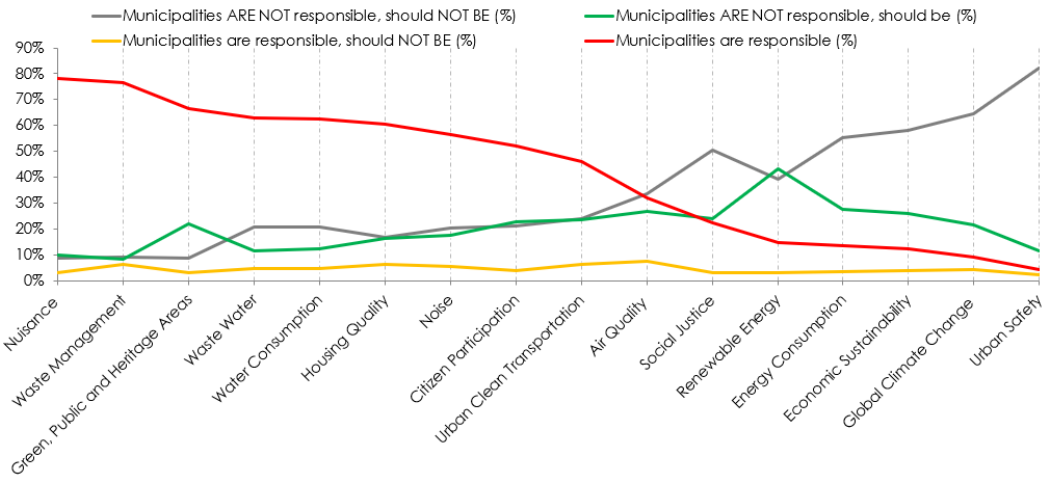
Adaptation works should not be considered as a new obligation for municipalities although the studies carried out by the municipalities in Turkey and the measures taken by them in various management areas are not directly addressed under the heading “adaptation”. Municipalities have very significant powers in their areas of responsibility such as "transport, buildings and waste management” in mitigation and adaptation in the fight against climate change in Turkey.

[12] With the Law No. 5747 on the Establishment of Districts within the Borders of the Metropolitan Municipality and the Amendment to Certain Laws, villages in some metropolitan cities have been linked to districts and caused a statistical increase in the population living in provinces and districts.

The authority sharing between the central and local administrations determine what the municipalities can do in terms of climate change. Municipalities have very significant powers in their areas of responsibility such as "transport, buildings and waste management" in mitigation and adaptation in the fight against climate change in Turkey. Moreover, the fact that the population is so dense also places the responsibility to take a step on the cities in terms of climate change. However, according to a survey for the municipalities conducted by REC Turkey in 2015, 65% of the municipalities do not see climate change in their areas of responsibility and they do not demand responsibility in this area (see).

Figure 10).

Figure 10 - Areas of Responsibility of Municipalities (REC Turkey, 2015)



On the other hand, local governments try to fulfil their increasing role in combating climate change by taking part in international cooperation and learning from each other. There are various associations/organizations established to facilitate these processes. Turkish municipalities have started to participate in these global initiatives. The most known global initiatives these municipalities participate in, member states, the number local governments from Turkey can be seen in Table 3.

Table 3 - Local Government Climate Initiatives (CoM, 2018; C40, 2018a)

Initiative	Covenant of Mayors	C40 Cities
Number of Countries	53	50
Number of Local Governments	7755	92
Number of Local Governments in Turkey	16	1

2.1. EFFORTS OF LOCAL GOVERNMENTS IN DIFFERENT COUNTRIES

Some selected municipalities that are members of the above mentioned local government climate initiatives are listed below. These selected municipalities have made significant progress in fulfilling the criteria of these initiatives by preparing their GHG inventories and CCAPs and following their outputs.

Table 4 lists 32 model cities from European local governments with over 500,000 inhabitants who are members of Covenant of Mayors (CoM) initiative and who have prepared and followed the action plan. Some of these metropolises have committed 20% or more, which is CoM's 2020 target, while some leading metropolises such as Barcelona, Paris and Hamburg have increased their target to 40%, updated for 2030 by CoM. While some of the cities only prepared a mitigation action plan, some cities prepared and followed up their adaptation plans.

Unlike the Covenant of Mayors, the cities of C40 are cities with high populations that can be classified as mega cities or metropolitan cities. Therefore, the number of C40 member local governments is relatively low compared to Covenant of Mayors members. C40 member local governments can be seen on the map below.

Table 4 - Selected Local Governments from the Covenant of Mayors Initiative (CoM, 2018)

City	Population	Commitment	Affiliation	City	Population	Commitment	Affiliation
Berlin, DE	3439132	2020	2010	Zagreb, HR	790017	2020 2030 ADAPT	2008
Paris, FR	2265886	2020 2030 ADAPT	2008	Lviv, UA	758351	2020	2009
Hamburg, DE	1814597	2020 2030 ADAPT	2008	Bordeaux, FR	720000	2020	2009
Vienna, AT	1731236	2020	2012	Frankfurt am Main, DE	670000	2020 ADAPT	2008
Warsaw, PL	1680000	2020	2009	Genova, IT	661887	2020	2009
Barcelona, ES	1604555	2020 2030 ADAPT	2008	Helsinki, FI	628208	2020	2009
München, DE	1464962	2020 ADAPT	2009	Glasgow, GB	612000	2020 ADAPT	2009
Milan, IT	1300000	2020	2008	Nantes, FR	600000	2020	2008
Grand Lyon , FR	1300000	2020	2008	Düsseldorf, DE	597102	2020	2010
Tbilisi, GE	1100000	2020	2010	Málaga, ES	568305	2020 2030 ADAPT	2008
Bruxelles, BE	1048491	2020	2008	Vilnius, LT	553904	2020	2012
Birmingham, GB	1028700	2020 2030 ADAPT	2009	Bremen, DE	546451	2020 2030 ADAPT	2008
Napoli, IT	970438	2020	2009	Nice Côte d'Azur, FR	525000	2020	2008
Torino, IT	910504	2020 ADAPT	2009	Dublin City Council , IE	506211	2020 2030 ADAPT	2009

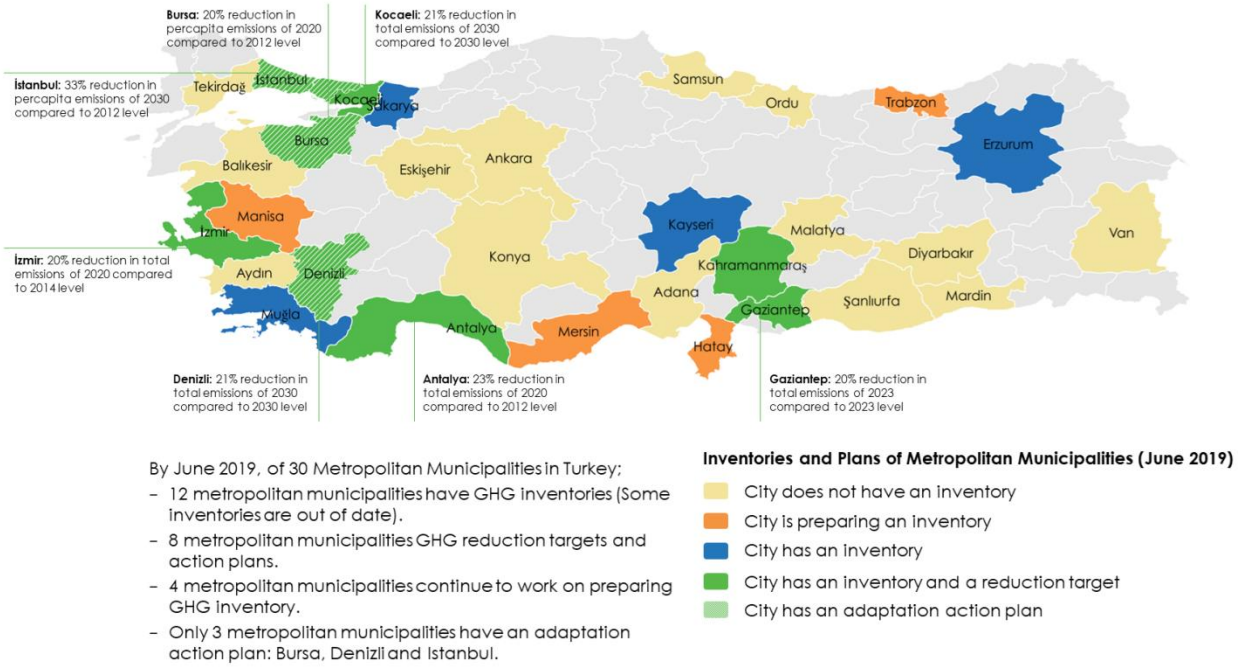
Figure 11 - Member Local Governments of C40 Climate Leaders Group (C40, 2018a)

2.2. EFFORTS OF LOCAL GOVERNMENTS IN TURKEY

As of 2018, only 9 of 30 Metropolitan Municipality in Turkey, namely, Antalya, Bursa, Erzurum, Gaziantep, İstanbul, İzmir, Kocaeli and Muğla have completed their GHG inventories. 5 of them, Kahramanmaraş, Kayseri, Manisa, Mersin and Trabzon, continue to prepare it (Figure 12)[13].

[13] Gaziantep has prepared a total of 3 inventories for 2011, 2013, and 2015 and Istanbul has prepared a total of 2 inventories for 2013 and 2016.

Figure 12 - Greenhouse Gas Inventory Status of Metropolitans 2019 (REC Turkey, 2019)



Of the 9 metropolitan municipalities that have prepared GHG inventory, Antalya, Bursa, Denizli, Gaziantep, Izmir and Kocaeli, have the targets of the emission reduction and CCAPs (Figure 12). Among these municipalities, Bursa, Denizli and İstanbul Metropolitan Municipalities have action plan mitigation and adaptation activities.

Figure 13 - Comparison of the Metropolitan Municipalities with Action Plan (REC Turkey, 2018)

Base Year	2016	2012	2014	2015	2015	2014	2016
Population (Base Yeanı)	79.814.871	2.092.537	2.787.539	1.931.836	14.657.434	4.113.072	1.830.772
Provincial GHG E (Total CO_2e) (Base Year)	496,1 mt	9,0 mt	12,8 mt	10,1 mt	48,0 mt	22,0 mt	25,1 mt
Ratio within Turkey's Total (Base Year)	%100	%2	%3	%2	%10	%5	%5
Provincial GHG E (Total CO_2e) (Target Year)	2030	2020	2030	2023	(FTTB-unpublished)	2020	2030
Mitigation Target	%21	%23	%20	%20	(FTTB-unpublished)	%20	%21
Mitigation Type	Decrease from the Increase (Total Emissions at 2030 in comparison to 2030 BaU)	Net Mitigation (Total Emissions at 2020 in comparison to 2012)	Net Mitigation (Per Capita Emissions at 2030 in comparison to 2014)	Decrease from the Increase (Per Capita Emissions at 2023 in comparison to 2023 BaU)	(FTTB-unpublished)	Net Mitigation (Total Emissions at 2020 in comparison to 2012)	Decrease from the Increase (Total Emissions at 2030 in comparison to 2030 BaU)
Notes	Without LULUCF	Without Industrial Processes			Without Industrial Processes and Agriculture/Husbandry	Mitigation Target does not includes Industry and LULUCF emissions	

Total emissions according to the Greenhouse Gas Inventories and also other relevant information of these cities are seen in Figure 13. Istanbul and Kocaeli stand out as the two largest municipalities with 48 and 25 million tons of CO_2e/year. Emissions of Istanbul correspond to 10% of Turkey's total emissions and the emissions of Kocaeli correspond to 5%. Although it is definitely not known, Ankara is expected to be located somewhere between Istanbul and Kocaeli, as it has not prepared GHG inventory yet.

The number of plans including adaptation actions lagged behind the mitigation actions in a similar manner to those in the EU. Among the metropolitan municipalities mentioned above, only Bursa and Istanbul Metropolitan Municipalities prepared a plan including adaptation as well as mitigation actions.

The Adaptation to Climate Change Support Package (CASP) for the cities has been prepared within the scope of the Project for Increasing the Institutional and Technical Capacity for the Development of Climate Adaptation Strategies which is supported by the Ministry of Environment and Urbanization and of which Bursa Metropolitan Municipality is the beneficiary.[14]

[14] Climate Change Adaptation Support Package for Cities (2014), URL:https://webdosya.csb.gov.tr/db/turkce/editordosya/Uyum%20Destek%20Paketi(1).pdf

3. CURRENT SITUATION IN DENIZLI

Climate change is a challenging social phenomenon that arises from the functioning of interrelated biophysical and human systems and that causes complex problems in different fields. Therefore, it is extremely important to evaluate the current situation with a holistic view. In this chapter, information on Denizli's climate, soil, water and natural characteristics and the economy and livelihoods of the province have been collected.

3.1. GEOGRAPHY AND CLIMATE

Geography

Denizli is located at the intersection of the Aegean-Central Anatolia and the Mediterranean Regions, in the southwest of the Anatolian peninsula, and southeast of the Aegean region. It neighbours provinces of Burdur, Isparta, Afyon in the east and Aydın, Manisa in the west, Uşak in the north, and Muğla in the south.[15]

With a total of 19 districts, Denizli has a surface area of 12.134 km^2.[16] The altitude is 354 m in central Denizli, 609m in Buldan, 800m in Güney, 850 m in Cal and Cardak, 950 m in Acıpayam and Tavas, 975m in Çivril, 1,000 m in Kale, 1.359m in Çameli and 170 m in Sarayköy. Plains in Denizli are concentrated in Civril, Baklan and Kaklik.[17]

Figure 14 - Neighbouring Provinces and Districts of Denizli

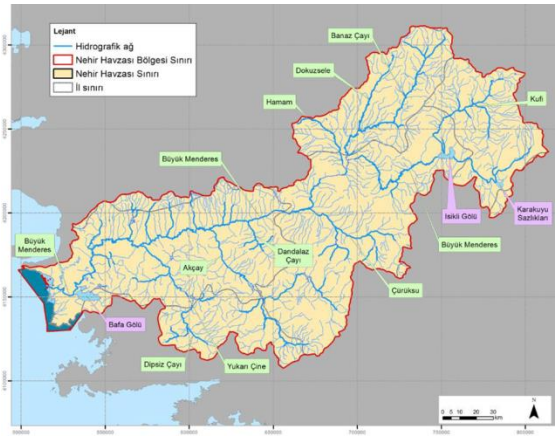
The province of Denizli is located in Buyuk Menderes, West Mediterranean and Burdur Basin. The upper part of the Buyuk Menderes Basin covers a large part of Denizli. Approximately 71% of the province's area

[15] Denizli Provincial Directorate of Culture and Tourism, URL: http://www.pamukkale.gov.tr/tr/Yeryuzu-Sekilleri
[16] Denizli Province, 1:25.000 Scale Master Plan Description, November 2018
[17] River Basin Atlas of Buyuk Menderes (2012), WWF Turkey

is located in the Buyuk Menderes Basin, while the rest of it is located in the western Mediterranean, Burdur and Gediz basins.

The sub-basins within the boundaries of Denizli and located within the Büyük Menderes basin are: Küfi River Basin (5.435 km^2), Adıgüzel Dam 84 km^2, Buldan Buharkent Basin (1.817 km^2) and Curuksu Basin (2.105km^2). Other provinces within the boundaries of the Buyuk Menderes Basin are Afyonkarahisar, Aydin, Burdur, Isparta, Izmir, Kutahya, Manisa, Mugla and Usak.[18]

Figure 15 - Buyuk Menderes Basin and Denizli Province[19]



Climate

Mediterranean climate impact is observed in the south-south eastern regions of Denizli as the mountains which are perpendicular to the sea carry the humid and warm sea climate to the inner parts, while other regions have continental climate characteristics. Cameli, Kale and Beyagac districts are dominated by the Mediterranean climate; Sarayköy, part of the Buldan and Denizli central districts in the Curuksu Valley are located in Agean Region climate, and other districts are included in the climate of the Central Anatolia region..[20] Different climate classes can be seen throughout the province according to the climate classifications known in connection with the spreading of the geographical borders of Denizli from north to south and from west to east:[21]

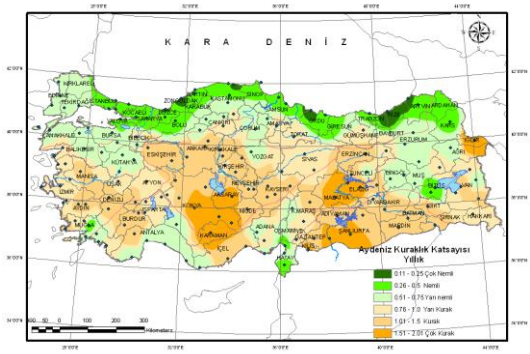
- **Climate of Turkey according to Aydeniz:** Semi-arid and Dry
- **Climate of Turkey according to De Martonne**: Semi-arid - Humid
- **Climate of Turkey according to Erinc:** Semi-humid
- **Climate of Turkey according to Thornthwaite**: Semi-arid - Humid

[18] Büyük Menderes Basin Protection Action Plan, General Directorate of Water Management
[19] Buyuk Menderes River Basin Management Plan, November 2018
[20] Denizli Provincial Directorate of Culture and Tourism, URL: http://www.pamukkale.gov.tr/tr/Genel-Bilgiler-Denizli/Fiziki-Yapi
[21] Climate Classifications Turkey, General Directorate of Meteorology, URL: https://www.mgm.gov.tr/iklim/iklim-siniflandirmalari.aspx?m=DENIZLI

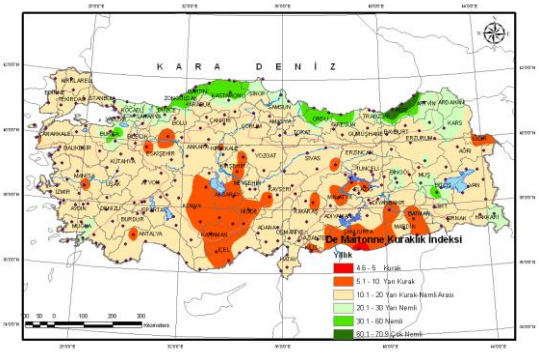
- **Climate of Turkey according to Köppen:** A climate of warm winter, very hot and dry summer (Mediterranean climate)
- **Climate of Turkey according to Köppen-Trewartha**: Subtropical dry summer climate, Mediterranean climate, Terrestrial temperate climate, Marine temperate climate

Figure 16 - Denizli Climate Classification

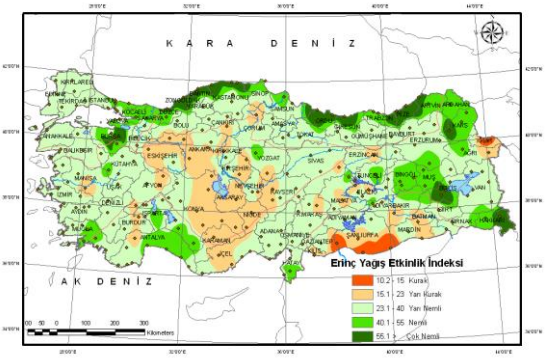
Climate of Turkey according to Aydeniz



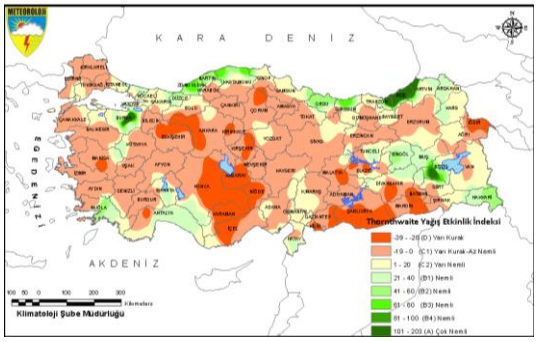
Climate of Turkey according to De Martonne



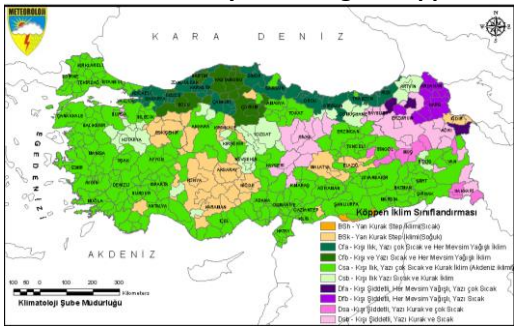
Climate of Turkey according to Erinc



Climate of Turkey according to Thornthwaite



Climate of Turkey according to Köppen



Climate of Turkey according to Köppen-Trewartha

* All evaluations used the climate period of 1981-2010.

In the light of the above information, it can be said that Denizli has semi-humid and semi-arid climate. While the surplus water in Denizli is seen in the winter, temperatures can rise to very high values when

the impact of Basra Low Pressure Centre is seen in summer. The average and extreme values recorded in Denizli in the period 1926-2016 are listed below.[22]

- Several years long average temperature: 16,3°C
- Average relative humidity: 59,1%
- Average sunshine time: 7,3 hours
- Average wind speed: 1,2 m/s
- Average annual precipitation: 564,7 mm
- Highest temperature (°C): 44,4 - Date:15.08.2007
- Lowest temperature (°C): -11,4 - Date: 09/02/1965
- Highest precipitation (kg/m²): 105,6 - Date: 09/07/1995
- Fastest wind (km/h): 132,8 - Date: 13/12/1967
- Highest snow (cm): 38 - Date: 06/01/2002

3.2. POPULATION

As of 2017, the population of Denizli province is 1.018.735. 63% (639.000 people) of this population is located in only 2 districts (Pamukkale and Merkezefendi), and 80% (800.000 people) in 5 districts (Pamukkale and Merkezefendi, Çivril, Acıpayam and Tavas districts). More than half of the 19 districts in Denizli (10 districts) have populations under 20.000 people. [23] While approximately 30% of the population live in villages and towns in Denizli province according to pre 2013 data, this ratio is 7 points over Turkey's average and shows the prevalence of rural life in Denizli (DESKİ, the 2018 Performance Program).

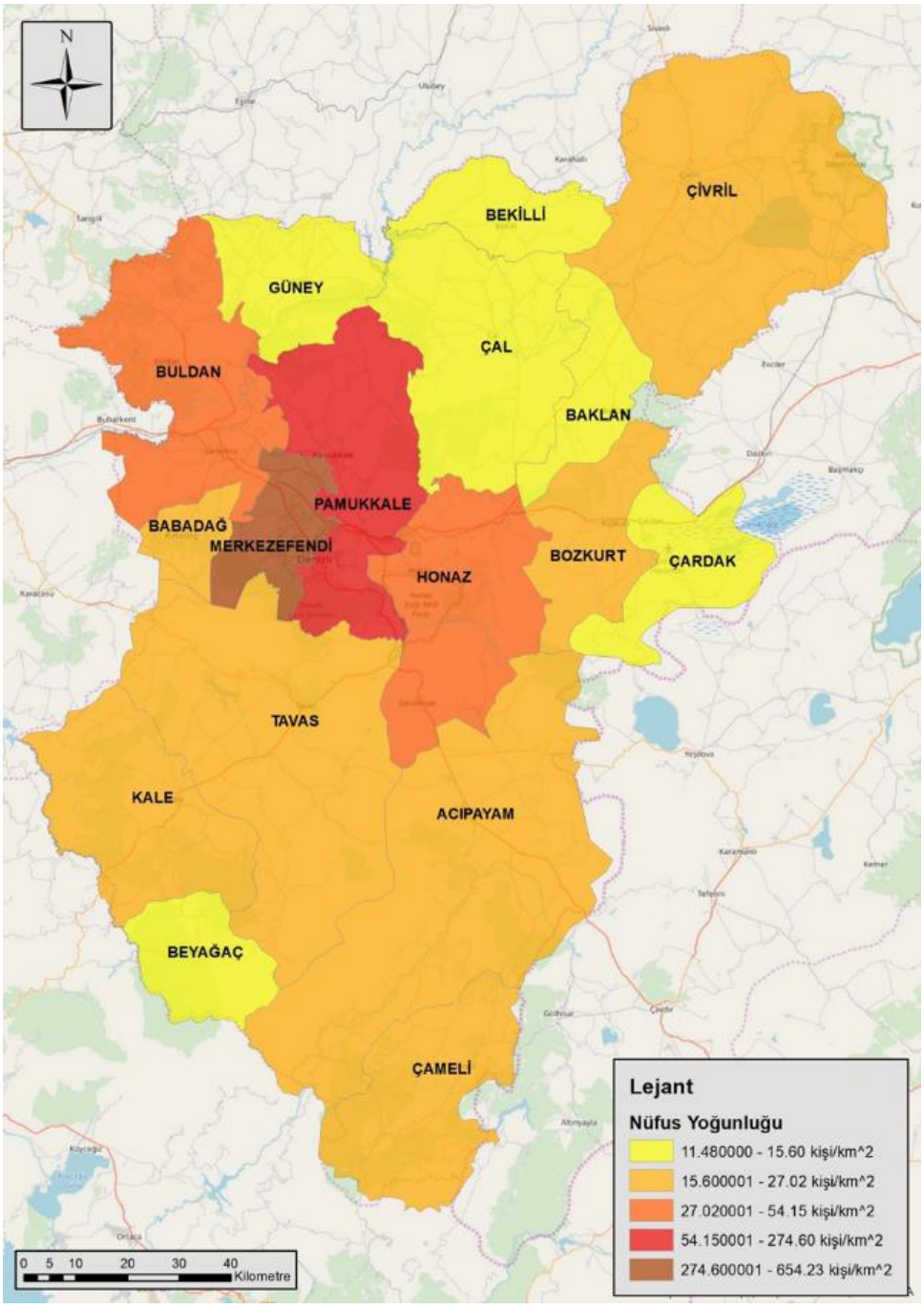
[22] Denizli Environmental Status Report 2017 https://webdosya.csb.gov.tr/db/ced/icerikler/den-zl-2017 cdr son-20181103081224.pdf

[23] TurkStat, Population Projections, 2018-2080, URL: http://www.tuik.gov.tr/PreHaberBultenleri.do?id=30567

Figure 17 - 2018 Satellite View of Denizli Central Districts

In the last decade, the population of Denizli has increased by 12%, and almost all (96%) of this increase has occurred in Merkezefendi and Pamukkale which are the central districts of Denizli. While the total population of the districts of Merkezefendi and Pamukkale increased by 28%, the population of 14 districts decreased. The highest decrease has been observed in Cal and Tavas districts.

Figure 18 - Population Density by Districts



3.3. DENIZLI WITH SOCIOECONOMIC INDICATORS

Considering the increase in population of Denizli and national income in recent years, it can be said that electricity and fuel consumption will increase in parallel. Therefore, the impact of the city on greenhouse

gas emissions and climate change is rapidly increasing. This section summarizes the main indicators of the province of Denizli in socio-economic, industrial, energy, environmental and land use areas which cuts the issue of combating climate change in the horizontal axis. Considering that all data belong to 2016, which is selected as the inventory year, the data compiled in the following table are predominantly for this year.

Table 5 - Selected Basic Indicators of Denizli Province in 2016

Data	Quantity	Unit	Rank in 81 Provinces:	Source	Year
Population	1.005.687	person	21	TSI	2016
Area	1.186.800	ha	25	MAF	2016
Per Capita GDP	24.772 ₺ (11.327 $)[24]	₺ ($)	15	TURKSTAT	2014
# of vehicles	374.219	vehicles	15	TURKSTAT	2016
# of Households	318.423	household	19	TURKSTAT	2016
Coal Consumption (housing)	112.424	tonne	25[25]	PDEU	2016
Electricity consumption	3.274	GWh	19	EMRA	2016
Diesel Consumption	431.286	tonne	12	EMRA	2016
Petrol Consumption	28.752	tonne	19	EMRA	2016
Natural Gas Consumption	1.095 million	Sm^3	10	EMRA	2016
Amount of Municipal Waste	400.787	tonne	25	TURKSTAT	2016
Amount of Hazardous Waste	10.204	tonne	23	TURKSTAT	2016
Amount of Wastewater	46.490.636	m^3	25	TURKSTAT	2016
Animal Population	830.906	heads	24	TURKSTAT	2016
Agricultural Area	376.738	ha	22	MAF	2016
# of OIZ	3	OIZ	32	MT&I	2016
# of Companies[26]	1.549	companies	11	TOBB	2016
# of ISO 500 Companies	11	companies	8	IIC	2016
Employment	69.169	person	11	TUCEC	2016
# of Companies (Foreign Cap.)	14	companies	16	TUCEC	2016
Average Temperature	16,3[27]	°C		GDM	2018
Heating Day Degree	1.374/144	HDD / T≤15°C	44	GDM	2016
Cooling Day Degree	696/124	CDD / T>22°C	11	GDM	2016

3.4. DENIZLI'S CURRENT EFFORTS TO COMBAT CLIMATE CHANGE

Various works have been carried out by the stakeholders on reducing greenhouse gas emissions and adaptation prior to the said CCAP study in order to combat climate change in Denizli.

[24] 47% comes from service sector and 38% comes from industrial sector.
[25] 8 provinces without data were excluded from the ranking.
[26] Main Industries: Apparel, electrolytic, glass, raw material and metal, natural stone, travertine and marble, modern livestock, feed and dairy
[27] Temperate / continental climate

With the increase in the population of the city and thus the need for energy, water, health, housing, transportation, communication, security Denizli Metropolitan Municipality aims to develop rational strategies for the more efficient use of the resources that meet these needs. Various applications realized with the “Smart City Denizli” project is the most concrete example of the efforts of the municipality to reduce greenhouse gas.

Figure 19 - Smart City Denizli (akillisehir.denizli.bel.tr) (AŞD, 2018)

The main examples of direct greenhouse gas emission reduction within the smart city applications developed by the DMM are listed below.

Table 6 - Smart City Applications Providing Greenhouse Gas Emission Reduction in Denizli (AŞD, 2018)

Implementation	Description
 Traffic Management System Project	The aim is to establish the technological infrastructure for applications to be established in the future for different purposes so as to establish a traffic control centre, to obtain record and manage data related to urban transportation network, to update automatically the signalized junction times in line with traffic data, to create urban traffic density maps, and to monitor them live through traffic cameras and to record images with the system to be established to manage the urban transportation network of Denizli which is under the authority and responsibility of DMM more efficiently, impactively, on a planned, expandable and sustainable basis. While the amount of fuel wasted at an intersection used approximately by 24.500 vehicles per hour during heavy traffic is about 1.120 lt/h, this amount will be reduced to 816 lt per hour with the system to be established. Considering all intersections in Denizli and the one-year period, the emission reduction will be very significant.
 Scada System	SCADA System aims to control and command the drinking water system in Denizli from a single centre. The SCADA System provides impactive and efficient control and command of the drinking water grid with the water distribution facilities. Water levels and volumes of water tanks, the amount of water supplied to the grid from the water stations and pumped to the upper level, the force main pressure values, the position and states of the motors and valves are monitored from the centre. The system can automatically open and close the pumps and valves from both the central and the lower stage pump stations according to the water levels of the water stations in the upper stages. Thanks to this system, all of the water supplied from the drinking water sources to the grid will be delivered to the homes and workplaces with the least loss. Thus, the loss of water and energy will be prevented and thus the emissions of the city will be reduced.
 Green Wave System	The coordinated traffic signalling created to solve the drivers' problem of continuous and frequent red light especially at successive signalized junctions is generally called "green wave coordination systems".The use of green wave coordination systems in traffic signalling has gained importance especially with the multiplication of successive signalized intersections in the city. The main purpose of such systems is to ensure that the vehicles travelling at certain speed in the selected main arteries without stopping at the red light at the successive signalized intersections. This system is applied in multiple main arteries in Denizli and traffic density and loss of fuel and time is largely prevented.

Energy Generation from Biogas

Power is generated from biogas in the solid waste landfill site and waste water treatment plant of the DMM. Landfill gas (methane-containing gases) formed in the solid waste disposal plant is collected with the help of special pipes placed. The gases transferred to the power plant are converted into electrical power by burning in the combustion engine. 3.765 MWh power is generated form annual average of 2.110.969 m^3 of waste gas from the landfill gas.

In this way, greenhouse gas emissions from the landfill are reduced and the risk of bad odour, self-ignition, explosion and pollution of underground water resources are prevented. In addition, an average of 6.000 cubic meters of biogas is produced per day from the sludge that is produced as a result of processing at the plant owned by DESKİ which is actively used in Denizli.

Powered by Sun Project

The project was implemented in order to disseminate the use of renewable energy resources in different fields, to reduce the impact of fossil resources in power generation and to increase energy efficiency. First of all, the roof of Kayıhan Closed Market has been covered with solar panels under the project. In this way, the electricity needs of the information centres and the course centres in 10 different parts of the city have been met with renewable energy. In addition, a solar power plant (SPP) was established in Akhan District and electricity production started.

Although there is no direct implementation under the target of adapting to climate change in the projects carried out by the DMM, activities that support the adaptation under the headings of urban planning, green space arrangement, water management and emergency management have been discussed.

Table 7 - DBB Smart Drip Irrigation System (AŞD, 2018)

Smart Drip Irrigation System

Thanks to the intelligent drip irrigation system, the green areas are irrigated according to the humidity values and temperature data of the soil or air and the data are stored Thanks to the system, the efficiency is increased with the watering performed at the desired time and level. The system, which is computer controlled with full automation and which irrigates in connection with the satellite, provides advantages both in terms of labour force and the amount of water used. Activated by the telephone call or radio frequency, the system starts and ends the irrigation in this way. Another important feature of the system is to prevent accidents that may occur due to water slashing over the road.

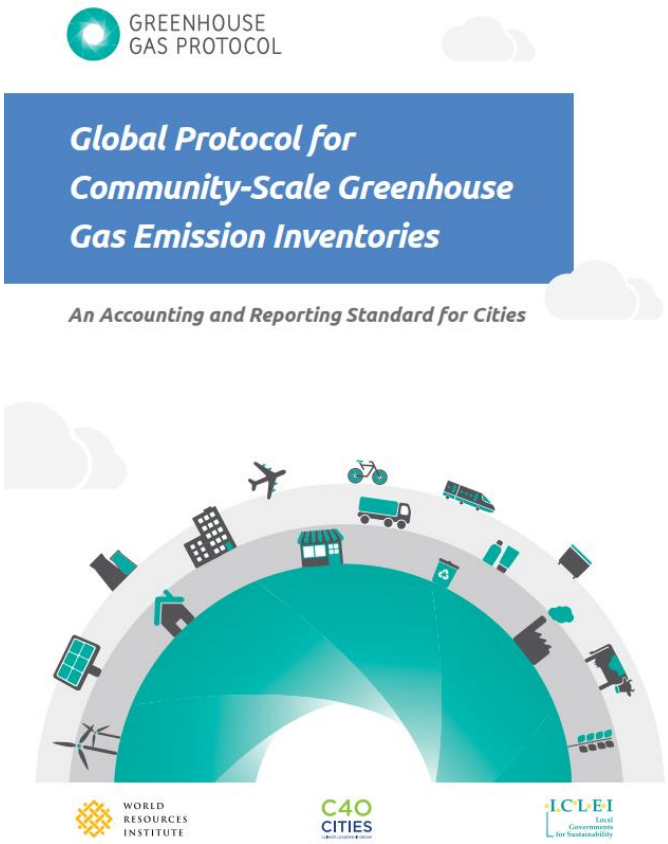
4. DENIZLI GREENHOUSE GAS INVENTORY

4.1. METHODOLOGY

4.1.1. PRINCIPLES OF CALCULATION AND REPORTING

The Denizli Greenhouse Gas Inventory has been prepared in accordance with Global Protocol for Local GHG Emissions (GPC) which was prepared in 2014 by C40 Cities Climate Leadership Group (C40), the International Council of Local Environmental Initiatives (ICLEI) and the World Resources Institute (WRI) and which is widely used by local governments (see Figure 20). The GPC was prepared on the basis of the IPCC National Greenhouse Gas Inventory Guidelines developed by the Intergovernmental Panel on Climate Change (IPCC) in 2006 and updated periodically. In this way, the results described in the following chapters are intended to be comparable and acceptable on a global scale.

Figure 20 - Global Protocol for Local GHG Emissions (GPC, 2014)



In the process of collecting data entered into the inventory preparation tool, “Data Collection Principles” of GPC listed below were followed.

- Establishment of the collection process
  - Resource prioritization
  - Planning, implementation, documentation/reporting
- Prioritizing improvement of key category estimates
  - With the largest share
  - With the biggest change potential
  - With the biggest uncertainty
- Review of data collection activities and methodological needs
- Working with data providers

In the process of analysis and reporting of data, “Calculation and Reporting Principles“ of GPC listed below have been followed.

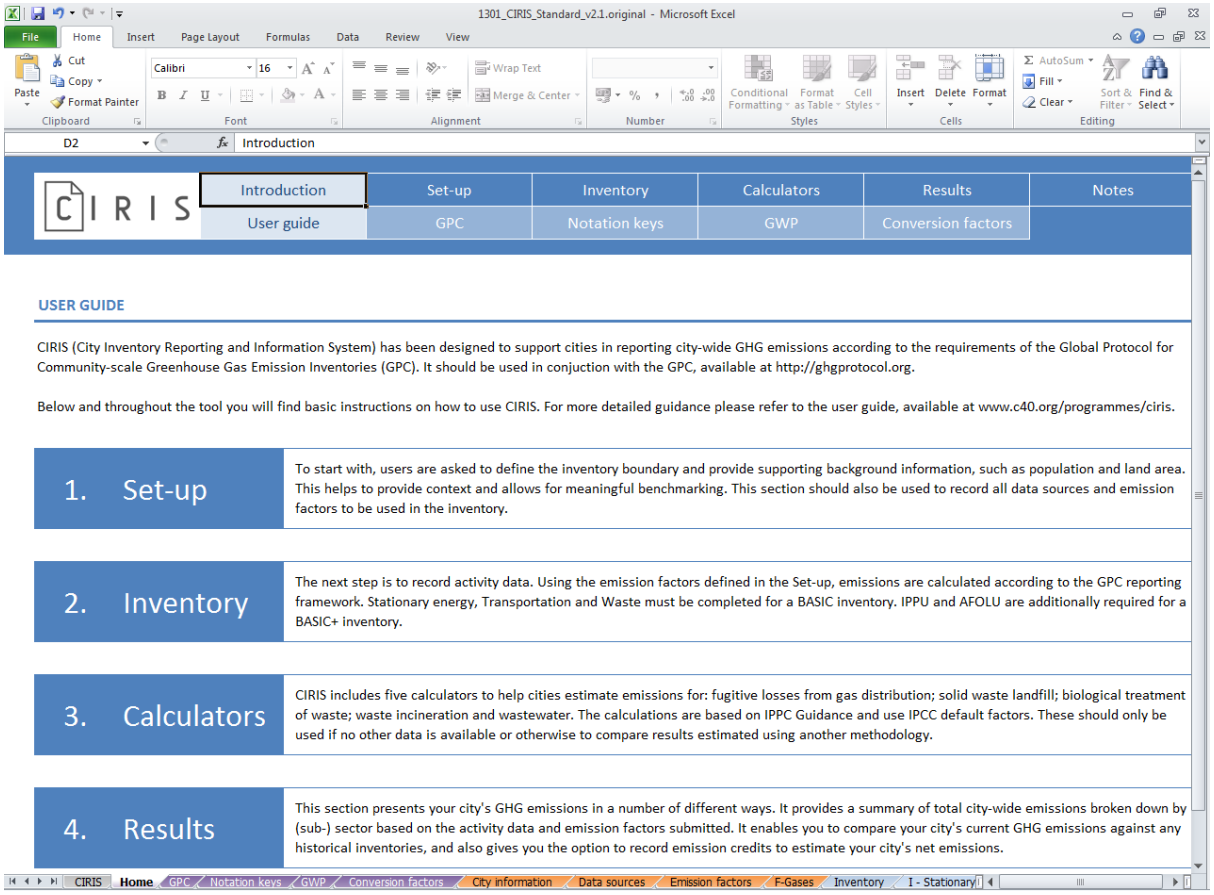
- Relevance
  - Urban activities and consumption models
  - Significance in choosing a data source, identifying and prioritizing data improvements
- Transparency
  - Activity data, emission source, emission factors, calculation methods
  - Use of the same resources by others and achieving the same result
- Accuracy
  - Not too low or far above current emissions
  - The confidence of decision-makers and the public should be ensured
- Consistency
  - Helps measurement, development and comparison
  - In approach, limit and method
- Integrity - Completeness
  - Dta as complete as possible
  - Key to data status

4.1.2. GREENHOUSE GAS INVENTORY PREPARATION TOOL

C40, ICLEI and WRI in the same collaboration created the inventory preparation tool "City Inventory Reporting and Information System - CIRIS) based on GPC for the local governments to prepare their inventories of greenhouse gases in a practical way and to meet a certain standard.

CIRIS is the latest and most comprehensive GHG inventory preparation tool created in 2017, prepared in accordance with the IPCC emission sources categories for metropolitan cities (see Figure 21). The Greenhouse Gas Inventory of Denizli 2016 was prepared using the standard version of CIRIS dated 17 August 2017 v2.1.

Figure 21 - CIRIS Greenhouse Gas Inventory Preparation Tool (C40, 2018b)



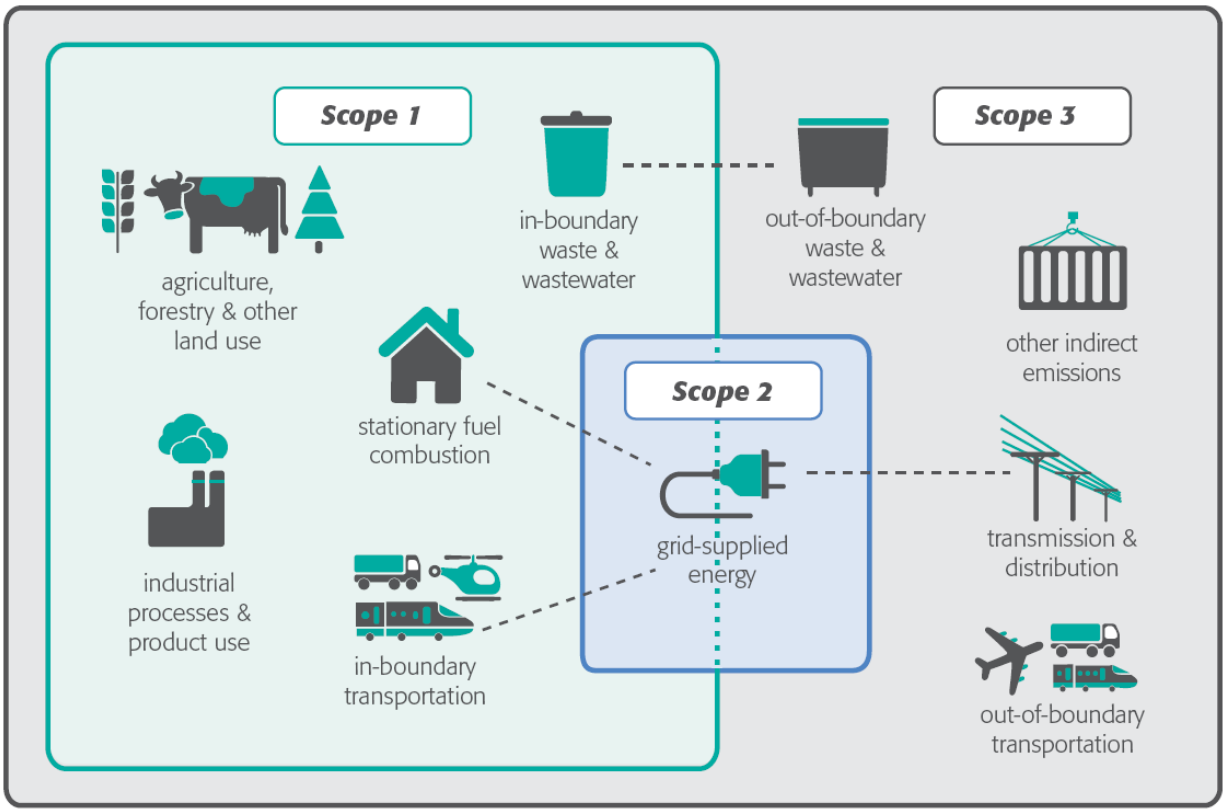
4.1.3. SCOPE OF THE INVENTORY

The inventory prepared at the urban scale includes all the emission sources within the realm of authority of Denizli Metropolitan Municipality. The authority of Denizli Metropolitan Municipality covers the provincial boundaries of the province. 2016 was chosen as the inventory year. The main reasons for this

are that the most current, holistic and accurate data on the national scale and the Denizli scale can be reached in this year.

The scope of the inventory was determined on the basis of the classification of emission sources set by the Global Protocol for Local GHG Emissions (GPC) . When preparing inventory in the framework of GPC, it is necessary to choose between the approaches in the 3 different contexts below, depending on the degree of detail, accuracy and reliability of the available data.

Figure 22 - Scopes Specified by GPC (GPC, 2014)



Scope	Source of Emission
Scope 1: Direct emissions	Fuel consumption by vehicles, at locations such as facilities, buildings etc. in the city.
Scope 2: Indirect Emissions	Power purchased from grid and consumed in the city and power for heating/cooling
Scope 3: Indirect (Consumption Based) Emissions	Production/transport of goods or services purchased by the inhabitants of the city

During the preparation of the inventory, all emission sources within the realm of authority of the municipality were scanned and the maximum amount of data was tried to be reached but the emissions under Scope 1 and Scope 2 were included in the inventory due to the fact that it is very difficult to reach the data under Scope 3.

In the light of available data and emission factors, three greenhouse gases, carbon dioxide (CO_2); (methane (CH_4) and nitrous oxide ($N2_O$) were included. Calculated CH_4 and N_2O emissions were converted into carbon dioxide equivalent (CO_2e) and included in total emissions. CO_2e cycles were obtained by multiplying the mass of greenhouse gases and the global warming potentials given by the IPCC 5th Assessment Report (AR5). Greenhouse gases Hydrofluorocarbons (HFCs); Perfluorocarbons (PFCs), sulphur hexafluoride (SF6), etc. were not included in the inventory due to the failure to obtain information on the activities that cause them.

4.1.4. BASIC DATA SOURCES AND DATA QUALITY

The main sources used in data collection process are; United Nations Climate Change Framework Convention (UNFCCC), Intergovernmental Panel on Climate Change (IPCC), Turkey Statistical Institute (TSI), Energy Market Regulatory Authority (EMRA), Denizli Governorship Provincial Directorate of Environment and Urban Planning (PDEU) and Denizli Metropolitan Municipality (DMM) databases and reports. The main sources used are listed in Table 8.

Table 8 - Key Stakeholders and Basic Data Sources

Source Name	Data	Year of Source	Source Institution
National Inventory Report 2018	National Emission Factors	2018	UNFCCC & TURKSTAT
2006 IPCC Greenhouse Gas Inventory Guides	International Emission Factors	2018	IPCC
2016 Denizli Environmental Status Report	Coal Consumption Data	2017	PDEU
2016 Natural Gas Market Sector Report	Natural Gas Consumption Data	2017	EMRA
Market Progress Report for Electricity Market for the Year 2016	Electricity Consumption Data	2017	EMRA
2016 Petroleum Market Sector Report	Fuel Consumption Data	2017	EMRA
TURKSTAT Municipal Waste Statistics Database	Solid Waste Disposal Data	2018	TURKSTAT
Denizli Metropolitan Municipality Water and Sewerage Administration (DESKİ) Database	Wastewater Disposal Data	2018	DESKİ
2016 TURKSTAT Animal Husbandry Statistics Database	Livestock Data	2018	TURKSTAT

The quality of the collected data and the emission factors used were classified into 3 categories: high, medium or low according to GPC methodology (Table 9). The quality of the data is generally classified as medium since the data used in the inventory and the emission factors are predominantly derived from national reports.

The emission factors used have been taken from the IPCC Greenhouse Gas Inventory Guidelines and Turkey 2018 National Inventory Report, thus they are intended to be consistent with the results of national reports and international inventories.

Table 9 - Data Quality Assessment (GPC, 2014)

Data Quality	Activity Data	Emission Factor	Scale
High (H)	Detailed / actual activity data	Specific Emission Factor	Local
Medium (M)	Solid activity data modelled using realistic assumptions	General Emission Factor	National
Low (L)	Excessive modelling or imprecise activity data	Default Emission Factor	International

4.2. COLLECTED DATA

The basic data required for inventory preparation are the residential, commercial buildings, power generation facilities, industrial facilities, solid waste and wastewater treatment plants within the municipal boundaries and the amounts of fuel and electricity used for road transportation, railways, waterborne navigation, aviation and agriculture/animal husbandry purposes. Active data gathering processes such as stakeholder workshops, overseas site visits, bilateral meetings and desktop data collection processes such as literature search, telephone interviews and protocol creation were carried out in order to reach these data. The collected data are classified according to GPC standards in order to be comparable and reportable internationally. Unreachable data were categorized again, justified by GPC's impressions and abbreviations listed below.

Included Elsewhere (IE): Emissions within this activity are calculated and presented under another category of inventory.

Not Estimated (NE): Emissions emerge; but not calculated or reported.

Not Occurring (NO): No activity or process takes place under this activity.

Confidential (C): Emissions emerge; however, it is protected by confidentiality principle because it is based on private sector data.

4.2.1. STATIONARY SOURCES

In this section, the main objective is to compile greenhouse gas emissions from buildings and fuel and electricity data used in residential, commercial buildings, institutional buildings, street lighting, manufacturing industry and construction sector, energy sector, agricultural activities are summarized. The data used are all real figures and the acknowledgement and assumptions made are presented at the end of the section.

Table 10 - Stationary Sources-Based Emission Sources

	Activity	Quantity	Unit	Source	Year
I.1. Residential					
I.1.1 Emissions from fuel used	Natural gas	145.830.284	Sm^3	EMRA	2016
	Hard Coal	112.424	tonne	PDEU	2016
	Fuel oil	8.254	tonne	EMRA	2016
I.1.2 Emissions induced from power from the grid	Electricity	630.531	MWh	EMRA	2016
I.1.3 Emissions from transmission and distribution leaks in the grid	Electricity	NE			
I.2. Commercial / Institutional Buildings					
I.2.1 Emissions induced from fuel used	Natural gas	37.527.949	Sm^3	EMRA	2016
I.2.2 Emissions induced from power from the grid	Electricity	677.552	MWh	EMRA	2016
	Street Lighting	70.656	MWh	EMRA	2016
I.2.3 Emissions from transmission and distribution leaks in the grid	Electricity	NE			
I.3. Manufacturing Industry and Construction					
I.3.1 Emissions induced from fuel used	Natural gas	175.926.662	Sm^3	EMRA	2016
	Hard Coal	193.500	tonne	PÜ	2017
I.3.2 Emissions induced from power from the grid	Electricity	1.817.625	MWh	EMRA	2016
I.3.3 Emissions from transmission and distribution leaks in the grid	Electricity	NE			
I.4. Power Industry					
I.4.1 Emissions induced from fuel used	Natural gas	IE	Included in I.3.1		
I.4.2 Emissions induced from power from the grid	Electricity	IE	Included in I.3.2		
I.4.3 Transmission and distribution leaks in the grid	Electricity	NE			
I.4.4 Emissions from leaks from power in the grid for generation purposes	Electricity (natural gas conversion)	4.135.754	MWh	PDEU	2016
I.5. Agricultural Activities					
I.5.1. Emissions induced from fuel used	Fuel	IE	Included in transportation (II.1.1)		
I.5.2. Emissions induced from power from the grid	Electricity	77.871	MWh	EMRA	2016
I.5.3 Emissions from transmission and distribution leaks in the grid	Electricity	NE			
I.6. Other sources not identified					

I.6.1. Emissions induced from fuel used	Fuel	NE
I.6.2. Emissions induced from power from the grid	Electricity	NE
I.6.3 Emissions from transmission and distribution leaks in the grid	Electricity	NE
I.7. Fugitive Emissions from Mining, Processing, Storage and Distribution of Coal	Greenhouse gas	NO
I.8. Fugitive Emissions from Petroleum and Natural Gas systems	Greenhouse gas, Fuel	NE

Acceptances and Assumptions

- The fuels used in agricultural activities Section I.5.1. are included in Section II.1.1 fuels used for road transport.
- The amount of natural gas used by the power industry in section I.4.1 is included in the amount of natural gas used by the manufacturing industry and construction sector in section I.3.1.
- The amount of energy used by the power industry from the grid in section I.4.2 is included in the amount of electricity used by the manufacturing industry and the construction sector in section I.3.2.
- Data on fugitive emissions from transmission and distribution in the grid classified under Scope 3 are not reported in the inventory.
- I.6. No data has been reported due to inaccessibility of other sources.
- I.7. Fugitive Emissions from Mining, Processing, Storage and Distribution of Coal are not reported due to lack of such activities in the city.
- I.8. Fugitive Emissions Originating from Oil and Natural Gas Systems have not been reported due to inaccessibility of such data.

4.2.2. TRANSPORTATION

This section summarizes fuel data mainly used in road, rail and air transport compiled to calculate greenhouse gas emissions from transportation. The data used are all real figures and the acceptances and assumptions made are presented at the end of the section.

Table 11 - Transport-Based Emission Sources

	Activity	Quantity	Unit	Source	Year
II.1. On-road transportation					
II.1.1. Emissions induced from fuel used	Gasoline	28.752	tonne	EMRA	2016
	Diesel	431.286	tonne	EMRA	2016
	LPG	74.006	tonne	EMRA	2016
II.1.2. Emissions induced from power from the grid	Electricity	NE			
II.1.3 Emissions from out-of-town transport and transmission and distribution leaks in the grid	Fuel, Electric	NE			
II.2. Railways					
II.2.1. Emissions induced from fuel used	Diesel	1.543.673	lt	TCDD	2016
II.2.2. Emissions induced from power from the grid	Electricity	2.647	MWh	TCDD	2016
II.2.3 Emissions from out-of-town transport and transmission and distribution leaks in the grid	Fuel, Electric	NE			
II.3. Waterborne navigation					
II.3.1. Emissions induced from fuel used	Fuel oil	NO			
II.3.2. Emissions induced from power from the grid	Electricity	NO			
II.3.3 Emissions from out-of-town transport and transmission and distribution leaks in the grid	Fuel, Electric	NO			
II.4. Aviation					
II.4.1. Emissions induced from fuel used	Jet Fuel	3.579	tonne	EMRA	2016
II.4.2. Emissions induced from power from the grid	Electricity	NE			
II.4.3 Emissions from out-of-town transport and transmission and distribution leaks in the grid	Fuel, Electric	NE			
II.5. Off-road transportation					
II.5.1. Emissions induced from fuel used	Fuel	IE	Included in II.1.1		
II.5.2. Emissions induced from power from the grid	Electricity	NE			
II.5.3 Emissions from out-of-town transport and transmission and distribution leaks in the grid	Fuel, Electric	NE			

Acceptances and Assumptions

- It is assumed that all fuel sales figures taken from EMRA are of fuel used within the city.
- Data on energy-related emissions from the grid have not been reported due to inaccessibility.
- Fugitive Emissions from transmission and distribution out of urban transport and network classified under Scope 3 have not been reported in the inventory.
- For fuel and electricity consumption data for the calculation of emissions from rail transport, statistics yearbook published by Turkey State Railways (TCDD) for the period 2012-2016 was used. Quantity of diesel and electricity consumed for rail transport in Denizli has been calculated approximately using information on the number of passenger and freight in Turkey and Denizli.

Calculation:

Diesel / Electric Consumption in Denizli for Rail Transportation = Diesel / Electric Consumption in Denizli for Rail Transportation in Turkey x (Number of Railway Passengers in Denizli / Number of Railway Passengers in Turkey + Amount of Railway Freight in Denizli / Amount of Railway Freight in Turkey / 2

1.543.673 lt = 126.839.000 lt x (533.126 passengers / 41.581.774 passengers + 575.329 tons of freight / 49.943.843 tons of freight) / 2

2.646.950 kWh= 217.492.000 kWh x (533.126 passengers / 41.581.774 passengers +575.329 tons of freight/ 49.943.843 tons of freight) / 2

4.2.3. WASTE

This section summarizes the amount of solid waste disposed by landfill, incineration and biological treatment and the wastewater discharged by biological treatment to calculate greenhouse gas emissions from waste management The data used are all real figures and the acceptances and assumptions made are presented at the end of the section.

Table 12 - Waste Management -Based Emission Sources

	Activity	Quantity	Unit	Source	Year
III.1. Solid Waste Disposal					
III.1.1. Emissions due to the landfill of wastes created in the city	Landfill of domestic waste	225.053	tonne	TURKSTAT	2016
	Uncontrolled disposal of waste	146.665	tonne	TURKSTAT	2016
III.1.2. Emissions due to the landfill outside the city of wastes created in the city		NO			
III.1.3. Emissions due to the landfill in the city of wastes created outside the city		NO			
III.2. Biological Treatment of Wastes					
II.2.1. Emissions due to biological treatment outside the city of wastes created in the city	Composting	4.192	tonne	TURKSTAT	2016

III.1.2. Emissions due to biological treatment outside the city of wastes created in the city.		NO			
III.1.3. Emissions due to biological treatment in the city of wastes created outside the city		NO			
III.3. Waste Incineration (Energy Production and Incineration)					
III.1.1. Emissions due to incineration in the city of wastes created in the city		NO			
III.1.2. Emissions due to incineration outside the city of wastes created in the city		NO			
III.1.3. Emissions due to incineration in the city of wastes created outside the city		NO			
III.4. Wastewater Treatment and Discharge					
III.1.1. Emissions from urban wastewater treatment in the city	Domestic and industrial wastewater of domestic quality	47.950.173	m^3	DESKİ	2016
		(5.689.358)	*kg C*		
		(3.426.998)	*kg N*		
III.1.2. Emissions from urban wastewater treatment outside the city		NO			
III.1.3. Emissions from urban treatment of waste water created outside the city		NO			

Acceptances and Assumptions

- Emissions from landfills outside the city of urban wastes classified under Scope 3, emissions from biological treatment have not been reported in the inventory.
- Emissions from out-of-town wastes on landfills within the city and their biological treatment have not been reported due to non-occurrence in Denizli.
- The treatment outside the city of emissions from urban wastewater classified under Scope has not been reported in the inventory.
- The emissions from treatment in the city of wastewater generated outside the city have not been reported due to the fact that they do not occur in Denizli.
- Wastewater data of Denizli Metropolitan Municipality Water and Sewerage Administration (DESKİ) have been used to calculate emissions from wastewater treatment. In order to calculate emissions from wastewater treatment, these emissions should be expressed in terms of emission factors offered by TURKSTAT. For this reason, the amount of soluble carbon and nitrogen in the waste water was calculated.

Calculation:

Source/Method	*(PDEU, 2016)*	*Calculation*	*(DESKİ, 2016)*	*(DESKİ, 2016)*	*(USEPA, 2010)*	*(USEPA, 2010)*	*Calculation*	*Calculation*
Facility	**Wastewater Quantity (m^3/day)**	**Wastewater Quantity (m^3)**	**BOI (mg/l)**	**TN (mg/L)**	**CH_4/BOI (g/)**	**N/TN (g/g)**	**Total C (kg)**	**Total N (kg)**
Denizli WWTP	1.33	41,942,880	240 00	46.00	0.50	1.57	5,033,145.60	3.031.871,04
Akköy WWTP	0.083	2,617,488	207.00	38.00	0.50	1.57	270,910.01	156,301.43
Bozkurt WWTP	0.0057	179,755	204.00	97.80	0.50	1.57	18,335.03	27,625.81
İnceler WWTP	0.0069	217,598	300.00	50.00	0.50	1.57	32.639,76	17,097.02
Yeşilyuva WWTP	0.0104	327,974	317.00	50.00	0.50	1.57	51,983.94	25,769.42
Gümüşsu WWTP	0.0024	75.686	300,00		0.50	1.57	11,352.96	-
Gözler WWTP	0.0052	163,987	250.00	40.00	0.50	1.57	20,498.40	10,307.77
Serinhisar WWTP	0.0149	469,886	384.00	96.00	0, 0	1.57	90,218.19	70,885.72
Civril WWTP	0.0314	990,230	275.00	56.00	0.50	1.57	136,156.68	87,140.28
Köke/Acıpayam PWWTP	0.0003	9,461	50.00		0.50	1.57	236.52	-
Bölmekaya Buldan PWWTP	0.0005	15,768	50.00		0.50	1.57	394.20	-
Oğuz/Buldan PWWTP	0.0005	15,768	50.00		0.50	1.57	394.20	-
Beylerbeyi/Sarayköy PWWTP	0.0007	22,075	50.00		0.50	1.57	51.88	-
Köprübaşı-Sazak/Sarayköy PWWTP	0.0011	34.690	50.00		0.50	1.57	867.24	-
Kavaklar/Baklan PWWTP	0.0002	6,307	50.00		0.50	1.57	157.68	-

Gömce/Bekilli PWWTP	0.0005	15,768	50.00		0.50	1.57	394.20
Gömce/Bekilli PWWTP	0.0004	12,614	50.00		0.50	1.57	315.36
Mahmutgazi/Çal PWWTP	0.00 4	12,614	50.00		0.50	1.57	315.36
Kavakköy /Çivril PWWTP	0.00009	2,838	50.00		0.50	1.57	70.96
Karateke/Honaz PWWTP	0.000	28,382	50.00		0.50	1.57	709.56
Emirazizli/Honaz PWWTP	0.0004	12,614	50.00		0.50	1.57	315.36
Hayriye/Çardak PWWTP	0.0001	3,154	50.00		0.50	1.57	78.84
Akçapınar/Pamukkale PWWTP	0.0002	6,307	50.00		0.50	1.57	157.68
Korucuk/Pamukale PWWTP	0.002	63,072	50.00		0.50	1.57	1,576.80
Çalıköy/Tavas PWWTP	0.0005	15,768	50.00		0.50	1.57	394.20
Horasanlı/Tavas PWWTP	0.0009	28,382	50.00		0.50	1.57	709,56
Ovacık/Tavas PWWTP	0.0003	9.461	50.00		0.50	1.57	236.52
Altınova/Tavas PWWTP	0.0011	34,690	50.00		0.50	1.57	867.24
Zeytinyayla/Denizli PWWTP	0.0025	78,840	50.00		0.50	1.57	1,971.00
Gemiş/Çardak PWWTP	0.0046	145,066	50.00		0.50	1.57	3,626.64
Beydilli/Çivril PWWTP	0.0017	53,611	50.00		0.50	1.57	1,340.28
Dayılar/Çal PWWTP	0.0007	22,075	50.00		0.50	1.57	551.88
Eskiköy/Acıpayam PWWTP	0.0023	72,533	50.00		0.50	1.57	1,813.32
Çambaşı/Bozkurt PWWTP	0,0011	34,690	50 00		0.50	1.57	867.24
Alikurt/Bozkurt NWWTP	0.0011	34,690	50.00		0.50	1.57	867.24
Pınarlık/Tavas NWWTP	0.0055	173,448	50.00		0.50	1.57	4,336.20
TOTAL		**47.950.173**					**5.689.357.73**

4.2.4. INDUSTRIAL PROCESSES AND PRODUCT USE

This section summarizes manufacturing data mainly used in cement, lime and glass industry compiled to calculate greenhouse gas emissions from industrial processes. These three industries are considered to have a large share in industrial processes and product use, and are estimated to have a high level of representation. Data on industrial emissions from electricity and fuel use are in the Stationary Sources section. Data on emissions from sectors such as textile, copper and marble, which are among the main industrial branches of Denizli, were also compiled in the Stationary sources section. The data used are all real figures and the acceptances and assumptions made are presented at the end of the section.

Table 13 - Emission Sources of Industrial Processes and Product Use

	Activity	Quantity	Unit	Source	Year
IV.1 Direct emissions from industrial processes within boundaries					
Mineral Industry	Cement (Clinker) Production	1.800.000	tonne	DÇ	2.016
	Lime Production	879.339	tonne	ÇÇ	2.016
	Glass Manufacturing	2.482	tonne	DC	2.016
	Carbonates' Other Process Uses	NE/NO			
Chemical industry	Ammonia Production				
	Nitric Acid Production				
	Adipic Acid Production				
	Caprolactam Production				
	Carbide Production				
	Titanium Dioxide Production				
	Soda Ash Production				
	Petrochemical and Black Carbon Production	NE/NO			
	Fluorochemical Production				
Metal industry	Iron and Steel Production				
	Ferrous Alloy Production				
	Aluminum Production				
	Magnesium Production	NE/NO			
	Lead Generation				
	Zinc Production				
IV.2 Emissions from product use within boundaries					
Use of non-energy products from fuel and solvent usage	Use of grease Use of paraffin wax Solvent use	NE			
Use of electronic industry products	Integrated circuit or semiconductor TFT flat panel displays Photovoltaic Heat transfer fluid	NE			
Use of products that substitute substances depleting ozone layer	Cooling and air conditioning gases Insulation foam gases Fire extinguishing gases Aerosols Solvents	NE			
Production and use of other products	Electrical equipment SF_6 and PFCs from other product uses N_2O from use of product	NE			

Acceptances and Assumptions

- It is considered that these three industries, whose production data are obtained within the scope of section IV.1, constitute a significant share in industrial processes and product use and it is considered that high level of representation is provided.
- The capacity utilization rate for the lime production plant in Denizli is 125% while the capacity utilization rate of the glass manufacture plant is 43%. The clinker production capacity of the cement production plant was accepted to be 100%.

Calculation:

Facility	Production Capacity (tonne)	Capacity utilization rate (%)	Production Quantity(tonne)	Source
Denizli Çimento (Clinker Production)	1.800.000	100%	1.800.000	DÇ, 201
Çimsa Çimento (Lime Production)	700.000	125%	879.339	ÇÇ, 2016
Denizli Cam (Glass Manufacture)	5.729	43%	2.482	DC, 2016

- No data could be reported due to the lack of production related to other industries within the scope of Section IV.1 or the lack of relevant data.
- No data could be reported due to the inability to access data on the use of products that substitute non-energy products, electronic industrial products and ozone-depleting substances from the use of fuels and solvents under section IV.2.

4.2.5. AGRICULTURE, FORESTRY AND OTHER LAND USE

This section summarizes agricultural and livestock data compiled to calculate greenhouse gas emissions from fertilizer use, manure management and enteric fermentation. The data used are all real figures and the acceptances and assumptions made are presented at the end of the section.

Table 14 - Agriculture and Livestock-Based Emission Sources

	Activity	Quantity	Unit	Source	Year
V.1. Direct emissions from livestock activities					
	Cattle	242.262	Heads	TURKSTAT	2016
	Water Buffalo	127	Heads	TURKSTAT	2016
	Sheep	408.735	Heads	TURKSTAT	2016
	Goats	179.782	Heads	TURKSTAT	2016
	Camels	45	Heads	TURKSTAT	2016
	Horses	1.153	Heads	TURKSTAT	2016
	Donkey/Mule	2.256	Heads	TURKSTAT	2016
	Poultry	4.274.741	Heads	TURKSTAT	2016

V.2. Emissions from land					
	Change in forest area	NE			
	Change in agricultural area	NE			
	Change in meadow / pasture area	NE			
	Change in residential area	NE			
V.3. Emissions from bulk sources on land and non-CO2 sources					
	Burning / fire (forest, agriculture, meadow / pasture areas)	NE			
	Liming	NE			
	Urea fertilization	NE			
	Direct N_2O from ploughland	97.956	tonne	PDEU	2016
	Indirect N_2O from ploughland	NE			
	Direct N_2O from fertilizer processing	NE			
	Rice cultivation	NE			
	CH_4 from ploughed organic soil	NE			
	N_2O from aquaculture	NE			
	Harvested Wood Products	NE			

Acceptances and Assumptions

- Emissions from the lands were not reported since the data on the land use change within the scope of section V.2 could not be reached.
- As V.3 does not provide any data other than data on the use of fertilizers, the relevant emissions have not been reported.

4.3. GREENHOUSE GAS INVENTORY

4.3.1. INVENTORY SUMMARY

The numbers and scope of the emissions included in the GHG inventory under the GPC classification are listed in Table 15. The reasons for why emissions that are not included in the inventory cannot be included are also summarized in the same table. Emissions included in the inventory constitute an important part of the total emissions at the city level and are included in the inventory by other cities preparing inventory.

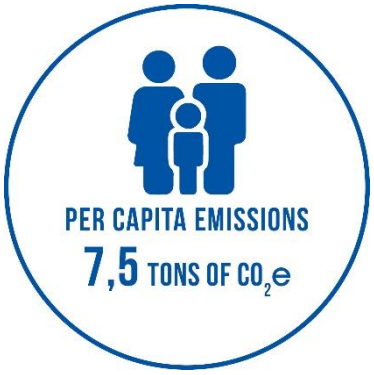
Table 15 - Summary of Emissions Included in Inventory

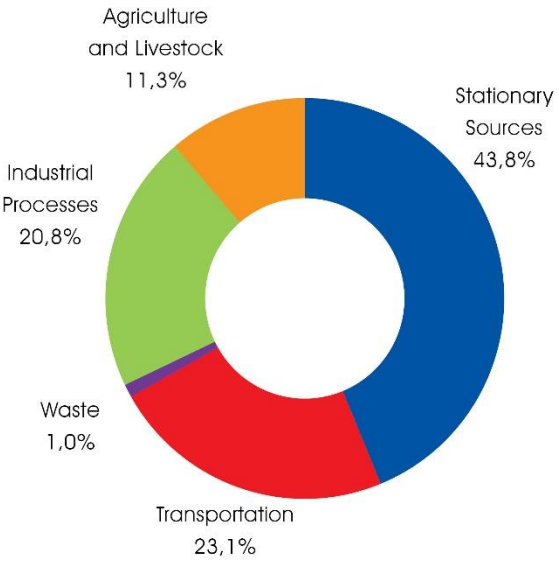
GPC No.	Scope	Emissions	Inclusion	Indicator / Rationale
I.1.1	1	Residential (*Direct Emissions*)	Yes	
I.1.2	2	Residential (*Indirect Emissions*)	Yes	
I.2.1	1	Commercial / Institutional Buildings *(Direct Emissions)*	Yes	
I.2.2	2	Commercial / Institutional Buildings *(Direct Emissions)*	Yes	
I.3.1	1	Manufacturing Industry and Construction *(Direct Emissions)*	Yes	
I.3.2	2	Manufacturing Industry and Construction *(Indirect Emissions)*	Yes	
I.4.1	1	Energy Industry *(Direct Emissions)*	Yes	IE (Included in I.3.1)
I.4.2	2	Energy Industry *(Indirect Emissions)*	Yes	IE (Included in I.3.2)
I.5.1	1	Agricultural Activities *(Direct Emissions)*	Yes	IE (Included in II.1.1)
I.5.2	2	Agricultural Activities *(Indirect Emissions)*	Yes	
I.6.1	1	Unspecified resources *(Direct Emissions)*	No	NE (lack of data)
I.6.2	2	Unspecified resources *(Indirect Emissions)*	No	NE (lack of data)
I.7.1	1	Fugitive Emissions from mining, processing, storage and distribution of coal	No	NE (lack of data)
I.7.2	1	Fugitive emissions from petroleum and natural gas systems	No	NE (lack of data)
II.1.1	1	On-road transportation (*Direct Emissions*)	Yes	
II.1.2	2	Highway (*Indirect Emissions*)	No	NE (lack of data)
II.2.1	1	Railways (*Direct Emissions*)	Yes	
II.2.2	2	Railways (*Indirect Emissions*)	Yes	
II.3.1	1	Waterborne navigation (*Direct Emissions*)	No	NO (no transportation via waterborne navigation)
II.3.2	2	Waterborne navigation (*Indirect Emissions*)	No	NO (no transportation via waterborne navigation)
II.4.1	1	Aviation (*Direct Emissions*)	Yes	
II.4.2	2	Aviation (*Indirect Emissions*)	No	NE (lack of data)

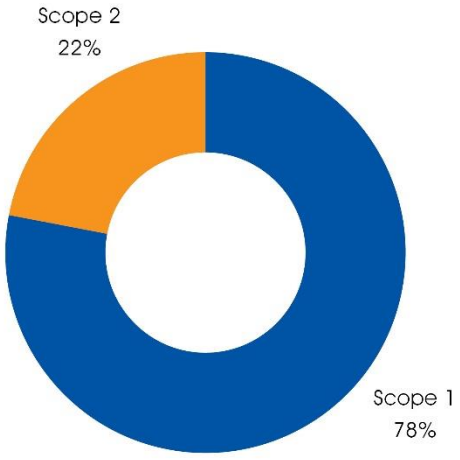
II.5.1	1	Off-road transportation *(Direct Emissions)*	Yes	IE (Included in II.1.1)
II.5.2	2	Off-road transportation *(Indirect Emissions)*	No	NE (lack of data)
III.1.1	1	Solid Waste Disposal *(Direct Emissions)*	Yes	
III.1.3	1	Solid Waste Disposal *(Indirect Emissions)*	No	NO (non-urban wastes are not stored)
III.2.1	1	Biological Treatment of Wastes *(Direct Emissions)*	Yes	
III.2.3	1	Biological Treatment of Wastes *(Indirect Emissions)*	No	NO (biological treatment of wastes generated outside the city)
III.3.1	1	Waste Incineration (Energy Production and Incineration) *(Direct Emissions)*	No	NO *(no disposal by waste incineration)*
III.3.3	1	Waste Incineration (Energy Production and Incineration) *(Indirect Emissions)*	No	NO *(no disposal by waste incineration)*
III.4.1	1	Wastewater Treatment and Discharge *(Direct Emissions)*	Yes	
III.4.3	1	Wastewater Treatment and Discharge *(Indirect Emissions)*	No	NO (biological treatment of wastewater generated outside the city)
IV.1	1	Direct emissions from industrial processes within boundaries	Yes	
IV.2	1	Emissions from product use within boundaries	No	NE (lack of data)
V.1	1	Emissions from livestock activities	Yes	
V.2	1	Emissions from land	No	NE (lack of data)
V.3	1	Emissions from bulk sources on land and non-CO2 sources	Yes	

According to the results of the GPC approach, the total greenhouse gas emissions of Denizli province for the year 2016 were estimated to be **7,5 million tons of CO_2e**. This amount refers to **7,5 tons of CO_2e** per capita, which is proportional to the population of Denizli in the same year (1.005.687). Figure 23 shows the scope and sectoral distribution of the emissions analysed within the scope of inventory. 43,8% of total emissions are based on stationary sources, 23,1% transportation, 20,8% industrial processes, 11,3% agriculture and livestock and 1,0% waste management. 78% of these emissions are from Scope 1 - Direct Emissions and 22% from Scope 2 - Indirect Emissions. The breakdown of greenhouse gas emissions in the sub-sectors is detailed in the next section.

Figure 23 - GHG Inventory Summary Results







Sector (ton CO_2e)	Scope 1	Scope 2	Sectoral Total
Stationary Sources	1.635.897	1.649.444	3.285.341
Transportation	1.729.770	1.333	1.731.104
Waste	78.092		78.092
Industrial Processes	1.560.472		1.560.472
Agriculture and Livestock	847.659		847.659
Scope Total	5.851.890	1.650.777	**7.502.667**

4.3.2. DETAILED INVENTORY RESULTS

In this section, the breakdowns analysed in the scope of inventory are presented at the scale of main sectors and sub-sectors. The method used by the CIRIS GHG inventory calculation tool to perform the basic calculations is given as an example below for "emissions from the use of diesel in road transport".

Example calculation:

CO_2 Emission from Diesel Use in Road Transportation

Amount of Activity x Emission Factor x Cycle Factor = Total CO2 Emission

431.286 ton x 73,43 tons of CO_2/TJ x 0,043 TJ/tonne = **1.372.228 tons of CO_2e**

(EMRA, 2016) (TURKSTAT, 2016d) (IPCC, 2006)

CH_4 Emissions from Diesel Use in Road Transportation (as CO_2e)

Amount of Activity x Emission Factor x Cycle Factor x Global Warming Potential = **Total CH_4 Emission**

431.286 tons x 3,9 tons of CH4 / TJ x 0.043 TJ / tons x 28 = **2.041 ton CO_2e**

(EMRA, 2016) (TurkStat, 2016d) (IPCC, 2006) (IPCC, 2014)

N_2O Emission from Diesel Use in Road Transportation (as CO_2e)

Amount of Activity x Emission Factor x Cycle Factor x Global Warming Potential = **Total N_2O Emission**

431.286 tons x 3,9 ton N_2O/TJ x 0.043 TJ / tonne x 265 = **19.314 tons of CO_2e**

(EMRA, 2016) (TurkStat, 2016d) (IPCC, 2006) (IPCC, 2014)

CO_2e Emission from Diesel Use in Road Transport

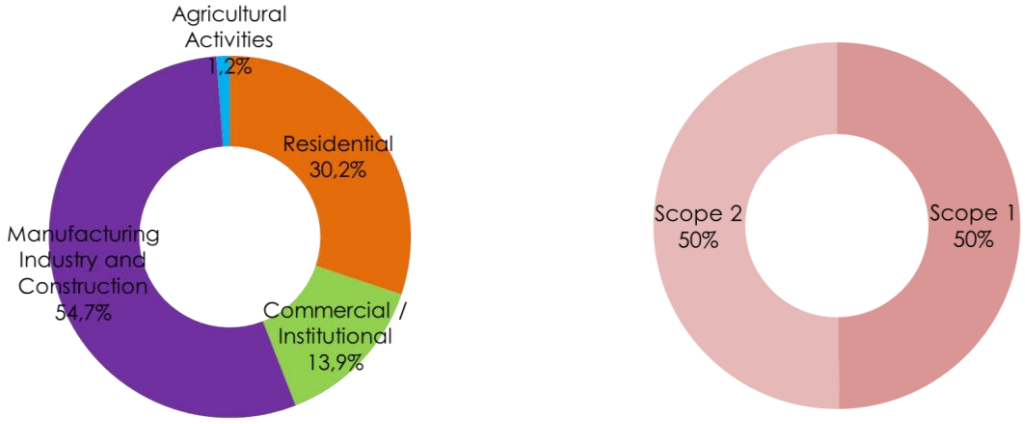
Total CO_2 Emissions + Total CH_4 Emissions + Total N_2O Emissions = **Total CO_2e Emissions**

1.372.228 tons of CO_2e + 2.041 tons of CO_2e + 19.314 tons of CO_2e = **2.780.145 tons of CO_2e**

4.3.2.1. STATIONARY SOURCES

As part of the stationary sources sector, emissions from residential, commercial / institutional buildings, manufacturing industry and construction, energy industry and agricultural activities have been calculated. 54,7% of stationary-source-based emissions, which account for 43,8% of total emissions, are generated by manufacturing industry and construction-related emissions. Emissions from other stationary sources were calculated as 30,2% for residential, 13,9% for commercial / institutional buildings, and 1.2% for agricultural activities, respectively. 50% of the emissions in this sector are caused by Scope 1 - Direct Emissions, and 50% by Scope 2 - Indirect Emissions (see Figure 24).

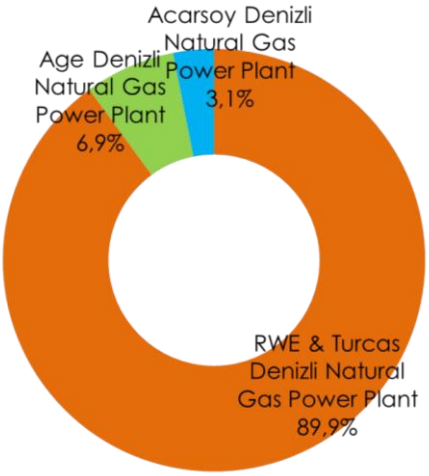
Figure 24 - Breakdown of Emissions from Stationary Sources



Sector	Scope 1	Scope 2	Amount of Emissions (tons of CO_2e)
Residential	673.050	317.639	990.689
Commercial / Institutional	80.703	376.921	457.623
Manufacturing Industry and Construction	882.145	915.655	1.797.800
Agricultural Activities		39.229	39.229
Total	1.635.897	1.649.444	**3.285.341**

Emissions from electricity given to the grid have been calculated but not included in the inventory so as to avoid double counting between the emissions from electricity given to the grid and the emissions from the electricity consumed in the stationary sources (see Annex 2). Figure 25 shows the sub-breakdown of these emissions.

Figure 25 - Emissions from Electricity Generation for the Grid

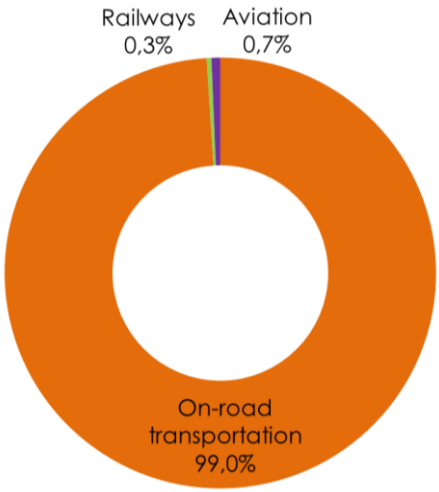


Sector (Scope 1)	Amount of Emissions (tons of CO_2e)
RWE & Turcas Denizli Natural Gas Power Plant	1.874.005
Age Denizli Natural Gas Power Plant	144.580
Acarsoy Denizli Natural Gas Power Plant	64.862
Total	**2.083.447**

4.3.2.2. TRANSPORTATION

Emissions from road transport, railways, waterborne navigation and aviation have been calculated in the transportation sector. Transportation-related emissions correspond to 23,1% of total emissions. Among the total emissions of the sector, emissions from on-road transportation alone have a share of 99,0%. Emissions from other transport methods were 0,3% for railways and 0,7% for aviation, respectively (see Figure 26).

Figure 26 - Breakdown of Emissions from Transport

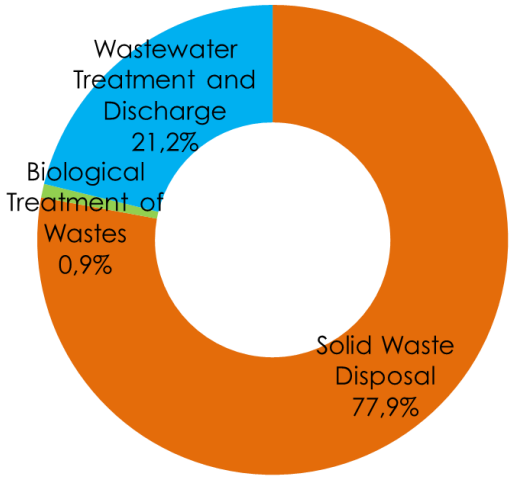


Sector (Scope 1)	Amount of Emissions (tons of CO_2e)
On-Road Transportation	1.713.552
Railways	6.154
Aviation	11.397
Total	**1.731.104**

4.3.2.3. WASTE

Emissions from solid waste disposal (landfill), biological treatment of waste (composting) and wastewater treatment / discharge have been calculated within the scope of the waste sector. In the three waste management processes, emissions from storage alone correspond to 77,9% of total emissions. Emissions from other disposal methods such as wastewater treatment / discharge and composting have been calculated as 21,2% and 0,9%, respectively (see Figure 27). Waste management-related emissions account for only 1,0% of total emissions.

Figure 27 - Breakdown of Waste-Based Emissions

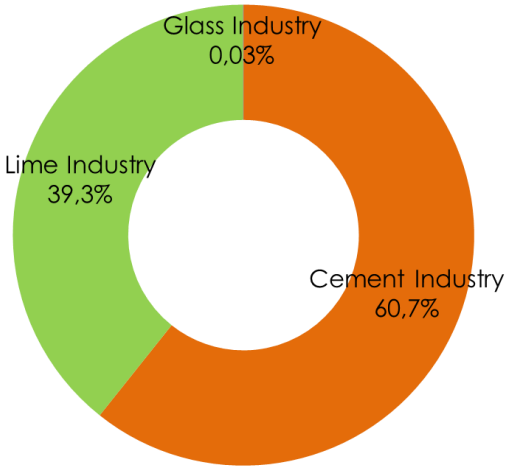


Sector (Scope 1)	Amount of Emissions (tons of CO_2e)
Solid Waste Disposal	60.825
Biological Treatment of Wastes	736
Wastewater Treatment and Discharge	16.531
Total	**78.092**

4.3.2.4. INDUSTRIAL PROCESSES AND PRODUCT USE

Emissions from cement, lime and glass sectors have been calculated within the scope of industrial processes and product use. These three industries are considered to have a large share in emissions from industrial processes and product use, and are estimated to have a high level of representation. These emissions, which account for 20,8% of the total emissions, have a breakdown of 58,4% for cement industry, 32,2% for steel industry and 9,4% for lime industry (see Figure 28).

Figure 28 - Breakdown of Emissions from Industrial Processes

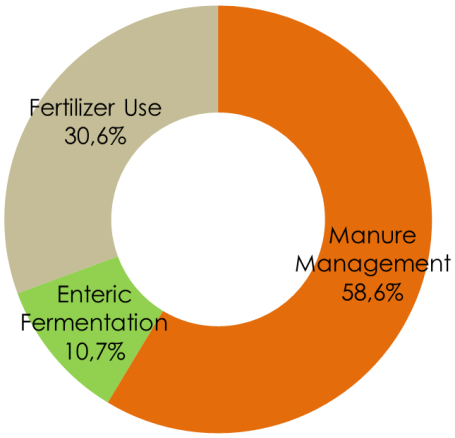


Sector (Scope 1)	Amount of Emissions (tons of CO_2e)
Cement Industry	947.436
Lime Industry	612.635
Glass Industry	400
Total	**1.560.472**

4.3.2.5. AGRICULTURE, FORESTRY AND OTHER LAND USE

Within the scope of agriculture, animal husbandry and other land use sector, mainly emissions from fertilizer use, manure management and enteric fermentation from agriculture and animal husbandry have been calculated. These emissions, which correspond to 11,3% of total emissions, consist of 58,6% enteric fermentation, 30,6% use of fertilizers and 10,7% manure management (see Figure 29).

Figure 29 - Breakdown of Emissions from Agriculture and Livestock

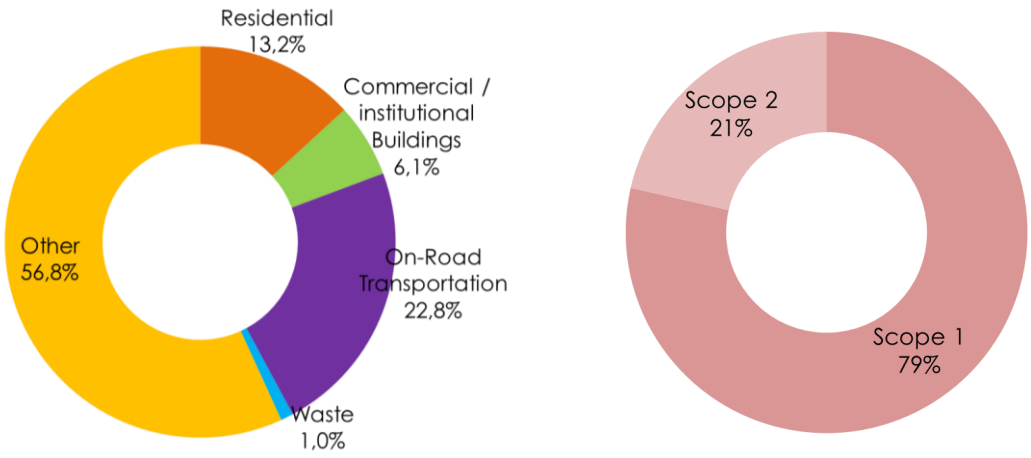


Sector (Scope 1)	Amount of Emissions (tons of CO_2e)
Manure Management	497.019
Enteric Fermentation	91.056
Fertilizer Use	259.583
Total	**847.659**

4.3.2.6. THE EMISSIONS THAT THE DMM CAN INTERVENE DIRECTLY

There are “hot spots” in the total emissions of Denizli where Denizli Metropolitan Municipality can rapidly mitigate emission through direct actions. They are primarily Residential, Commercial / Institutional Buildings, Road Transportation and Waste Sector. The emissions from these 4 sectors account for 43,2% of total emissions and in this sense, places an important responsibility on the municipality. 79% of these emissions are from Scope 1 - Direct Emissions and 21% from Scope 2 - Indirect Emissions. Since the remaining 56,8% of the total emissions are mainly from industry, the municipality's actions towards reducing these emissions will be limited. Emissions in which the DMM can be directly involved are shown in Figure 30.

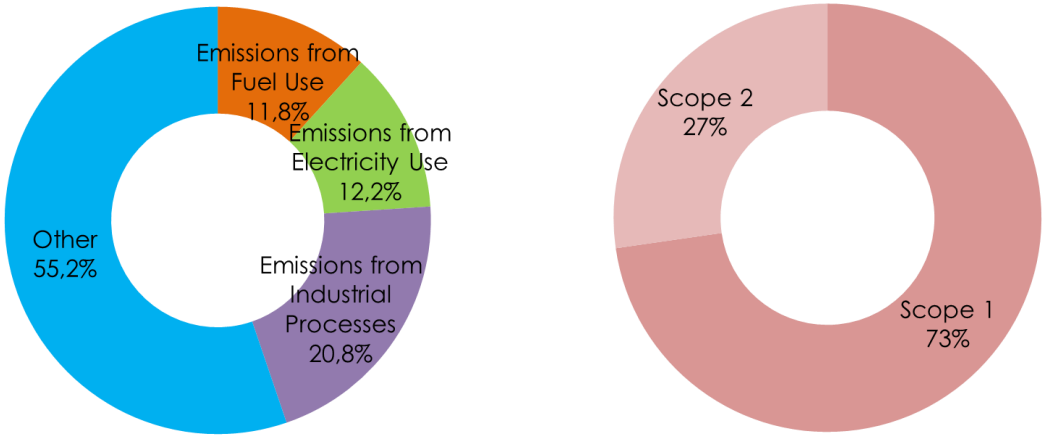
Figure 30 - Emissions in which the DMM can be directly involved



Sector (tonne CO_2e)	Scope 1	Scope 2	Sectoral Total
Residential	673.050	317.639	990.689
Commercial / institutional Buildings	80.703	376.921	457.623
On-Road Transportation	1.713.552		1.713.552
Waste	78.092		78.092
Total	2.545.397	694.560	**3.239.956**

The impact of industry in Denizli's total greenhouse gas inventory is 44,8%. While 11,8% of this ratio is from direct fuel burning, 12,2% is caused by the electricity use of the sector and 20,8% by the production processes in the sector (see figure 13).

Figure 31 - Emissions from Industry



Sector (tonne CO_2e)	Scope 1	Scope 2	Source Total
Emissions from Fuel Use	882.145		882.145
Emissions from Electricity Use		915.655	915.655
Emissions from Industrial Processes	1.560.472		1.560.472
Total	2.442.167	915.655	**3.358.272**

4.4. VALIDATION, MONITORING AND DATA IMPROVEMENT

Monitoring emissions over time is an important component of the greenhouse gas inventory. Monitoring provides information on past emission trends and helps to monitor the impact of policies and action plans created to reduce urban-scale emissions. All emissions over time should be consistently estimated, that is to say, the time series should be calculated using the same methods, data sources and boundary definitions in all years. Using different methods, data or creating different discrepancies in a predetermined time sequence will cause inconsistency.

The most important tools for the implementation of the principles mentioned above are the verification of the greenhouse gas inventory and the periodic audit of the information management system.

Quality Control for compliance with the content of the reports: Quality control (QC) is a series of technical activities that measure and control the quality of the inventory being developed. These activities are designed for the following reasons:

- To provide routine and consistent controls to ensure data integrity, accuracy and completeness
- To define errors and deficiencies
- To document and archive inventory materials and record all QC activities

- QC activities include accuracy checks and emission calculations for data acquisition and calculations, measurements, estimation of uncertainties, use of approved standard procedures for archiving information and reporting. QC activities at higher stage include technical reviews of resource categories, efficacy and emission factor data and methods.

Quality Assurance for the integrity of the management system process: Quality assurance (QA) activities define a system of planned review procedures carried out by personnel who are not directly involved in the inventory collection / development process. Preferably, the comments made by independent third parties should be performed when the inventory is completed following the implementation of QC procedures. The reviews reflect that the data quality objectives are met and that the inventory represents the best emission estimates based on current scientific knowledge and data (GPC, 2014).

It is useful to plan and implement the following QA activities to improve data:

- Data management procedure
- Uncertainty calculation and data improvement process
- Defining roles and responsibilities
- Internal control

The following parameters should be examined in the validation study:

- Clear, net and accurate definition of inventory limits
- Accurate identification of all emission sources with relevant codes
- Calculation compliant with GPC requirements
- Activity data measured by specific activity specific to time and geographic inventory limits (MoEU, 2018)

Validation of inventory reports by 3rd parties, though not mandatory, is recommended for the establishment of inventory principles.

Covenant of Mayors (CoM), which contains 7.755 small and large municipalities and C40 Climate Leaders Group including 96 megacities, covering 25% of the global national income, stand out among the said '3rd parties'. For example, CoM's Sustainable Energy (and Climate) Action Plan (SECAP) analysis process focuses on assessing a number of eligibility criteria. Failure to comply with these criteria will prevent the adoption of the SEEP analysis by the Joint Research Centre. This analysis process also focuses on the consistency of the data provided. The criteria to be met by the municipalities are:

- The SECAP must be approved by the Municipal Assembly or equivalent institution.
- The Baseline Emission Inventory results should cover the key sectors of the activity (three in at least four key sectors).
- The SECAP should include a comprehensive set of actions in the key sectors of the activity (two of at least four key sectors) (CoM, 2016).

5. VISION

The vision of the Denizli Climate Change Action Plan is the future message given by Denizli on its target to be on the national and international scale in terms of its goal of combating climate change.

In this context, the vision of the plan is defined as “making Denizli a low carbon, climate change resistant model city**”**. The realization of the actions within the framework of the plan and the reduction of greenhouse gas emissions to the set target and minimizing the risks arising from climate change will be the main task of the stakeholders who are responsible for implementing this vision.

> “Making Denizli a low carbon, climate resilient model city”

6. DENIZLI GREENHOUSE GAS MITIGATION ACTION PLAN

A fully participatory process has been followed while preparing the Action Plan and all relevant stakeholders have been included in the preparation process. The experiences and recommendations of key stakeholders were transferred to the study through three stakeholder meetings and three stakeholder workshops aimed at mitigation action plan held in Denizli. In the first workshop, a road map was prepared for data collection. In the second workshop greenhouse gas inventory results and future projections were evaluated and actions were finalized through structured surveys in the third workshop. A parallel comprehensive literature review was conducted and national and international sources were scanned and the previous successful CCAP studies were benefited from.

In this section, first, the vision and mitigation target that constitute the basis of the Denizli Greenhouse Gas Mitigation Action Plan are presented. The implementation period for the objectives and actions determined in line with the said vision and target, the emission reduction potential, the estimated costs, the responsible stakeholders, and the risks that may occur in the implementation are presented in this section through action fiches.

6.1. REDUCTION TARGET

In parallel with the national projections, Denizli's greenhouse gas emissions are expected to continue to increase. Denizli's macro data indicate that this growth will remain close to the average of Turkey. Population of the province is increasing at the same rate as Turkey's population. The increase in production and consumption is expected to be close to the average in Turkey.

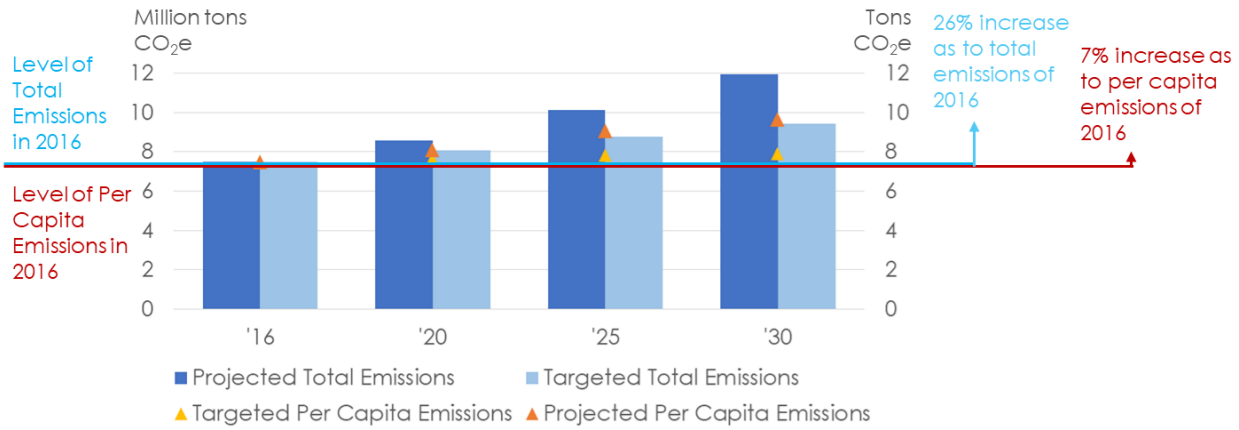
The majority of greenhouse gas emissions in Denizli are due to fuel use and industrial processes in the industry. On the other hand, Denizli Metropolitan Municipality has limited impact on these emissions and limited chance to respond.

21% reduction from increase is determined in the light of this information and with the participation of relevant stakeholders, covering all emission sources on the provincial scale and taking into account Turkey's Intended Nationally Determined Contribution (INDC). Taking into account the INDC, the target year is determined as **2030**, which is the year envisaged in international processes. If Turkey signs the Treaty of Paris and reviews its INDC, Denizli Municipality will also assess the reduction target again.

"A realistic target: **21% reduction from increase** in 2030"

The future projections scenario works carried out in the determination of the reduction target have been an important factor. **According to the target, total and per capita emissions of Denizli are expected to increase over the years.** Achieving this goal will be an important means of making Denizli's growth sustainable. Future projections are examined in detail in Section 9.

Figure 32 - Denizli 2030 Emission Reduction Target: (21% reduction from 2030 emissions foreseen)



With the survey conducted within the scope of the study, the stakeholders were consulted on important topics such as the target of the reduction target, the reduction rate, the scope of the emissions subject to reduction target. Stakeholders answered these questions as follows:

- Selection of 2030 as Reduction Target Year: 84% supports,
- Reduction from Increase: 69% supports,
- Determination of 21% as Reduction Ratio: 75% supports,
- Inclusion of industrial emissions: 69% supports,
- Inclusion of the issues of CCAP in DMM's strategic plan for 2020-2024: 81% supports,
- Inclusion of sectoral targets apart from the general target foreseen, 88% supports,

Table 16 shows the potential emission reductions expected from the implementation of the action plan.

Reduction target is determined as 21% reduction from the projected emissions in 2030, to be compatible with the INDC of Turkey. Following sectoral emission reductions have been projected in 2030 throughout Denizli under the action plan. These emissions should not be considered as sectoral targets but as expected reductions in different sectors.

Table 16 - Sectoral Emission Reduction Projections for 2030

Sector	2030 Projected Emission (million tons of CO_2e)	Amount of Reduction (million tons of CO_2e)	Estimated Reduction Ratio (%)
Buildings	2,36	0,78	%33
Transportation	2,76	0,49	%18
Waste/Wastewater	0,12	0,07	%54
Industry	5,36	0,98	%18
Land Use	1,35	0,20	%15
Energy**			
TOTAL	11,95	2,51	%21

*Sectoral targets are not foreseen in the CCAP. The given reduction rates indicate the estimated reduction amounts to be achieved as a result of the foreseen actions.
** Reductions in the energy sector are included in other sectors.

Total emissions in the buildings sector are expected to be 2,36 million tons of CO_2e in 2030. A reduction of 0,78 million tons of CO_2e corresponding to 33% of the emission was envisaged. 0,19 million tons of the reduction was foreseen as a result of the conversion of coal for heating purposes in buildings to 75% natural gas under normal case scenario by 2030. A reduction of 25% (0,25 million tons of CO_2e) from coal and natural gas emissions after this reduction measure is projected from insulation and smart/green building applications. A reduction of 0,25 million tons of CO_2e was envisaged in the emissions from power usage in buildings from the grid. This projection is based on the expectation of 21% reduction of emissions from Turkey's electricity generation and not included in the measures Denizli will take. Finally, 0,09 million tons of CO_2e are foreseen to be saved in electricity use in buildings.

Total emissions in the industrial sector are expected to be 5,36 million tons of CO_2e by 2030. A reduction of 0.98 million tons of CO_2e, which corresponds to 18%, from this emission is possible. A reduction of 0,3 million tons of CO_2e was envisaged in the emissions from power usage in industry from the grid. This projection is based on the expectation of 21% reduction of emissions from Turkey's electricity generation and not included in the measures Denizli will take. 0,19 million tons of the reduction was foreseen as a result of the conversion of coal to 50% natural gas under normal case scenario by 2030. A reduction of 0.25 million tons is possible from industrial processes and finally, another 0.23 million tons will be possible thanks to productivity growth in energy sector and other measures envisaged in the action plan.

Total emissions in the transportation sector are expected to be 2,76 million tons of CO_2e in 2030. A reduction of 0,49 million tons corresponding to 18% from this emission is envisaged. An important part of the saving will be the productivity increases of 0,27 million tons in the vehicles. Rail systems are not foreseen in Denizli in the short term. In this context, emission reduction from public transport will be limited. An additional reduction of 0,22 million tons was planned with public transport practices and other measures in the action plan.

Total emissions in the waste sector are expected to be 0,12 million tons of CO_2e by 2030. A reduction of 0.066 million tons corresponding to 54% from this emission is envisaged. The reduction is intended to be achieved by completing the on-going waste incineration plant and increasing the amount of waste to

recycling. It envisaged that the population provided with wastewater treatment service will increase and wastewater treatment will be reduced.

Emissions from land use planning, agriculture and livestock sector are expected to be 1,35 million tons CO_2e in 2030. A reduction of 0,20 million tons corresponding to 15% from this emission is envisaged.

Actions to ensure these reductions are discussed in detail in Section 6.2.

6.2. OBJECTIVES AND ACTIONS

A total of **12 objectives and 36 actions** have been created under Denizli CCAP under **6 action areas** in terms of greenhouse gas reduction. Implementation period for the objectives and actions set forth, the emission reduction potential, the estimated costs, the responsible stakeholders, and the risks that may occur in the implementation are in this section through action fiches. The following table shows the application period, emission reduction potential, and the levels set for the estimated costs in action fiches. These levels have been created by REC Turkey specifically for Denizli CCAP work.

Table 17 - Descriptions of Levelling in Action Fiches

Implementation Period	Emission Reduction Potential	Estimated Costs
Short: Up to 3 years (2019-2021)	Low: <10.000 tons/year CO_2e	Low: <5 million TL
Medium: Up to 7 years (2019-2025)	Medium: 10.000-100.000 tons/year CO_2e	Medium: 5 million -100 million TL
Long: Longer than 7 years (2019-2030)	High: >100.000 tons/year CO_2e	High: >100 million TL

6.2.1. BUILDINGS

The number of buildings in Turkey is gradually increasing as the impact of population growth and migration to urban centres. According to TurkStat data, it is known that there were 7,8 million buildings in 2000. The area used as residential, commercial and public buildings was estimated to be 913 million m^2 and approximately half of them were heated.

According to the National Energy Efficiency Action Plan (2017-2023), there are 9,1 million buildings in Turkey as of 2017 and 87% of them are estimated to be residential buildings. The sector's final energy consumption reached 32,4 MTEP (32.8% in final consumption) in 2015. Accordingly, the number of buildings increased by 1,3 million (17%) from 2000 to 2017 (EVEP, 2017).

13% of Turkey's total emissions in 2016 is from buildings. Energy consumption of buildings in Turkey is 300-350 kWh/m^2, while it is 30-60 kWh/m^2 in Germany (IYSD, 2018). It is possible to make up this difference, which is about 10 times, with the energy efficient designs used in the construction of the buildings. It is expected that “energy efficiency in buildings”, which constitutes a very large emission

reduction potential, will be more comprehensive in the development legislation in the following years.[28] Energy Performance Regulation on Buildings was published in 2008 and design and implementation principles were defined for the efficient use of energy in buildings. Based on these definitions, the Energy Identity Certificate (EIC), which will be created for the buildings, will ensure both taking the building inventory and the realization of energy efficient practices in the buildings. EIC application will also become compulsory for existing buildings from 2020.

According to the results of the GHG inventory, buildings (residential and commercial / public buildings) account for about 19% of Denizli's greenhouse gas emissions, 9% of which is electricity use and 10% of it is fuel burning. 13%, an important part of total emissions is from residential and the remaining 6% is from commercial and public buildings.

Because the buildings sector, unlike industrial processes, does not have direct energy consumption, the emissions from buildings arise from the heat and electrical energy used in the buildings and the losses during use. Therefore, one step of reducing emissions in the buildings sector is to reduce losses while the other is to reduce the energy consumed. Determined actions have been discussed in this framework.[29]

3 objectives and 9 actions were determined for the buildings sector within the framework of CCAP. Actions set under each objective and activities to be carried out to implement these actions are presented with details below.

Objectives
Objective B1: Reduction of the energy consumption of existing buildings
Objective B2: Paying regard to the impacts of climate change on new development activities
Objective B3: Redesign of the city to reduce the impact of climate change

Objective B1: Reduction of the energy consumption of existing buildings	
Target: Reducing the energy consumption-related emissions of existing buildings through energy efficiency practices	**Stakeholders:** DMM, PDoEU, MoENR, homeowners and tenants, manufacturers of insulation material, application firms, professional organizations, IZODER, ENVERDER, CATIDER, CEDBIK
Action B1.1: Insulation in existing buildings	
Action B1.2: Green roof application in large buildings such as municipal buildings, industrial facilities and shopping centers	
Action B1.3: Ensuring transition to central heating / cooling systems in existing buildings	
Action B1.4: Ensuring transition to smart building systems in large buildings such as municipal buildings, industrial facilities and shopping centers	
Action B1.5: Supporting and creating vertical gardens	

[28] Green Building practices are expected to increase with the Regulation on Energy Performance of Buildings and Settlements.
[29] The awareness raising and implementation activities for fuel and electricity (energy) efficiency are defined in the actions under the energy sector.

Action B1.1: Insulation in existing buildings	
Current Status / Purpose	Most of the heat used in uninsulated buildings is lost from walls, roofs, windows and doors. The heat loss, which is as high as 90%, can be reduced to 50% with a simple wall insulation in multi-storey buildings and to 20% with window insulation (İMO, 2015). In the pilot study conducted by the Chamber of Mechanical Engineers, external insulation applied to one of the two blocks with the same physical conditions, and the projected 40-50% theoretical energy saving was recorded as 57% (MMO, 2011). The reliability of existing records is questioned although the number of buildings with/without insulation and buildings with EIC in Denizli is unknown. The first objective of this action is to build a database by constructing an accurate and reliable registration system.
Activities to be Conducted	▪ Establishment of a registration system for updating buildings inventory and updating data ▪ Providing information to the site and building managers to access the system ▪ Inspection of the insulations entered into the system ▪ Determination of the existence of wall, window and roof insulations ▪ Completion of wall, window and roof insulations throughout the province, especially wall insulations ▪ Determination and realization of necessary insulation investments in municipal buildings
Implementation Period	Medium
Estimated Cost	High
Emission Reduction Potential	High
Investors	Owners, building and site management, DMM
Stakeholders	DMM, PDoEU, district municipalities, professional chambers, contractors, property owners, tenants, site and building managers, insulation companies, CATIDER, IZODER
Risks	▪ Property owners to avoid long-term investments

Action B1.2: Green roof application in large buildings such as municipal buildings, industrial facilities and shopping centers	
Current Status / Purpose	25% of the heat losses of single-storey buildings and 7% of multi-storey buildings are from the roof (IMO, 2015). The impacts of buildings on climate change are not only through energy consumption, but also heat islands they create.[30] Green roofs are used as a suitable method for preventing the heat island impact of buildings and the heat losses occurring through the building. The amount heat loss is higher in industrial facilities as they are usually single-storey, they spread over a large area, and they are uninsulated. Therefore, industrial facilities are suitable for green roof applications With this action, energy losses from buildings were expected to be reduced by extending green roof applications in the city. It can also be considered with adaptation actions, since it will also reduce the heat island impact.
Activities to be Conducted	▪ Informing the industrial facilities, OIZ administrations and shopping centre managements about the green roof

[30] Heat islands prevent the environment from being cooled, especially in the absence of the sun by radiating the heat they absorb during the day.

	▪ Completion of feasibility studies including load calculations on green roof ▪ Gradual application of green roof to all possible areas of application starting from the widest areas ▪ Completion of green roof feasibility studies for municipal buildings ▪ Green roof application to municipal buildings starting from the most suitable areas
Implementation Period	Short-Medium
Estimated Cost	Medium
Emission Reduction Potential	Medium
Investors	DMM, OIZs and individual industrial enterprises, shopping centres
Stakeholders	DMM, OIZs and individual industrial enterprises, shopping centres, PDoEU, district municipalities, professional chambers, architects, industrial enterprises, CATIDER
Risks	▪ Uneconomicalness of implementation even in the long-term

Action B1.3: Ensuring transition to central heating / cooling systems in existing buildings	
Current Status / Purpose	Due to its climate, Denizli is a city where the central heating system is used less, for example, than Central Anatolia. The fact that the natural gas line has not yet reached every home has a high impact on this situation. The transition to the central heating systems, starting from the existing natural gas line, in existing buildings will significantly reduce the heating emissions from the buildings. This method, which can also be used in industrial zones, can be evaluated in cases where the regional heating systems cannot be installed in the industry.
Activities to be Conducted	▪ Determination of buildings that can switch to central heating via the building inventory issued in Action B1.2 ▪ Realization of necessary feasibility studies ▪ Switching to central heating / cooling systems throughout the city, particularly in areas such as public housing, OIZs, etc.
Implementation Period	Medium-Long
Estimated Cost	High
Emission Reduction Potential	High
Investors	DMM, home-owners, site and apartment managements, OIZs, contractors
Stakeholders	DMM, PDoEU, district municipalities, professional chambers, architects, home-owners, contractors
Risks	▪ Home-owners do not accept the central system claiming that it is “unjust”

Action B1.4: Switching to smart building systems in large buildings such as municipal buildings, industrial facilities and shopping centres	
Current Status / Purpose	It is important to switch to the smart building system for the energy-intensive buildings to control the energy consumption. The buildings which are under the control of the municipality, industrial facilities, shopping centres and sports complexes are very suitable for smart management systems. In this context, the existing buildings are envisaged to reduce the energy consumption and therefore the energy consumption-related emissions thanks to transformation to semi-smart buildings, if not smart buildings.
Activities to be Conducted	▪ Determination of buildings with high energy density thanks to the database created in Action B1.2 ▪ Determination of the smart systems that can be used by detailing the energy consumption of the large structures. ▪ Completion of necessary feasibility studies for determined smart systems ▪ Implementation of smart systems starting from the most appropriate solution in a short time
Implementation Period	Medium-Long
Estimated Cost	Medium
Emission Reduction Potential	Medium
Investors	DMM, managements of shopping centres, sports complexes, and industrial facilities
Stakeholders	DMM, managements of shopping centres, sports complexes, and industrial facilities, PDoEU, MoENR
Risks	▪ High cost of integration with existing building stock

Action B1.5: Supporting and creating vertical gardens	
Current Status / Purpose	25% of the heat losses of single-storey buildings and 40% of multi-storey buildings are from the roof (IMO, 2015). The impacts of buildings on climate change are not only through energy consumption, but also heat islands they create. This heat escaping out of the building causes an increase in the ambient temperature. Vertical walls are used as a suitable method for preventing the heat island impact of buildings and the heat losses occurring through the building. This method, which will be very useful especially for multi-storey buildings, will be an additional advantage of enhancing the city view while its main impact will be the reduction of energy-induced emissions and will support the adaptation actions by preventing heat losses caused by the buildings.
Activities to be Conducted	▪ Investigation of vertical gardening applications in the buildings where insulation requirement is determined in Action B.1.1 ▪ Implementation in appropriate buildings
Implementation Period	Short
Estimated Cost	Medium
Emission Reduction Potential	High
Investors	DMM, MoENR, home-owners, managements of sites and buildings,
Stakeholders	DMM, PDoEU, district municipalities, professional chambers, architects, home-owners, contractors
Risks	▪ Difficulty in social acceptance due to image concern

Objective B2: Paying regard to the impacts of climate change on new development activities	
Target: To ensure the energy efficient and environmentally friendly design of the buildings to be constructed during the construction phase and to reduce the emissions of the building sector by performing these applications in the buildings constructed under the control of the municipality.	**Stakeholders:** DMM, MoEU, MoENR, contractors and construction companies
Action B2.1: Issuing Metropolitan Municipality Zoning Regulation	
Action B2.2: Designing the buildings built by the municipality as smart and green building systems	
Action B2.3: Encouraging the use of local and renewable materials in buildings	

Action B2.1: Issuing Metropolitan Municipality Zoning Regulation	
Current Status / Purpose	Current Zoning Law and regulations do not include direct provisions related to climate change. Therefore, the municipality has limited sanctions to impose on the new buildings. On the other hand, metropolitan municipalities have examples of their own zoning regulations. Denizli Metropolitan Municipality will have increased power of sanction with the issuance of a Zoning Regulation under the Zoning Law which can directly consider the climate change.
Activities to be Conducted	■ Examining the inclusion of detailed definitions of the following issues in the regulation to be adopted; • Thermal insulation in buildings • Detailing the location/orientation and physical environmental control of the building • Energy use and management in buildings • Regular collection, disposal and use in compost production if necessary of household waste • Natural ventilation, • Natural lighting, • Positioning according to sun, wind and silhouette impacts, • LED lighting, • Access to public transport network • Renewable energy practises, • Incentives for green certificates and smart building practises • Size of green space, • Regulations on the planning of car parks ■ In the first stage, issuing a municipal zoning regulation by adding as many areas as possible. ■ Starting the national and international processes required to cover all the above issues of the Municipal Zoning Regulation
Implementation Period	Medium
Estimated Cost	Medium
Emission Reduction Potential	Medium
Investors	DMM
Stakeholders	DMM, MoEU
Risks	■ No risk is foreseen for this action.

Action B2.2: Designing the buildings built by the municipality as smart and green building systems	
Current Status / Purpose	Current Zoning Law and regulations do not include provisions related to climate change. Therefore, the municipality has limited sanctions to impose on the new buildings. However, the use of energy-efficient, smart and green building applications in the buildings it builds itself will be an example for citizens and will contribute to the sharing of experience during the implementation stages of citizens.
Activities to be Conducted	■ In all buildings to be built by the Municipality; • Smart system • Thermal insulation in buildings • Detailing the location/orientation and physical environmental control of the building • Energy use and management in buildings • Regular collection, disposal and use in compost production if necessary of household waste • Natural ventilation, • Natural lighting, • Positioning according to sun, wind and silhouette impacts, • LED lighting, • Access to public transport network • Renewable energy practises, • Encouraging the public by obtaining a green certificate • Size of green space, • Consideration of adequate parking ■ Increasing the technical personnel capacity of the construction supervision staff of local governments
Implementation Period	Medium
Estimated Cost	Medium
Emission Reduction Potential	Medium
Investors	DMM
Stakeholders	DMM, PDoEU, architects, contractors, CEDBIK, ENVERDER, CATIDER, IZODER
Risks	■ No risk is foreseen for this action.

Action B2.3: Encouraging the use of local and renewable materials in buildings	
Current Status / Purpose	One of the biggest side impacts of the construction sector is the process of transporting raw materials. Considering Turkey as a country entering in the urban transformation, the second major side impact of the construction sector is excavation waste. This action envisages to reduce the emissions from raw material transport and excavation wastes caused by the buildings. This action, which does not directly provide input to the calculation of the greenhouse gas inventory, will indirectly help reduction.
Activities to be Conducted	■ Providing citizens with price comparisons by searching domestic and foreign applications such as insulation for new buildings, LED lighting, natural ventilation, natural lighting etc. ■ Providing incentives such as tax discount to make necessary investment primarily for renewable products and then renewable and domestic products.

Implementation Period	Medium
Estimated Cost	Medium
Emission Reduction Potential	Low
Investors	Contractors
Stakeholders	DMM, PDoEU, IZODER, ENVERDER, CATIDER, architects, contractors,
Risks	▪ No risk is foreseen for this action.

Objective B3: Redesign of the city to reduce the impact of climate change	
Target: Reducing emissions from all sectors, primarily transport, buildings and energy, with a better and more environmentally friendly urban planning	**Stakeholders:** DMM, PDoEU, MoENR, contractors, landscape architects, construction firms
Action B3.1: Change in urban plans	

Action B3.1: Change in urban plans	
Current Status / Purpose	Having a single centre may be practicable for small cities with a small surface area, but not a very efficient method with the increase of surface area along with the population. Travel to the city centre from distance will increase, and thus the traffic will intensify. This method, which causes a direct increase of vehicle-induced emissions, will also create urban heat islands. Instead, in cities with distributed-centres, citizens' travelling to the lower centres in their own area will reduce emissions, and will be a good adaptation action preventing the urban heat islands. On the other hand, in this method, which can increase the consumption of energy, water etc causing unnecessary expansion of cities, it is necessary to avoid excessive horizontal development and to prevent the vertical development by keeping the high-rise buildings at the optimum level. As the creation phase of the sub-centres will need each part of the city to be integrated, there will also be requirements for renewal of buildings in the slum areas. With the consent of the parties related to urban transformation, it is also possible to reduce the emissions from heating in the city with the urban transformation practices that the low-income group can afford.
Activities to be Conducted	- Distributing the centre and creating and increasing the mixed use for the creation of sub centres - When creating sub-centres, optimal placement of the number and the locations for shopping centres which are important for citizens - Production of the optimum solution in high-rise constructions while preventing the expansion of the city - Transformation, consolidation and harmonization of socio-economic depression areas
Implementation Period	Medium
Estimated Cost	Medium
Emission Reduction Potential	High
Investors	DMM, construction companies
Stakeholders	DMM, PDoEU, construction companies, citizens, businesses
Risks	▪ No risk is foreseen for this action.

6.2.2. ENERGY

According to TurkStat data, 73% of Turkey's total greenhouse gas emissions in 2016 was caused by the energy industry, and electricity generation and conversion sector constituted a part of 29%, manufacturing and construction industries 12%, and buildings 13%. Considering the breakdown of the resources of Turkey's power generation, it is seen that fossil fuels consisted a part of 68% and hydrology consisted 25%, and other renewable sources consisted only 7% of the remaining amount.

Just as in Turkey, the share of renewable energy in electricity generation in Denizli is at 30% (see. Table 18).

Table 18 - Licensed Electricity Production Distribution in Denizli Province (EMRA, 2018)

Facility Type	Number of Facilities	Capacity in Operation (MW)	Capacity Under Construction (MW)	Total Installed Power (MW)	Ratio of Operational Capacity in Total
Biomass	1	0.635	0	0.635	%0
Solar	1	10	0	10	%1
Wind	1	0	66	66	%0
Geothermal	8	296.257	5.52	301.777	%18
Thermal	10	1.133.244	3.25	1.136.494	%70
Hydroelectric	15	180.664	7.068	187.732	%11
Total	**36**	**1.620.8**	**81.838**	**1.702.638**	**100%**

43,8% of Denizli's greenhouse gas emissions are from stationary sources. The energy industry is included in the manufacturing industry and construction sector, which accounts for 54,7% of emissions from stationary sources, and is very low.

Referring in particular to the electricity consumption of 3.274 GWh in 2016, according to the EMRA, Denizli is # 19 in electricity consumption in Turkey. 22% of total greenhouse gas emissions calculated for Denizli is from electricity consumption and 28% is from electricity generation. It is possible to reduce emissions from energy and electricity consumption/generation by means of energy efficiency and renewable energy policies.

According to the Eurostat data, solar energy area of Germany, which produces 38,1 TWh solar energy, receives 1000-1200 kWh / m2 of solar radiation per year, whereas the province of Denizli has a solar radiation value of 1600-1750 kWh/m2 (see Figure 33) but its solar energy generation is only 10 MW, and 1% of total production (see Table 18).

Figure 33 - Total Solar Radiation of Denizli (KWh / m2-year) (GDRE, 2018a)

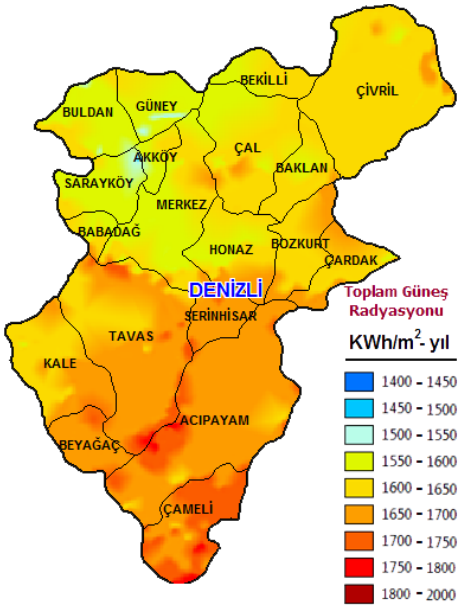
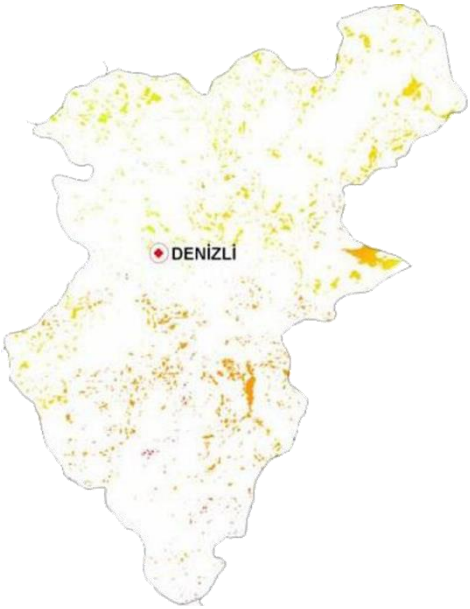


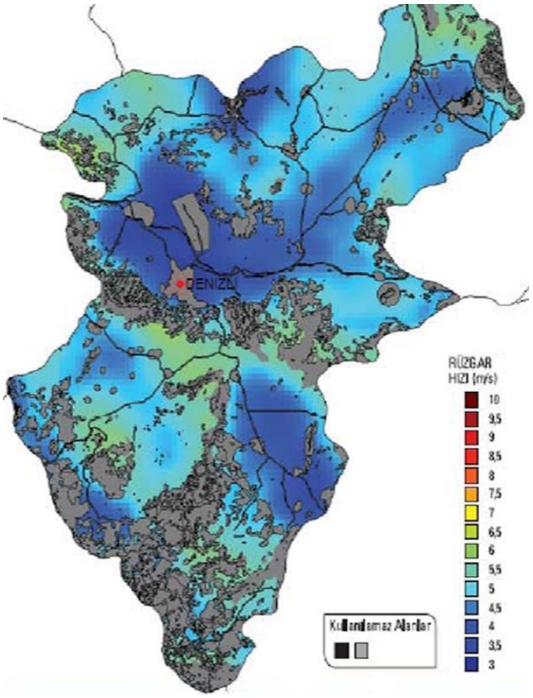
Figure 34 - Solar Potential Areas of Denizli Province (GEKA, 2011)



Denizli is a city with high potential for solar energy thanks to its geographical location. Sunshine duration is 12 hours especially in summer months, and it is over 5 hours except in December and January (REGD, 2018a). Figure 33 shows solar radiation in Denizli, and Figure 34 shows usable areas. There is a potential to achieve significant gains considering that the usable areas are provided to Denizli with a solar power plant.

According to the geographical conditions of Denizli province, the wind energy potential is not very efficient. According to a study conducted by the General Directorate of Renewable Energy, MENR, the maximum wind speed at 50 meters in Denizli is 6.5 m/s (see Figure 35). Although it is generally suggested that the investments that can be considered as economic are to be established in regions with wind speeds above 7 m/s, it is predicted that the implementation will not be very inefficient considering the renewed wind turbine technology and the tower sizes of 80 meters. However, the low wind speed in the available areas suggests that there should be a shift towards renewable sources other than wind in Denizli. The total area is calculated to be 47,71 km^2 according to Figure 35 and the wind energy potential that can be established in Denizli is determined as 238,56 MW (GDRE, 2018b). According to Turkey Wind Energy Association (TUREB) report and EMRA data, there is no Wind Power Plant (WPP) in operation in Denizli, but there is one under construction, 66 MW WPP (TUREB, 2018). It is noteworthy that this WPP, which is still being constructed is not located within the boundaries of Denizli according to the wind energy atlas of TUREB (TUREB, 2018b).

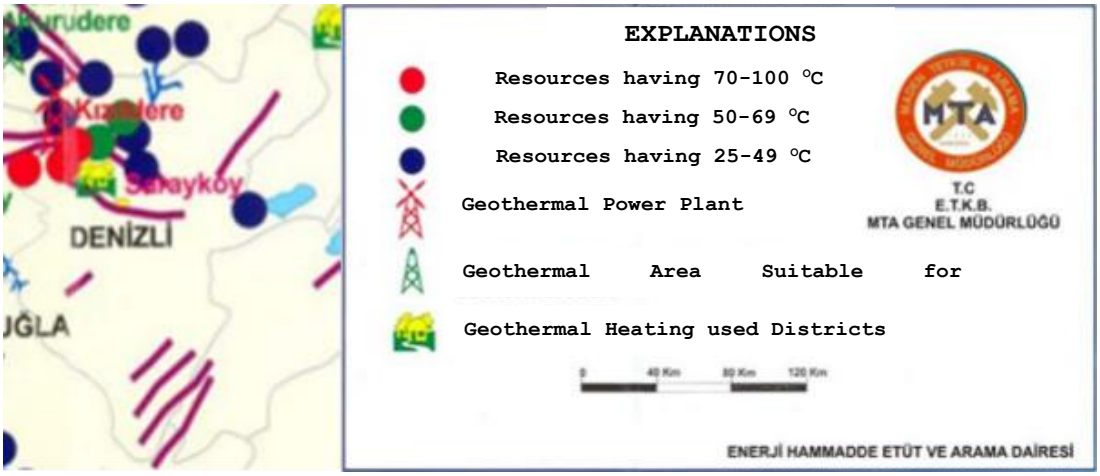
Figure 35 - Wind Potential of Denizli Province (REGD, 2018b)



According to the biomass energy potential atlas prepared by the General Directorate of Renewable Energy, 2 million tons of agricultural waste and 2,9 million tons of animal waste are generated in Denizli (GDRE, 2018c). Assuming that power/electricity can be generated from all of these wastes, it is seen that the energy equivalent of the plant wastes is 1.117 MW and the animal wastes is 29 MW. However, it is not possible to convert all of the waste to energy, and not all have the same energy characteristic. In 2016, FAO reported the highest energy potential of agricultural waste with 364.071 tons, bovine animal waste of 2,86 million tons, and poultry animal waste of 134.716 tons (FAO, 2016). The energy equivalent of the plant wastes, which allows the production of combined heat and energy, was determined as 2,6 MW, and the electricity energy of the plant wastes that enable the generation of electricity was calculated as 6,2 MW and the electricity energy equivalent of animal wastes was determined as 8,33 MW. Currently Denizli has one licensed biogas power plant with a capacity of 0,65 MW.

The province of Denizli is located in a region rich in geothermal resources which is very useful both in terms of energy and electricity generation. Büyük Menderes Graben (the area between Aydın-Ortaklar and Denizli-Sarayköy) has been determined by MTA to have a very high geothermal resource potential. All of 8 geothermal power plants in the city are located in Sarayköy district (see Figure 36) and have a high rate of 18% in total electricity generation in the city (see Table 18).

Figure 36 - Geothermal Resource Potential and Energy Use of Denizli Province (MTA, 2018)



Turkey's National Energy Efficiency Action Plan states the primary energy intensity in Turkey in 2015 was 0,12 TEP/ $ 1000, which was higher than the average of 28 Member States of the European Union (0,09) and the average of OECD countries (0,11). This comparison is enough to show that the potential for energy efficiency cannot be underestimated (EVEP, 2017).

Considering the renewable energy potentials mentioned above, together with the electricity and energy consumption of Denizli, the actions that will be taken to reduce the emissions from energy will be very important. It should be noted that the use of renewable energies will be at the highest level taking into consideration the energy efficiency potential.

2 objectives and 6 actions were determined for the energy sector within the framework of Denizli CCAP. Actions set under each objective and activities to be carried out to implement these actions are presented with details below.

Objectives
Objective E1: Reducing the use of fossil fuels and increasing the use of renewable energy sources and low carbon fuels
Objective E2: Increasing energy efficiency practices

Objective E1: Reducing the use of fossil fuels and increasing the use of renewable energy sources and low carbon fuels	
Target: Sustaining economic development while reducing emissions by using less fossil fuels in industry and more renewable energy. Improvement of air quality by using low carbon fuel at home.	**Stakeholders:** DMM, district municipalities, MoENR, PDoEU, OIZs, industrial enterprises, natural gas companies and ENERYA, households, solar energy companies
Action E1.1: Extension of low-carbon fuel consumption where fossil fuel consumption is mandatory	
Action E1.2: Proliferation of green energy consumption in industrial buildings	
Action E1.3: Renewable energy applications in buildings and areas under municipal responsibility	
Action E1.4: Encouraging the use of geothermal resources for heating purposes (such as greenhouses)	

Action E1.1: Extension of low-carbon fuel consumption where fossil fuel consumption is mandatory	
Current Status / Purpose	According to the GHG inventory coal accounts for 50% of the emissions from fuel consumption in households and 57% in industry in Denizli. 43% of the fuel combustion emissions of the industry is due to the use of natural gas. This rate in households is 47% and the remaining 3% is recorded as fuel oil. According to the results of a study conducted in Denizli, it was observed that heating of the same building with natural gas instead of coal was both economical and low emission (PAU, 2012). However, thanks to the carbon footprint calculation tool prepared within the scope of the project, comments were made that the use of natural gas is not possible in Denizli's non-central districts . It was envisaged that increasing the access and utilization rate of natural gas would improve emissions and improve the public health by improving air quality.
Activities to be Conducted	▪ Providing natural gas pipelines to each house in coordination with district municipalities ▪ Each house's gradual mandatory shift to the use of natural gas ▪ Investigation and reporting of low carbon fuel alternatives and mobilized financial resources that can be used primarily in large furnaces and boilers in industry
Implementation Period	Medium
Estimated Cost	High
Emission Reduction Potential	High
Investors	DMM, district municipalities, natural gas companies, households, industrial enterprises
Stakeholders	DMM, MoENR, industrial companies, industrial chambers, natural gas companies, households, OIZs, PDoEU
Risks	▪ Households reluctant to switch to natural gas ▪ Industrial enterprises reluctant to use alternative fuels ▪ Lack of legislation and lack of practice

Action E1.2: Proliferation of green energy consumption in industrial buildings	
Current Status / Purpose	In Denizli, 49% of the total emissions of industry other than process-related emissions are from fuel and 51% are from electricity consumption. It is foreseen that the industrial emissions from electricity use can be reduced significantly and that economic gain can be achieved in a short time thanks to the solar panels to be placed on the roofs of the industrial facilities.
Activities to be Conducted	▪ Feasibility studies to be conducted by industrial facilities for the integration of solar panels on roofs ▪ Reducing emissions from electricity consumption by gradual integration of the roofs of the industrial facilities into the solar panel starting from the facilities in the OIZs.
Implementation Period	Long
Estimated Cost	High
Emission Reduction Potential	High
Investors	DMM, OIZs, industrial enterprises

Stakeholders	DMM, PDoEU, MoENR, PDoIT, OIZs, industrial enterprises, EMRA, NGOs
Risks	▪ High costs ▪ Lack of legislation (lack of government support) ▪ Lack of appropriate space ▪ Lack of energy storage technology ▪ Adaptation to the weather conditions in the areas of installation (precipitation, infrastructure)

Action E1.3: Renewable energy applications in buildings and areas under municipal responsibility	
Current Status / Purpose	According to the GHG inventory, 75% of the emissions of commercial and institutional buildings are from the use of electricity. The solar panels to be installed on the buildings in the municipality's responsibility area will reduce the electricity consumption. Meeting the electricity needs of the information center and the course center in 10 different regions of the city through the photovoltaic panels placed on the roof of Kayıhan Pazaryeri within the scope of the Municipality's recent project "Denizli Metropolitan Municipality Powered by the Sun Project" provides the example of this action.
Activities to be Conducted	▪ Establishment and collection of actual energy consumption and emission data forms of municipal buildings and areas under municipal control and identification of energy densities ▪ Determination of energy saving targets starting from buildings with high energy density following analyses ▪ Feasibility study for the installation of photovoltaic systems on municipal buildings following analyses and energy efficiency practices ▪ Integration of solar panels to the lighting equipment used in areas such as public parks, Market places ▪ Obtaining electricity by placing in piezoelectric sensors especially on walkways and playgrounds ▪ Feasibility study of photovoltaic panel integration in large buildings (Shopping Centres, sports halls etc.) in Denizli province ▪ Preparation of energy efficiency guidelines for municipal buildings and large buildings such as shopping centres, sports complexes
Implementation Period	Medium
Estimated Cost	Medium
Emission Reduction Potential	High
Investors	DMM, Shopping centres, owners of sports complexes
Stakeholders	DMM, MoENR, energy generating companies
Risks	▪ No risk is foreseen for this action.

Action E1.4: Encouraging the use of geothermal resources for heating purposes (such as greenhouses)	
Current Status / Purpose	Geologically, Denizli is located in a region relatively rich in geothermal resources. It is known that 8 geothermal plants which produce a total of 296,257 MW of energy are located in Sarayköy and provide heat to households and greenhouses especially in Sarayköy district. Increasing this and making it compulsory especially for new facilities will reduce emissions from households and industry.

Activities to be Conducted	▪ Providing existing geothermal power generation facilities incentives for feasibility studies ▪ Houses' gradual switch to heating by geothermal source as a result of the feasibility studies ▪ Making the new geothermal power generation facilities to add heating to the household heating projects
Implementation Period	Medium
Estimated Cost	Medium
Emission Reduction Potential	High
Investors	Geothermal power plants, MoENR
Stakeholders	Sarayköy Municipality, geothermal energy production facilities, households,
Risks	▪ Insufficient heat of geothermal resources ▪ Negative results of feasibility study due to heat loss caused by transportation

Objective E2: Increasing energy efficiency practices	
Target: Reducing energy consumption to a level to be met by renewable energy by increasing energy efficiency in all sectors in Denizli including industry, buildings, transportation and electricity generation.	**Stakeholders:** DMM, PDoNE, MoENR, PDoEU, PDoIT, OIZs, universities and schools, industrial enterprises, NGOs, citizens
Action E2.1: Making lighting systems environmentally friendly	
Action E2.2: Providing non-formal and formal education on energy efficiency to all age groups	

Action E2.1: Making lighting systems environmentally friendly	
Current Status / Purpose	75% of the emissions of commercial and institutional buildings calculated within the scope of GHG inventory arises from electricity consumption, 18% from fuel consumption as natural gas, and 8% from street lighting. 32% of domestic emissions are caused by electricity consumption. With the development of LED technologies, the efficiency of illumination increased considerably. In this sense, with the transition of Denizli to LED technology in lighting systems, the reduction in electricity consumption and thus in emissions will be a considerable amount.
Activities to be Conducted	▪ Collection of information on energy saving and LED bulbs throughout Denizli ▪ Switching to LED lighting starting from areas with intensive lighting expenses, under authority of municipalities, primarily parks, gardens, underpasses and street lighting. ▪ Switching to LED lighting in the housing by providing the citizens with the necessary information
Implementation Period	Medium
Estimated Cost	Low-Medium
Emission Reduction Potential	High
Investors	DMM, citizens, industrial enterprises
Stakeholders	DMM, MoENR, PDoEU, NGOs, educational institutions, citizens, industrial enterprises
Risks	▪ Resistance to change ▪ Recycling problem of old type bulbs replaced with LED bulbs

Action E2.2: Providing non-formal and formal education on energy efficiency to all age groups	
Current Status / Purpose	In addition to encouraging the preference of energy efficient appliances and equipment, there is a need to raise the awareness of citizens and industrialists for the correct use of these products. Currently, the municipality has effective training opportunities such as Public Training Courses. Developing these courses for energy efficiency and providing new training opportunities will increase the capacity of industrialists and citizens in this field. In this direction, the amount of energy consumed at different levels will be reduced, thus contribute to the reduction of emission in Denizli.
Activities to be Conducted	▪ Investigating the energy consumption methods of SMEs, analyzing the current situation of SMEs on energy efficiency and submitting a recommendation report ▪ Organizing training activities on what to do about energy efficiency of SMEs ▪ Organizing energy efficiency trainings for adults and students in schools ▪ Organizing trainings to increase awareness of energy consumption and efficiency of employees of industrial enterprises and their families ▪ Organizing energy efficiency competitions between facilities for industrial enterprises in Denizli; between quarters for citizens and among schools for students
Implementation Period	Medium
Estimated Cost	Low
Emission Reduction Potential	Medium
Investors	DMM
Stakeholders	DMM, PDoIT, PDoEU, PDoNE, Pamukkale University and other educational institutions
Risks	▪ Low impact area of trainings

6.2.3. TRANSPORTATION

The transport sector is responsible for 16,5% of the total greenhouse gas emissions in Turkey in 2016. When the distribution of emission sources within transportation is examined, it is seen that roads account for 92,4% emissions. Of the remaining amount, 5,2% is from aviation, 1,2% is from waterborne navigation and 0,5% is from railways. According to 2015 data, 77% of the CO_2 emissions from roads is from diesel fuel, 9% from gasoline, 13% from LPG, 1% from natural gas (CNG) and biofuel (UAB, 2017).

Emission caused by transportation in Denizli constitutes a significant portion of total emissions (23.1%). Emissions from road transport have a share of 99,0%, and are calculated as 0,3% for railway and 0,7% for airline. For this reason, most of the actions under the area of transport action have been developed to reduce emissions from road transport.

The number of passenger cars, which were 41.752 in 1994 in Denizli, reached 190.469 in 2017 (TurkStat, 2017). It is estimated that this figure, which is still low when compared to the number of automobiles per thousand people in EU countries, will increase with economic and social developments along with the increase in urban population. This will increase vehicle traffic in the city centre.

Within the scope of public transportation services in the province, there are minibuses serving in the central districts of Denizli and buses of Denizli Ulaşım A.Ş., as well as minibuses serving the surrounding towns and villages. The routes of the said buses and minibuses of public transportation services are presented respectively in Figure 37 and Figure 38. Currently, there are 187 buses in the DMM fleet operating in 43 lines and a total of 763 minibuses operating in 22 lines. Buses transport 142.032 passengers a day and minibuses transport 102.625 passengers a day in the province. While the average bus line length is 28 km, minibus line length is 19,33 km. On average, there are 3 buses and 25 minibuses operating in a line and buses complete 29 services and minibuses complete 270 services. In addition, a total of 452 taxis are in operation including 371 in central districts and 81 in other districts. According to the data obtained, passenger transport by taxis is very low in the centre of Denizli (DMM, 2018).

Figure 37 - Denizli Bus Routes (DMM, 2018)

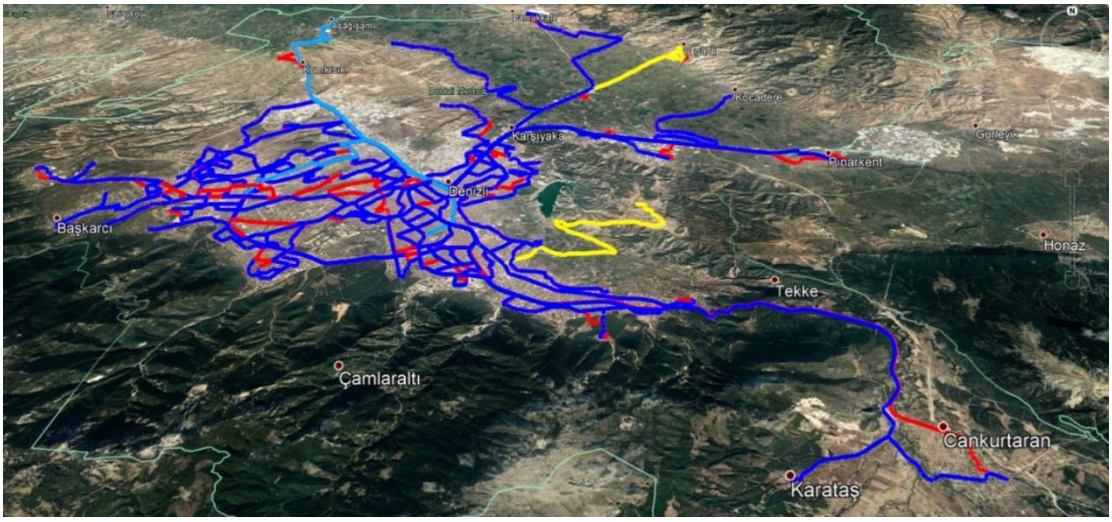
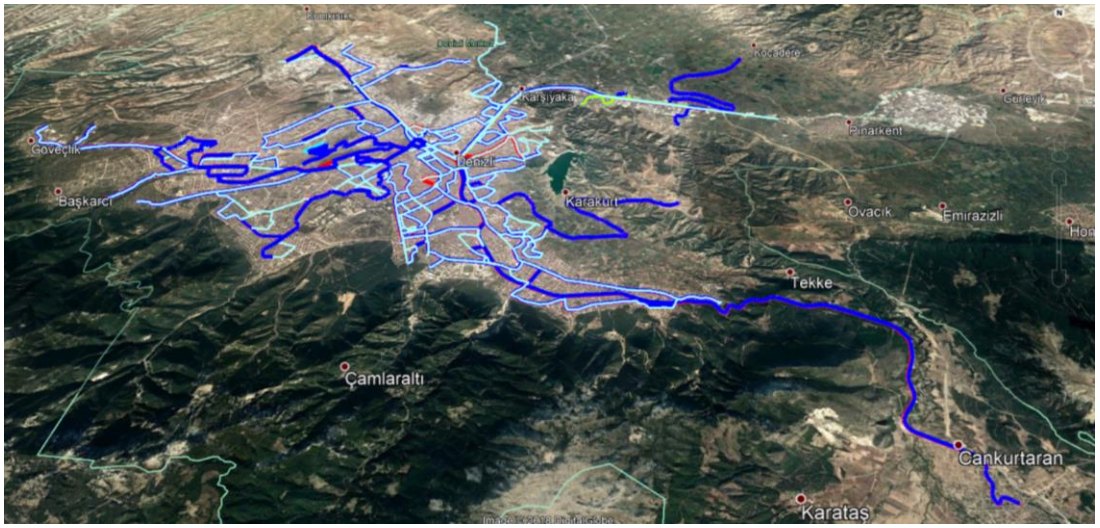
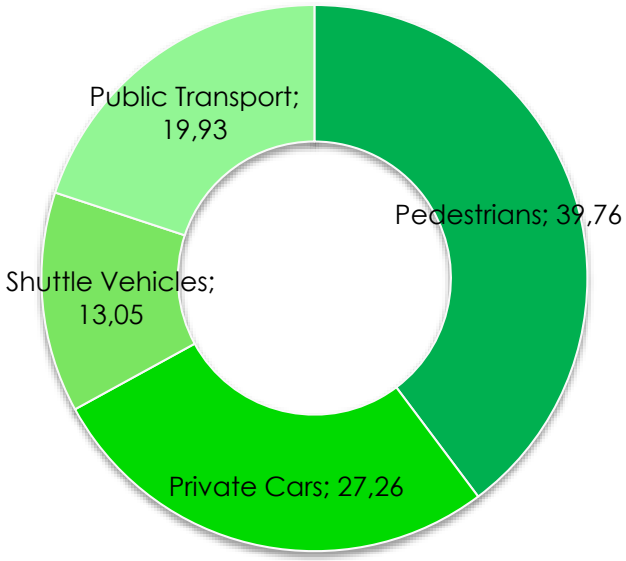


Figure 38 - Denizli Minibus Routes (DMM, 2018)



The chart below shows the breakdown of the journeys in Denizli by transportation types. While the rate of public transport use is 19,33%, the use of private vehicles is 27,26%. It is understood that one of the important reasons of the problems in the traffic in Denizli is that the percentage of private vehicle use is higher than the use of public transport. In an effective transportation network, it is expected that the public transport use rates will be higher and the rates of private auto use will be lower.

Figure 39 - Breakdown of Journeys by Transportation Types (%) (DMM, 2018)



The public transportation system in Denizli is not desirable in terms of breakdown by transportation types. The minibus system carries almost the same number of passengers as the municipal buses and functions as the main public transport system of the city. On the other hand, their efficiency is to low compared to buses, because their capacity per vehicle is lower than that of the buses, therefore they require a larger fleet, lack of higher number of vehicles and lack of fixed stops. Therefore, minibuses have a negative impact on the city traffic (DMM, 2018).

2 objectives and 6 actions were determined for the transportation sector within the framework of Denizli CCAP. Actions set under each objective and activities to be carried out to implement these actions are presented with details below.

Objectives
Objective T1: Reduction of urban vehicle traffic
Objective T2: Increasing alternative fuel and resource efficiency practices in public transport in the province

Objective T1: Reduction of urban vehicle traffic	
Target: Reduction of the number and traffic of motor vehicles in the city and therefore of emissions from these vehicles	**Stakeholders:** DMM, PDoIT, Denizli Ulaşım A.Ş., district municipalities, bus, minibus and motor transport cooperatives, Pamukkale University Technology Faculty, Pamukkale Teknokent, smart transportation technology producing companies
Action T1.1: Increasing public transport	
Action T1.2: Construction of bicycle paths and parks	
Action T1.3: Integration of smart transportation systems	

Action T1.1: Increasing public transport	
Current Status / Purpose	There are currently 187 buses operating in the DMM fleet in 43 lines. There are 763 minibuses operating in 22 lines within the boundaries of the province . In addition, a total of 452 taxis are in operation including 371 in central districts and 81 in other districts. Considering the current operational status of the minibuses that have an important role in the public transportation system of Denizli, it is observed that they do not have any systematic set up and they are not managed by any administration. This complicates the management of the public transport system in the city centre and leads to a decline in service standards. Considering the capacities, safety, cleaning, comfort systems, accessibility and pricing of minibuses, they do not constitute an attractive public transportation system in the city. (DMM, 2018). The level of service and the quality of public transport also obliges citizens to use special vehicles in some regions. This may lead to the development of urban transport in the direction of individual vehicle use. With the activities to be carried out within the scope of this action, it is aimed to increase the public transportation in the city centre and to reduce the use of individual vehicles by citizens.
Activities to be Conducted	▪ Purchase of new small buses ▪ Gradual transformation of urban minibus operation to bus system ▪ Applications that encourage the use of public transport (free transfer, free internet on the vehicle, charging station, internet ticket loading, etc.) ▪ To discourage the use of individual vehicles (emission-free zone, plate limitation, strip reduction etc.)
Implementation Period	Medium
Estimated Cost	High
Emission Reduction Potential	Low-Medium
Investors	DMM
Stakeholders	DMM, Denizli Ulaşım A.Ş., bus, minibus and motorized carrier cooperatives
Risks	▪ The lack of widespread public transport culture ▪ Resistance of minibus owners

Action T1.2: Construction of bicycle paths and parks	
Current Status / Purpose	In the current situation, construction of 12 km bicycle path on Acıpayam Boulevard, Şehit Öğretmen Yusuf Batur Street and Muhsin Yazıcıoğlu Street was completed by Denizli Metropolitan Municipality in Denizli, and 13 km bicycle path was started to be constructed on Ali Marım Boulevard and Üçler Boulevard (DMM, 2018). Construction of a 7,5 km bicycle path was completed by Merkezefendi Municipality. The construction of 8 bicycle stations, each with a capacity of 12 bicycles, has been commenced in Pamukkale. It is planned to carry out a total of 64 smart bikes and 96 parking lots, each of which has 4 empty parking spaces, 8 of which are filled with bicycles. In addition to the stations, works have been started for a 10 km bike path starting from Akköy, connected to Karahayıt, surrounding Karahayıt center connected to each other (PB, 2018). With the spread of these and similar applications across the province, it is aimed to reduce the emissions from vehicle use.
Activities to be Conducted	▪ Carrying out related infrastructure works such as segmentation, marking, parking place, public transport integration and security measures for bicycle paths ▪ Construction of bicycle parking in places such as parks, shopping centres, factories, hospitals, schools and sports facilities etc. ▪ Increasing bicycle rental stations at central points of the city ▪ Realization of awareness-raising activities in the city to increase the use of bicycles
Implementation Period	Medium
Estimated Cost	Low
Emission Reduction Potential	Low
Investors	DMM
Stakeholders	DMM, Denizli Ulaşım A.Ş., District Municipalities (Merkezefendi and Pamukkale)
Risks	▪ The risk of accidents due to narrowing of existing roads and further narrowing ▪ Failure to select routes where the safety of bicycle users can be ensured

Action T1.3: Integration of smart transportation systems	
Current Status / Purpose	In the current situation, a Traffic Management System Project is in progress in order to manage the urban transportation network of Denizli which is under the authority and responsibility of the DMM, in a more efficient, impactive, planned, expandable and sustainable way. A technological infrastructure is created within the scope of the project for applications for different purposes such as the establishment of a traffic control centre, collection of data related to urban transportation network, automatic updating of signalized junction times in accordance with traffic data, creation of urban traffic density maps, monitoring and recording of live traffic through cameras. For example, while the amount of fuel wasted at an intersection used approximately by 24.500 vehicles per hour during heavy traffic is about 1.120 lt/h, this amount will be reduced to 816lt per hour with the system to be established. Considering all intersections in Denizli and the one-year period, the emission reduction will be very significant(AŞD, 2018). The emissions from urban transportation is aimed to reduce with the implementation of these planned practices and similar systems for smart transportation for different purposes.

Activities to be Conducted	▪ Making the electronic bus stop signs that show the bus arrival and departure times regularly at the stop ▪ Reduction of stop-and-go time of vehicles by making signalling sources smart ▪ Extension of green wave system throughout the city
Implementation Period	Medium
Estimated Cost	Medium-High
Emission Reduction Potential	Medium
Investors	DMM
Stakeholders	DMM, PDoIT, Denizli Ulaşım A.Ş., Pamukkale University Technology Faculty, Pamukkale Teknokent, smart transportation technology producing companies
Risks	▪ Loss of reliability in the event that information is not available in time ▪ High investment and maintenance costs ▪ Failure of the system due to electrification and signalling problems

Objective T2: Increasing alternative fuel and resource efficiency practices in public transport in the province	
Target: Reduction of fossil fuel consumption and thus emissions from fuel in unit distance	**Stakeholders:** DMM, Denizli Ulaşım A.Ş., bus, minibus and motorized carrier cooperatives, minibus owners
Action T2.1: Increasing the number of alternative energy vehicles in the DMM public transport fleet	
Action T2.2: Reduction of fuel consumption per vehicle with economical driving techniques	
Action T2.3: Review of lines and reassessment of passenger potential	

Action T2.1: Increasing the number of alternative energy vehicles in the DMM public transport fleet	
Current Status / Purpose	Although the age of the existing vehicle fleet in the province cannot be fully calculated, it is estimated that the old vehicles in the fleet of buses and minibuses, which have a high share in public transportation, have high fuel consumption. It is known that 40% of the buses in the DMM fleet are new. Renewal of the entire fleet with more high-tech vehicles and replacing old minibuses with buses will reduce emissions from fossil fuel consumption.
Activities to be Conducted	▪ Increasing the number of CNG powered vehicles in the bus fleet ▪ Increasing the number of electrically powered vehicles within municipal buses
Implementation Period	Short
Estimated Cost	Medium
Emission Reduction Potential	Medium
Investors	DMM, Denizli Ulaşım A.Ş., bus, minibus and motorized carrier cooperatives
Stakeholders	DMM, Denizli Ulaşım A.Ş., bus, minibus and motorized carrier cooperatives
Risks	▪ Possible high costs

Action T2.2: Reduction of fuel consumption per vehicle with economical driving techniques	
Current Status / Purpose	The Regulation on the Procedures and Principles for Increasing Energy Efficiency in Transportation holds the municipalities responsible for fuel consumption with the statement "Municipalities primarily considers the fuel consumption in the traffic flow in the determination of the urban transportation routes" under the title of "Urban Transportation Plans". 99% of the emissions in the transport sector are from roads. Road emissions are mainly calculated from direct fuel consumption in private vehicles and public transport. Technical training and awareness raising activities for reducing the fuel consumption, which is one of the basic operating expenses for the municipality and one of the basic transportation expenses for the citizens, are not at the desired level. In fact, even the operating manuals of each particular vehicle indicate the speed at which the driving is most economical. Savings of up to 25% can be achieved with economical driving techniques. It is envisaged to provide significant emission reduction with trainings to be given to both citizens and public transport drivers throughout the province.
Activities to be Conducted	▪ Organizing trainings for economic driving techniques for road public transport drivers ▪ Establishment of a system to monitor the parameters of vehicle use of the drivers in the municipality and rewarding the successful drivers ▪ Establishment of a system to monitor the parameters of vehicle use of the minibus drivers and rewarding the successful drivers ▪ Adding courses for economic driving to the curriculum of the driving courses in the province
Implementation Period	Short
Estimated Cost	Low
Emission Reduction Potential	Low
Investors	DMM, Denizli Ulaşım A.Ş., bus, minibus and motorized carrier cooperatives
Stakeholders	DMM, Denizli Ulaşım A.Ş., bus, minibus and motorized carrier cooperatives
Risks	▪ No risk is foreseen for this action.

Action T2.3: Review of lines and reassessment of passenger potential	
Current Status / Purpose	This action will help reduce the fuel consumption and the number of optimum travel per hour and the number of buses by reviewing public transport capacities and passenger potentials.
Activities to be Conducted	▪ Reducing the number of passengers who transfer and who use minibuses by re-arranging the lines according to the routes used. ▪ Shifting buses with high passenger transport capacity to high-density lines ▪ Examining on site the demand of the buses at peak hour and the time of day and shifting buses on low-demand lines to high-demand locations and purchasing new buses if needed
Implementation Period	Short
Estimated Cost	Medium
Emission Reduction Potential	Low-Medium
Investors	DMM, Denizli Ulaşım A.Ş., bus, minibus and motorized carrier cooperatives
Stakeholders	DMM, Denizli Ulaşım A.Ş., bus, minibus and motorized carrier cooperatives
Risks	▪ No risk is foreseen for this action.

6.2.4. WASTE/WASTE WATER

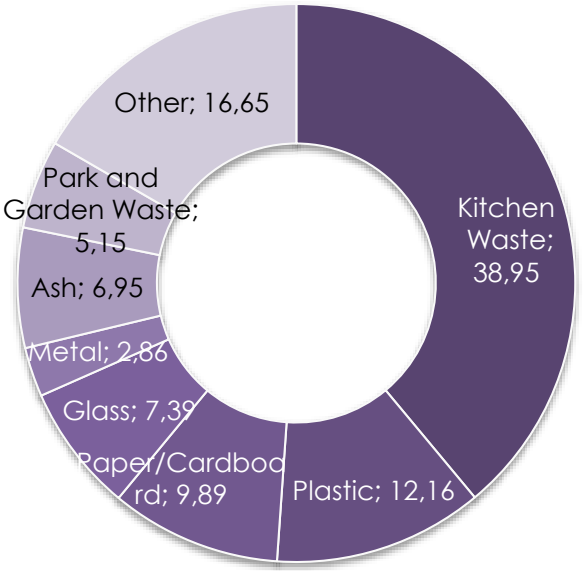
Waste Management

According to Turkstat data 3,3% of Turkey's total greenhouse gas emissions by 2016 is from the waste sector. Emissions from the waste / waste water sector in Denizli account for approximately 1% of all emissions.[31]

According to the inventory results, emissions from solid waste management constitute a large part of the emissions in the waste/waste water sector. While the share of the emissions from the landfill is 77,9%, the emissions from the waste water treatment/discharge are 21,2%. In addition, the share of the composting facility operated by the municipality is 0,9% of this part The main emissions of the sector are CH_4 resulting from landfill and biological treatment of solid wastes and CH_4 and N_2O from waste water treatment and discharges.

As of 2016, 225.053 tons of domestic waste was regularly stored in Denizli province and 146.665 tons of domestic waste was dumped as wild waste. The electricity need of 2000 houses were met with 3.765 MWh generated by the methane gas generated during the landfill. In addition, 4.192 tons of organic waste was disposed of by composting (TurkStat, 2016b). The following figure shows the composition of household waste in Denizli.

Figure 40 - Domestic Waste Composition in Denizli (%) (PDoEU, 2017)



[31] Emissions from electricity and fuel used during waste and wastewater management are calculated within stationary sources.

Other information regarding the facilities operating in the province in terms of waste management and the waste disposed or processed in these facilities is given in the table below.

Table 19 - Waste Disposal / Processing Facilities in Denizli Province (PDoEU, 2017)

Waste Branch	Facility Information	Number of Facilities	Note
Domestic Waste	Municipal Solid Waste Landfill	1	In 2017, 233.205 tons of domestic waste was disposed of in the landfill. Domestic wastes collected by district municipalities and non-hazardous domestic wastes from various industrial enterprises are brought to the facility.
Packaging Waste	Licensed Packaging Waste Collection Separation Plant and Recycling Facility	35	There are 16 collection separation facilities, 19 recycling facilities, 30 suppliers, 67 packaging manufacturers and 476 launching companies in Denizli for the management of packaging wastes. In addition, 10 district municipalities completed the packaging waste management plan.
Non-hazardous Waste	Non-Hazardous Waste Recycling Facility	28	In 2017, 70.895 tons of non-hazardous waste have been processed.
Hazardous waste	Hazardous Waste Recycling Facility	4	In 2017, 9.854 tons of hazardous waste were declared. 7.623 tons of these wastes were sent to hazardous waste recycling facilities and 2.165 tons were sent to disposal facilities.
WEEE (E-Waste)	Waste Electrical and Electronic Equipment Processing Plant	2	In 2017, 51,6 tons of WEEE was collected separately and disposed of.
Medical Waste	Medical Waste Sterilization Plant	1	In 2017, 1.427 tons of medical waste were disposed of by sterilization facility.
Waste Vegetable Oil	Waste Herbal Oil Recycling Plant	0	In 2017, 103,7 tons of waste vegetable oil were collected.
Waste Oil (engine oil and industrial oil)	Waste Oil Recycling Plant	0	In 2017, 512 tons of waste vegetable oil were collected.
Waste Battery and Accumulator	Waste Battery and Accumulator Recovery Plant	0	In 2017, 32,9 tons of waste accumulators, 8,7 tons of waste batteries were collected and sent for recycling.
End of Life Tire	End of Life Tire Recycling Facility	0	In 2017, 97 tons of ELT were sent to recycling plants for disposal and 30 tons of ELT were sent to cement plants.

The most preferred method of storage in the management of waste throughout the province corresponds to more than three-quarters of emissions. Extension of reduction at source, reuse, recovery and recycling activities offer high potential for reduction of emissions from landfills.

In addition, ongoing rehabilitation works of the wild waste dumping areas in the province will also have an impact on their emission rates.

Wastewater Management[32]

The drinking water and sewage services within the provincial boundaries of Denizli are provided by DESKI. As of the end of 2017, 93% of the Denizli population benefits from the sewerage service and 55% benefits from the service of Wastewater Treatment Plant (WWTP). There are 378.738 m sewer lines within the provincial boundaries. In 2017, a total of 70.459 m stormwater lines were laid within the scope of the transition from the combined sewer system to the discrete system. There are 39 WWTP (9 Reinforced Concrete WWTP, 26 Package WWTP, 4 Natural WWTP) with 132.500 m^3/day capacity in the province. In 2017, 30,9 million m^3 of waste water was treated. The 7 WWTP projects, which are under construction, are designed as Advanced WWTP.

In 2017, 29.566 tons of sewage sludge generated in the province was sent to licensed recycling/disposal facilities. On the other hand, the studies on the use of sludge formed in the treatment facilities in Denizli Cement Plant and the slag formed in industrial plants as alternative raw materials and additional fuel are ongoing.

3 objectives and 8 actions were determined for the waste/waste water sector within the framework of Denizli CCAP. Actions set under each objective and activities to be carried out to implement these actions are presented with details below.

Objectives
Objective W1: Improving existing solid waste and waste water services
Objective W2: Reducing the amount of landfilled organic waste and recyclable waste
Objective W3: Increasing renewable energy and energy efficiency practices in solid waste and waste water disposal

Objective W1: Improving existing solid waste and waste water services	
Target: Reduction of emissions from solid wastes and waste water within the provincial boundaries	**Stakeholders:** DMM, MoEU, PDoEU, district municipalities
Action W1.1: Disposal of all domestic solid wastes generated within the provincial boundaries by appropriate methods	
Action W1.2: Providing sewage and waste water treatment plant services to the entire population of the province	

[32] Fuel and electricity emissions from the collection and treatment of wastewaters are included in the stationary sources section.

Action W1.1: Disposal of all domestic solid wastes generated within the provincial boundaries by appropriate methods	
Current Status / Purpose	As of 2016, 225.053 tons of domestic waste was regularly stored in Denizli province and 146.665 tons of domestic waste was dumped as wild waste (PDoEU, 2017). With the activities to be realized under this action, it is aimed to reduce the amount of solid waste landfilled in the province as a high amount of dumped wild waste and thus the related emissions.
Activities to be Conducted	▪ Transportation of domestic wastes generated in Buldan, Güney, Sarayköy-Babadağ, Acıpayam-Serinhisar districts to the existing landfill ▪ Disposal of domestic wastes from Çivril, Çal, Bekilli and Baklan districts in Çivril landfill to be established for solid wastes. ▪ Disposal of domestic wastes from Tavas, Kale and Beyağaç districts in Tavas landfill to be established for solid wastes. ▪ Disposal of a portion of domestic solid waste by incineration ▪ Construction of 3rd lot in the existing landfill
Implementation Period	Medium
Estimated Cost	Medium
Emission Reduction Potential	Low-Medium
Investors	DMM
Stakeholders	DMM, MoEU, PDoEU, district municipalities
Risks	▪ Mixing of medical or hazardous wastes into household waste ▪ Accidents experienced while transporting waste ▪ Lack of coordination of relevant institutions ▪ The traffic density that may occur after the establishment of the facility to be established for 4 districts

Action W1.2: Providing sewage and waste water treatment plant services to the entire population of the province	
Current Status / Purpose	As of the end of 2017, 93% of the Denizli population is provided sewerage service and 55% is provided Wastewater Treatment Plant (WWTP) service. In 2017, 30,9 million m^3 of waste water was treated by 39 WWTPs. Transition from the combined sewerage system to the discrete system is in progress (PDoEU, 2017). The amount of waste water discharged without being treated with activities to be conducted under this action will be minimized and the excess waste water load to WWTPs will be reduced with the separation of the rain water from the sewage system.
Activities to be Conducted	▪ Construction of waste water treatment plant in districts with no WWTP ▪ Transition throughout the province to the dual sewerage system where rainwater is separated from the unified sewage system
Implementation Period	Medium
Estimated Cost	Medium
Emission Reduction Potential	Low-Medium
Investors	DESKİ
Stakeholders	DESKI, DMM, PDoEU
Risks	▪ Lack of coordination of relevant institutions

Objective W2: Reducing the amount of landfilled organic waste and recyclable waste	
Target: Reduction of emissions from landfill and waste water treatment	**Stakeholders:** MoEU, DMM, DESKI, district municipalities, authorized organizations, PDoNE, PDoEU, NGOs, mukhtars, citizens
Action W2.1: Increasing the training activities for separation at source and water saving	
Action W2.2: Disposal of a portion of domestic solid waste by an incineration plant to be established	

Action W2.1: Increasing the training activities for separation at source and water saving	
Current Status / Purpose	In the present case; DMM, district municipalities and authorized organizations organize training and awareness raising projects especially on separation at source in the province for different stakeholder groups. The impact of these trainings on public awareness is not yet fully measured. In spite of the increase in awareness raising activities, in a large part of the society, the habit of separation at source and water saving has not been established. By increasing training and awareness raising activities, it is aimed to reduce the amount of waste water going to landfills and the waste water going to the WWTPs and thus to reduce the related emissions.
Activities to be Conducted	▪ Preparing and implementing a systematic training program for adults, young people and children ▪ Organizing activities such as projects etc which preschool, primary and secondary school students can participate actively in recycling and saving. ▪ Organizing trainings to improve the capacities of relevant NGOs on waste and water management and sustainable consumption ▪ Organizing trainings for industrialists on reducing the amount of water used in production and the separation at source of solid wastes as a result of production and recycling ▪ Organizing relevant capacity building projects to include teachers and neighbourhood mukhtars ▪ Organizing training activities for separate collection to prevent waste oil from spilling into sewer lines
Implementation Period	Medium
Estimated Cost	Low
Emission Reduction Potential	Medium
Investors	DMM, DESKI, district municipalities, authorized organizations
Stakeholders	DMM, DESKI, district municipalities, authorized organizations, PDoNE, PDoEU, NGOs, mukhtars, citizens
Risks	▪ Insufficient collection infrastructure ▪ Lack of coordination of relevant institutions

Action W2.2: Disposal of a portion of domestic solid waste by an incineration plant to be established	
Current Status / Purpose	There is no similar facility in Denizli, and domestic solid waste is disposed of by landfill and open waste dumping. With such a facility supported by electricity and heat generation, it is aimed to significantly reduce the emissions from landfill.
Activities to be Conducted	▪ Mechanical biological pre-treatment plant to be installed at the entrance of the incineration plant and the separation of recyclable waste from the domestic wastes before incinerating and making the remaining part suitable for incineration ▪ Close monitoring of established facilities and related enterprises and making necessary controls ▪ Designing the plant for integration to a possible district heating / cooling infrastructure
Implementation Period	Medium
Estimated Cost	High
Emission Reduction Potential	Medium
Investors	DMM
Stakeholders	DMM, MoEU, PDoEU, citizens
Risks	▪ Failure of pollution prevention units at the plant ▪ High cost ▪ Social reaction

Objective W3: Increasing renewable energy and energy efficiency practices in solid waste and waste water disposal	
Target: Conversion of gases formed during solid waste disposal to energy and reduction of emissions from electricity used in waste water treatment	**Stakeholders:** DMM, DESKI, MoEU, MoAF, PDoEU, PDoAF, ILBANK A.Ş., district municipalities, agricultural cooperatives, agricultural chambers, farmers
Action W3.1: Evaluation of methane gas generated in existing landfill facilities as electrical energy	
Action W3.2: Establishment of biogas production facility (s) for WWTP sewage sludge and animal waste	
Action W3.3: Balancing the electricity consumption of WWTP with the integration of solar power plant	
Action W3.4: Reducing the electricity consumption of WWTP with efficiency applications	

Action W3.1: Evaluation of methane gas generated in existing landfill facilities as electrical energy	
Current Status / Purpose	As of 2016, 225.053 tons of domestic waste was regularly stored in Denizli province and 146.665 tons of domestic waste was dumped as wild waste (PDoEU, 2017). The electricity need of 2000 houses were met with 3.765 MWh generated by the methane gas generated during the landfill (SCD, 2018). With this action, it is aimed to increase the amount of electricity generated from the field by collecting the methane gas generated by the transportation of domestic wastes to the existing landfill facility in the various non-central districts.
Activities to be Conducted	▪ Construction of 3rd lot in the existing landfill ▪ Collecting methane gas from the 3rd lot and obtaining electricity

Implementation Period	Short
Estimated Cost	Medium
Emission Reduction Potential	Low
Investors	DMM
Stakeholders	DMM, MoEU, PDoEU, district municipalities
Risks	▪ Failure of separation of domestic solid wastes at source

Action W3.2: Establishment of biogas production facilitie for WWTP sewage sludge and animal waste	
Current Status / Purpose	According to a study conducted by Pamukkale University in 2017, the total amount of daily biogas potential that can be produced from 4.578.889 kg soft manure generated per day in Denizli province is 192.234 m^3 CH_4/kg. The number of people who can benefit from the biogas which has the potential to be produced is calculated according to the literature as 320.390 people (PAU, 2017). On the other hand, in 2017, 29.566 tons of sewage sludge generated in the province was sent to licensed recycling/disposal facilities. The studies on the use of sludge formed in the treatment facilities in Denizli Cement Plant and the slag formed in industrial plants as alternative raw materials and additional fuel continue (PDoEU, 2017). It is aimed to prevent emissions from these wastes with the implementation of the activities under this action, through such biological treatment technologies as anaerobic digestion and composting for the disposal of WWTP sludge and animal waste in the province and Cattle barns and WWTPs which balance their electricity consumption.
Activities to be Conducted	▪ Providing energy production by the conversion of methane gas from animal wastes in high capacity animal breeding facilities located within the provincial boundaries ▪ Establishment of a regional biogas production facility for WWTP sewage sludge generated within the provincial boundaries
Implementation Period	Long
Estimated Cost	Medium-High
Emission Reduction Potential	Medium
Investors	DESKI, PDoAF, district municipalities
Stakeholders	DMM, DESKI, MoEU, MoAF, PDoEU, PDoAF, district municipalities, agricultural cooperatives, agricultural chambers, farmers
Risks	▪ Lack of coordinated work of relevant institutions ▪ Higher than expected investment costs ▪ Lack of supervision

Action W3.3: Balancing the electricity consumption of WWTP with the integration of solar power plant	
Current Status / Purpose	The energy requirement of the units in the energy demand budget of DESKI was foreseen as the highest budget item in 2018 with a share of 6,17% (25 million TL) (DESKI, 2018). It is aimed to reduce the electricity consumption-related emissions from the WWTPs with the facilities to be implemented within the scope of the action.

Activities to be Conducted	▪ Determination of potential facilities and lands for solar energy project and implementation activities ▪ Integration of solar panel systems on suitable landfill sites and units
Implementation Period	Medium
Estimated Cost	Medium-High
Emission Reduction Potential	Medium
Investors	DESKİ
Stakeholders	DESKI, DMM, MoEU, MoENR, MoIT, ILBANK A.S., PDoEU
Risks	▪ Failure to select the facilities to be established/areas correctly ▪ Lack of coordination of relevant institutions

Action W3.4: Reducing the electricity consumption of WWTP with efficiency applications	
Current Status / Purpose	In the current situation, only one of the 9 reinforced concrete WWTPs is advanced treatment, and all of the 7 AAT projects under construction except those facilities are designed as Advanced WWTP. It is aimed to reduce the related emissions to a great extent by commissioning of these facilities with full capacity. Transition from the combined sewerage system to the discrete system is in progress (PDoEU, 2017).
Activities to be Conducted	▪ Bringing existing plants to the level of advanced biological treatment plants ▪ Conversion of existing waste water pumps into energy efficient pumps ▪ Replacement of existing blowers in WWTPs with less power consuming turbo types ▪ Reducing the pollution load of waste water coming to WWTPs ▪ Transition to separate rainwater and sewerage systems ▪ Prevention of fugitive discharges
Implementation Period	Medium
Estimated Cost	High
Emission Reduction Potential	Medium
Investors	DESKI, DMM
Stakeholders	DESKI, DMM, MoEU, ILBANK A.S.
Risks	▪ No risk is foreseen for this action.

6.2.5. INDUSTRY

The environmental impact of the industrial sector which makes a contribution of 26% in the Turkish economy in 2015 cannot be ignored. According to the data provided in the National Energy Efficiency Action Plan, the industry accounted for 32,4% of Turkey's total energy consumption and 47,6% of electricity consumption in 2015 (EVEP, 2017). As a result of such power and electricity consumption, the industrial sector accounted for 25% of the total GHG emissions in Turkey in 2016 including 12% used by manufacturing industry and 13% used by industrial processes (TurkStat, 2016).

Holding an important place in the economy in Denizli, the industrial sector constitutes 38% of the contribution of Denizli to Turkey's total GDP (TurkStat, 2014). By 2016, the province of Denizli realized 0.8% of the total imports and 1.7% of the exports in Turkey. According to per capita total exports and

imports figures in Turkey, Denizli ranks the 5th and the 9th, respectively. According to the data of Denizli Governorate, textile sector constituted 45% of Denizli's exports in 2015 (DG, 2015).

The impact of industry in Denizli's total greenhouse gas inventory is 45%, including 12% from direct fuel burning, 12% electricity use and 21% from the production processes in the sector itself. Although there were question marks in the minds at the stage of determination of the reduction target and composing the related actions at the beginning of the study, it was decided to include industrial emissions after the stakeholder workshops and surveys. With the actions to be taken in the three areas mentioned above, it is envisaged that the emissions of the industrial sector can be significantly reduced.

Within the scope of the industrial sector, 4 actions have been identified under 1 overall objective. Actions set under this objective and activities to be carried out to implement these actions are presented with details below.

Objectives
Objective I1: Improving processes through resource efficiency applications

Objective I1: Improving processes through resource efficiency applications	
Target: Reduction of fuel and electricity consumption in Denizli industry and reduction of emissions from this area through process improvements	**Stakeholders:** DMM, PDoEU, PDoIT, DCoI, OIZs, individual industrial enterprises, professional chambers
Action I1.1: Reduction of business-based electricity consumption	
Action I1.2: Re-use of semi-finished products in the process and recycling of waste	
Action I1.3: Establishment of regional / central heating / cooling centres for industrial heating / cooling needs	
Action I1.4: Reduction of unit/tonne emission of processes	

Action I1.1: Reduction of business-based electricity consumption	
Current Status / Purpose	With 3.274 GWh of electricity consumption in 2016, according to EMRA data, Denizli ranks # 19 in electricity consumption in Turkey and has a 1,5% share in Turkey's electricity consumption (EMRA, 2016). Within the scope of GHG inventory, 26% of Denizli's industrial sector total emissions are from fuel use, 27% from electricity use, and 46% from processes. Replacing electric motors and other equipment used by the industrialists with efficient ones will reduce emissions from direct electricity consumption. In addition, the reduction of the electricity used in the enterprise through efficiency works will contribute to the significant reduction of the industrial emissions as well as the financial gain provided to the industrialist.
Activities to be Conducted	▪ Carrying out energy studies for industry ▪ Increasing the ISO 50001 Energy Efficiency certificate in the industry ▪ Examining the best techniques, collaboration within the same sector ▪ Selection of machines with high energy efficiency, renewal of burning or process boiler/furnaces to this end, application of efficient combustion techniques ▪ Developing incentive mechanisms to increase efficiency classes used in industry ▪ Determination of external financing sources ▪ Energy efficient engine replacement in facilities that can benefit from finance

Implementation Period	Medium
Estimated Cost	High
Emission Reduction Potential	High
Investors	Individual industrial enterprises, DCoI, OIZs
Stakeholders	DCoI, DMM, PDoIT, PDoEU, OIZs, individual industrial enterprises
Risks	▪ Industrial organizations' resistance to change of engine ▪ Resistance due to interruption of production during change ▪ Resisting data sharing and cooperation with each other

Action I1.2: Re-use of semi-finished products in the process and recycling of waste	
Current Status / Purpose	Industrial wastes are more suitable for collection and recycling as they arise at intensive production points. In 2017, 851,6 tons of domestic industrial waste were disposed in landfills Denizli; 7.623 tons were sent to hazardous waste recovery facilities and 2.165 tons of hazardous waste were sent to storage (PDoEU, 2017). In order to reduce emissions from these wastes, facilities need to adopt cleaner production processes and consider in-plant recycling facilities and the possibility of inter-agency cooperation at local, national and international scale. Currently, OIZs do not have management for domestic waste, process waste, packaging waste and hazardous waste (MoIT, 2016). Within the scope of this action, it is aimed to reduce emissions starting from 3 OIZs primarily through reduction of waste, then through reuse and recovery activities, adopting “zero waste” or “waste hierarchy” approaches.
Activities to be Conducted	▪ Development of waste minimization applications within the facility ▪ Examination of the intra-plant and inter-plant processes and mapping semi-finished and finished products ▪ Finding out industrial symbiosis facilities within and between different OIZs in accordance with the maps ▪ Work on waste recycling and waste heat use in areas where industrial symbiosis facilities are not available ▪ Implementation by the industrialists of the best practice as a result of the work carried out
Implementation Period	Medium
Estimated Cost	Medium
Emission Reduction Potential	High
Investors	DMM, individual industrial enterprises, OIZs
Stakeholders	DMM, PDoIT, PDoEU, OIZs, individual industrial enterprises
Risks	▪ Technically incompatible processes ▪ Resistance to invest by industrial enterprises within OIZ and/or individual industrial enterprises

Action I1.3: Establishment of regional / central heating / cooling centres for industrial heating / cooling needs	
Current Status / Purpose	There are 3 OIZs in Denizli. Facilities existing together in OIZs can take advantage of a regional/central heating/cooling system where heating and cooling needs can be met. This opportunity will contribute to the efficient reduction of fuel-based emissions from industrial zones, especially for heating. For example, the waste heat to be used for the plants will be used without increasing the ambient temperature while the energy spent for the heating of the plants will be saved. Waste heat that can be used not only for plants but also for residential heating will meet the need for heating/cooling in households and will significantly reduce domestic emissions
Activities to be Conducted	▪ Informing the OIZs and households on the subject of heating/cooling and then making the needs/potential analysis ▪ Determination of waste heat potential originating from industry (mainly OIZs) and electricity generation facilities ▪ Appropriate design and implementation of the project
Implementation Period	Long
Estimated Cost	High
Emission Reduction Potential	High
Investors	individual industrial enterprises, OIZs, DMM
Stakeholders	Individual industrial enterprises, OIZs, DMM, MoENR, PDoIT, PDoEU
Risks	▪ Negative results of feasibility studies

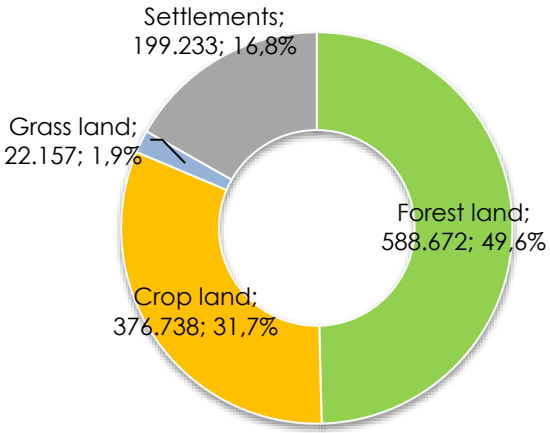
Action I1.4: Reduction of unit/tonne emission of processes	
Current Status / Purpose	The processes, which account for 21% of Denizli's total emissions, account for almost half of industrial emissions with a share of 46,5%. Reducing process emissions will significantly reduce overall industrial emissions. These emissions are mainly due to the glass and cement sectors. Within the scope of this action, it is aimed to reduce the amount of CO_2 emissions per unit from industry. In this context, significant reduction in emissions can be achieved with improvements in the processes. In particular, better techniques for glass and cement production processes will contribute to reducing emissions of the sector.
Activities to be Conducted	▪ Conducting national and international research to determine the best techniques on a sectoral basis to achieve clean production and reduce clinker ratio (literature studies, field visits, surveys, one-on-one interviews) ▪ Implementation of the best techniques determined by taking into consideration national and international cooperation opportunities ▪ Development of incentive systems such as tax exemption for the R&D activities to be carried out in order to provide emission reduction in cases where the best techniques are used in the current situation ▪ Preference of environmentally friendly raw materials and chemicals used in the facility ▪ Encouraging suppliers to choose eco-friendly raw materials and chemicals
Implementation Period	Short
Estimated Cost	Low

Emission Reduction Potential	High
Investors	DCoC, DMM, individual industrial enterprises, OIZs
Stakeholders	Individual industrial enterprises, OIZs, DMM, DCoC, PDoEU, PDoIT, MoENR,
Risks	▪ The best techniques are currently in use ▪ Resistance to investment

6.2.6. AGRICULTURE ANIMAL HUSBANDRY

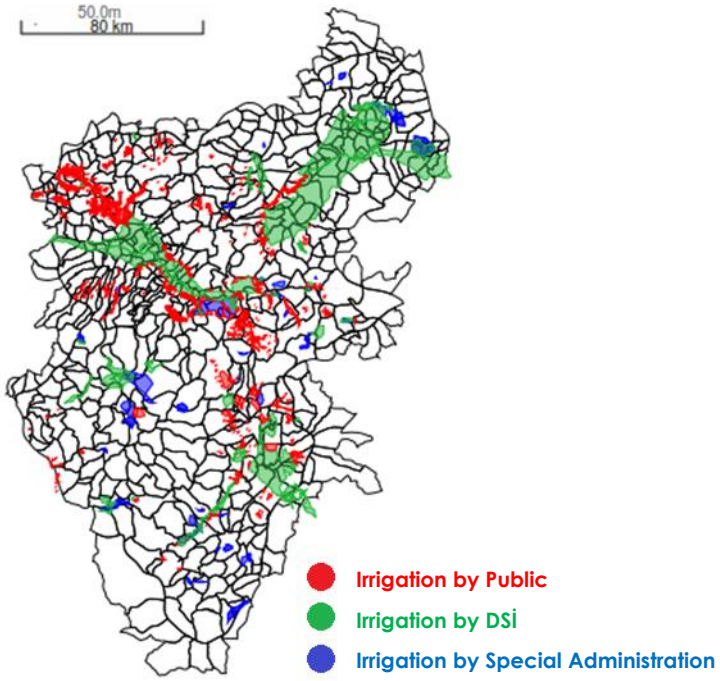
The total land assets of the province of Denizli was reported as 1.186.800 hectares as of 2017 by the Provincial Directorate of Agriculture and Forestry of Denizli and Figure 41 shows the land use The province's forest asset constitutes half of the land use with a share of 49,6%. This is followed by crop land with 31,7%. 80,4% of 376.738 ha of crop land are reserved for field crops, 8,2% for fruit, 8% for vineyard and 3,4% for vegetable. According to the gross production values in 2017, the top ten products were grape, tobacco, cherry, wheat, apple, barley, walnut, sunflower (confectionery), cotton and tomato respectively. The animal population in 2017 in Denizli was reported as 264.095 bovine, 616.815 sheep and 5.280.330 poultry (PDoAF, 2017).

Figure 41 - Land Use Status in Denizli (ha) (PDoAF, 2017)



153.359 hectares (40.7%) were irrigated within the total area of 376.738 ha of the province. The total irrigable area will increase to 194.158 (51,5%) hectares with 40.799 hectares to be opened for irrigation. Of the total irrigation, 96.617 hectares are carried out by DSI, 36.838 hectares by the Special Provincial Administration, and 19.904 hectares by public. While open channel irrigation systems with high water losses were preferred in the areas opened to irrigation in previous years, closed irrigation systems have been encouraged and supported in recent years (PDoAF, 2017).

Figure 42 - Map of Irrigated Land in Denizli (TOİM, 2017)



Although the environmental impact of land use in Denizli is important, its contribution to climate change is very limited. According to the GHG inventory results, land-use-related emissions correspond to 1,2% of total emissions, mainly from agricultural and livestock-related emissions.

1 objective and 3 actions were determined for the agriculture and animal husbandry sector within the framework of Denizli CCAP. Actions set under each objective and activities to be carried out to implement these actions are presented with details below.

Objectives
Objective A1: Improvement of agricultural and animal husbandry processes

Objective A1: Improvement of agricultural and animal husbandry processes	
Target: Reducing emissions from land-use by managing agriculture and livestock activities in a more sustainable way	**Stakeholders:** MoAF, DSI, RDoF, RDoM, Governorate of Denizli, DMM, DESKI, PDoEU, district municipalities, PDoAF, district governorates, agricultural cooperatives, agricultural chambers, land owners/farmers
Action A1.1: Increasing efficiency by reducing fossil fuel consumption through land consolidation	
Action A1.2: Preventing drought through efficiency practices	
Action A1.3: Reducing the use of chemical fertilizers and pesticides	

Action A1.1: Increasing efficiency by reducing fossil fuel consumption through land consolidation	
Current Status / Purpose	The land consolidation was carried out on 75.415 ha of land corresponding to 20% of the total agricultural area of 376.738 ha. When the ongoing land consolidation and in-field development services are completed, 53% of the total agricultural areas (200.065 ha) will have been consolidated. It is aimed with increasing consolidation efforts to produce a more economical and efficient production by combining scattered and multi-piece farmland. On the other hand, a total of 278 cooperatives (192 Agricultural Development, 83 Irrigation and 3 Aquaculture Co-operatives) are active in the province. The number of farmers in the cooperatives is 41.788 (PDoAF, 2017).
Activities to be Conducted	▪ Initiation of these works in other agricultural areas which are not subject to consolidation ▪ Supporting cooperative establishment processes
Implementation Period	Medium
Estimated Cost	Medium-High
Emission Reduction Potential	Medium
Investors	TOM, DSI, Governorate of Denizli, DMM, district municipalities
Stakeholders	TOM, DSI, Governorate of Denizli, DMM, district municipalities, PDoAF, agricultural cooperatives, agricultural chambers, land owners/farmers
Risks	▪ Opposition of landowners / farmers

Action A1.2: Preventing drought through efficiency practices	
Current Status / Purpose	While irrigation systems were open ditches in the areas opened to irrigation in previous years, closed irrigation systems have been encouraged and supported by abandoning these systems with high water losses in recent years. 7036 producers in the province use pressurized irrigation methods in 265 neighbourhoods. 130.756 da of the pressurized irrigation areas are irrigated by dripping, 43.818 da is sprinkling and 5.181 is dripping + sprinkling method (PDoAF, 2017). With the extension of efforts to all irrigation systems, it is aimed to optimize water use and therefore to reduce the related emissions.
Activities to be Conducted	▪ Gradual conversion of open ditch irrigation systems into a closed system ▪ Providing farmers with incentives and trainings for pressurized irrigation ▪ Preventing stubble burning thus avoiding fires and loss of the beneficial living creatures in the field ▪ Reducing neglect of summer fallow
Implementation Period	Long
Estimated Cost	Medium
Emission Reduction Potential	Medium
Investors	DSI, TOM, RDoF, PDoEU

Stakeholders	DSI, TOM, RDoF, PDoEU, RDoM, DMM, DESKI, Governorate of Denizli, district municipalities
Risks	▪ Producer who does not wish to switch to pressurized irrigation thinking that he will spend less money for fixed irrigation

Action A1.3: Reducing the use of chemical fertilizers and pesticides	
Current Status / Purpose	In 2017, a total of 149.177 tons of chemical fertilizers and 1.156.026 tons of agricultural pesticides (97.956 tons of nitrogen) were used for agricultural activities in Denizli (PDoEU, 2017). On the other hand, 1.286.128 tons of animal manure were produced in the same year (PDoAF, 2017). By applying activities under this action, it is aimed to reduce the use of nitrogen based chemical fertilizers and thus the related greenhouse gas emissions.
Activities to be Conducted	▪ Increasing the use of animal manure to substitute chemical fertilizer ▪ Providing incentives and trainings to reduce the use of chemical fertilizers and pesticides ▪ Introduction of sustainable agriculture (permaculture) practices throughout the province ▪ Prevention of the use of non-prescription pesticides
Implementation Period	Medium
Estimated Cost	Low
Emission Reduction Potential	Medium
Investors	TOM, agricultural cooperatives, landowners/farmers
Stakeholders	TOM, DMM, PDoEU, district municipalities, PDoAF, district governorates, agricultural cooperatives, agricultural chambers, land owners/farmers
Risks	▪ Opposition of chemical fertilizer companies ▪ Resistance of farmers

7. DENIZLI CLIMATE CHANGE ACTION PLAN

In this section, adaptation actions determined in line with the vision of Denizli CCAP are presented.

While determining the compliance actions, the results of the Climate Change Risk Analysis Report summarized in 0Annex 11, the Climate Change Impact Survey of Denizli shown in Annex 9 and two stakeholder workshops are taken into consideration as the basis.

Climate The Denizli Climate Change Risk Analysis prepared within the scope of the project confirms the most important finding for the cities in international and national reports:

- Climate change increases the socio-economic (irregular urbanization, land need, food security, drinking water demand, water demand management, etc.) and environmental (habitat loss, decrease in biodiversity, forest fires etc.) pressures.

The information compiled in the Climate Change Risk Analysis Report is presented in the annexes below.

- Annex 6 - Climate Change Models and Scenarios
- Annex 7 - Past and Present Climatic Impacts
- Annex 8 - Denizli's Climate Projections
- Annex 9 - Climate Change Impact Survey
- Annex 10 - Risk Assessment Framework
- Annex 11 - Results of Climate Change Risk Analysis

The sections referred summarize the current industrial vulnerabilities that increase the risks of climate change in the past and present. The assessments have tried to demonstrate how climate change risks and affectability levels may increase in the future.

The climate projections of different scenarios in Denizli for the risk analysis study were obtained from the data generated on the basis of the basin in the scope of the Project on the Impact of Climate Change on Water Resources of the General Directorate of Water Management of the Ministry of Agriculture and Forestry. HadGEM2-ES model and RCP4.5 and RCP8.5 scenarios were used while obtaining the climate projections of Denizli province. The study took into account the results of Buyuk Menderes basin.

Climate change for Denizli; the terms 2015-2044 (short period) and 2045-2074 (distant period) will bring about the following changes in temperature and precipitation regimes:

- Increase in all projections at average temperatures in Denizli;
- Increase in the number of extreme hot days for all periods;
- Increase in the number of heat waves;
- Increase in the intensity of precipitation;
- The variation in precipitation continues throughout the year and reduction in precipitation in summer;

- Increase in drought indicators.

The semi-arid and semi-humid climate of Denizli is expected to change towards the arid climate.

In the light of climate projections of two different scenarios for Denizli, the risks arising from climate change have been tried to be assessed for 2015-2044 (near period) and 2045-2074 (distant period) periods.

Within the scope of the climate change risk analysis, prioritization has been made in the light of the available data, expert opinions and stakeholder meetings and it has been decided to evaluate the following headings:

- Agriculture and Ecosystems;
- Water and Wastewater (Infrastructure);
- Transportation;
- Industry;
- Energy;
- Public health.

Exposure to the risks to occur in the specified sectors should be expected to occur differently in different regions of the city. In addition, it should be kept in mind that the impacts of climate change in the same region will vary according to the socio-economic level and the sensitivity of the affected groups.

It is a fact that nobody is exempt from the impacts of climate change, but that poor groups and individuals with low capacity to fight impacts will be more affected. While assessing the risks, it was shared with stakeholders that climate change is a social problem and social justice approach should be seen as a basic principle in the solution of this problem.

In contrast, in the workshops and surveys conducted, the representation of the disadvantaged and vulnerable groups (agricultural workers with disabilities, women and child labour, elderly and needy people) was not at the desired level. It should be emphasized that there is a need for detailed study in all districts in Denizli.

A fully participatory process has been tried to follow while preparing the Action Plan and all relevant stakeholders have been included in the preparation process. The experiences and recommendations of key stakeholders were transferred to the study through three stakeholder meetings and two stakeholder workshops aimed at adaptation action plan held in Denizli.

Current observations and future projections were presented and the risks for possible impacts were evaluated in the Risk Analysis Workshop, which was the first workshop for adaptation. In the subsequent Adaptation Workshop, adaptation action fiches were created through structured questionnaires for the risks identified in the Risk Analysis Workshop and actions were finalized. A parallel comprehensive literature review was conducted and national and international sources were scanned and the previous studies were benefited from.

In addition to these studies, more than 1200 people participated in Denizli Climate Change Impact Survey, which was prepared to gather the general opinions and experiences of the people living in Denizli. Survey results are presented in Annex 9.

Local governments play a role in providing public services such as water and waste water, health, education, emergency management, social protection, infrastructure repair and maintenance. Although many of the municipalities in Turkey do (could) not relate climate change to these public services, it would be possible to make significant progress in the provision of the adaptability capacity of the communities if they are presented in an efficient and equal manner and especially if the infrastructure and technology preferences are designed with a climate diagram.[33]

The correctly planned time and spatial scale of adaptation actions, the financing and the technical capacity of the region/city to which the actions will be implemented, and the political ownership are the determining factors of an impactive adaptation management.

Adaptation plans cover a large number of common/overlapping areas and require support and input from other units and organizations. It is critical that adaptation actions at city scale should be addressed under the plan for fights against climate change at provincial scale in some cases, on the scale of the basin, of investments for public housing, roads and railway, electricity generation, health services, disaster management, dam for irrigation, flood and drought prevention investments, where Metropolitan Municipality is out of the area of responsibility.

The implementation of the legally binding plan in the coordination of the Metropolitan Municipality and the institutional structure to be established within the scope of this project will be more impactive.

Adaptation actions should not be understood only the activities that public institutions and local administrations should implement. Despite the critical role of these structures using public resources, the interest of citizens and local initiatives on the issue and the level of influence on decisions are prerequisites for successful adaptation actions.

7.1. OBJECTIVES AND ACTIONS

The actions identified within the scope of Denizli CCAP were grouped in 6 action areas in accordance with the sectors monitored in Risk Analysis:

- Agriculture and Ecosystems;
- Water and Wastewater (Infrastructure);
- Transportation;
- Industry;
- Energy;
- Public health.

[33] https://base-adaptation.eu/sites/default/files/306-guidelinesversionefinale20.pdf

A total of 36 actions have been created for the above 6 action areas. In this section, climate change related risks which need to be solved through adaptation actions, the degree of importance of the relevant adaptation action, implementation period, estimated costs, the responsible stakeholders and the difficulties that can be experienced in the implementation are presented through action fiches.

Considering the seriousness of risks, the high cost of some adaptation options and limited resources, it is necessary to prioritize the adaptation actions at the provincial level. High-risk impacts were considered as priorities when determining adaptation actions.

It should not be considered that the adaptation actions in the CCAP include all the adaptation actions necessary for Denizli. Apart from these actions, all stakeholders will have important implementation options they will implement. It will be the responsibility of the relevant stakeholders to strengthen the actions of the CCAP as a result of monitoring and evaluation.

Adaptation actions can be classified under 4 main groups: physical measures (water storage and drainage systems, etc.), technological measures (early warning systems and hazard mapping), public service measures (emergency health services, water and waste water treatment etc.) and social measures (awareness raising and training programs or behavioural changes) .

The following table shows the application period, and the levels set for the estimated costs in action fiches.

Table 20 - Descriptions of Levelling in Action Fiches

Implementation Period	Estimated Costs
Short: Up to 3 years (2019-2021)	Low: <5 million TL
Medium: Up to 7 years (2019-2025)	Medium: 5 million -100 million TL
Long: Longer than 7 years (2019-2030)	High: >100 million TL

7.1.1. AGRICULTURE AND ECOSYSTEMS

The activities of agriculture, animal husbandry and textile industry, important means of living of the people in Denizli, are directly related to the health of ecosystems, that is their functioning. The short and long term adverse impacts on ecosystems will not only be limited to wetlands or forests, but will also affect agricultural products, food and water supply, industrial production, human and environmental health sectors.

Agricultural areas and green areas discussed in this section are classified as semi-natural and artificial ecosystems and have been accepted as part of existing ecosystems. For this reason, adaptation actions for agricultural areas, green areas and natural ecosystems are discussed in the same chapter.

Records regarding impact of meteorological events such as drought, hail, excessive flood and wind etc. on the agricultural sector are presented in ANNEX 7. The impacts of climate change on agriculture and livestock sectors are known to affect particularly groups in rural areas, which have low combat capacity and which are economically vulnerable. The crops affected by the overheating, the decrease in the irrigation water quality, the water prices expected to increase along with the drought and the excessive dependence on irrigation will be the main areas of difficulty.

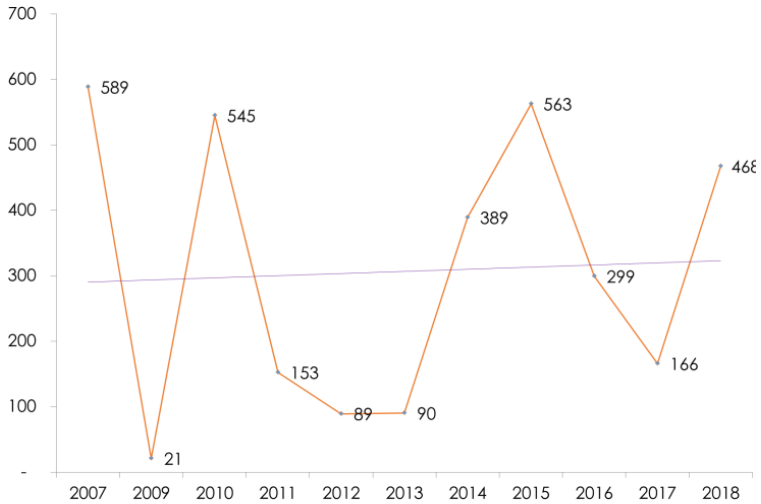
Agricultural sector is the most important economic activity in rural areas. The agricultural lands in Tavas, Civril, Acıpayam, Cal and Pamukkale districts account for almost 60% of all agricultural lands. While 153.359 hectares (40,7%) of the total 376.738 hectares of the province are irrigated, the total irrigable area with 40.799 hectares to be irrigated will increase to 194.158 (51,5%) hectares. This increase will raise the issue of prioritization of access to water between different sectors with the impacts of climate change that will be felt in the near future.

According to the data provided by Denizli Provincial Directorate of Agriculture and Forestry, a total of 337.200 hectares of land were affected in 2009-2018 period (except for 2008) and damages amounted to 354 million TL. The floods in Buldan, Acıpayam and Tavas account for more than half of all affected agricultural land and approximately 70% of all damage occurred in 2018. The areas affected by drought are about 12% and corresponds to 5% of total damage.

For 2018, **34%** of total damage (119.5 million TL) was caused by floods and droughts affecting agricultural areas in Denizli. When the losses in this year are examined by the affected products, the losses in the Vineyard products constitute approximately 31% of the loss.

Figure 43 - Agricultural area size affected by disasters in 2009-2018 period (km^2)

(Compiled from Denizli Provincial Directorate of Agriculture and Forestry.)



Legal and illegal discharges from the sources (which cannot provide treatment at desirable level) of domestic and industrial wastewater, leachate, vegetation water and geothermal waters to the Büyük Menderes Basin is a direct threat to the health of ecosystems. It was reported that small textile enterprises in Denizli could not operate the treatment plants very well. The geothermal waters, which are used for both tourism and energy production, reach the Büyük Menderes River causing thermal pollution, salinity and boron pollution problems. Apart from these point sources, wastewaters from non-point sources such as agriculture (artificial fertilizers and pesticide use), leaky septic tanks and fugitive discharges, irregular solid waste storage and mine sites pollute surface waters (creek, lake, dam lake) as well as groundwater.

Surface ecosystems and forest ecosystems have a special place in the ecosystems throughout Denizli. The Büyük Menderes Basin Management Plan sets out the risk status and protection measures of surface and underground water bodies in the Büyük Menderes Basin, which includes a large part of the territory of Denizli.[34,35] Apart from these reports, the West Mediterranean and Burdur Basin Protection Action Plans summarize the current situation and the measures to be taken in the relevant basins.

Figure 44 - Risk Assessment of Büyük Menderes Basin Surface water bodies

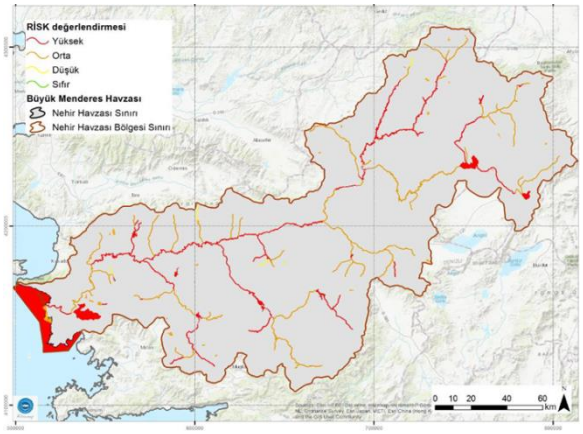
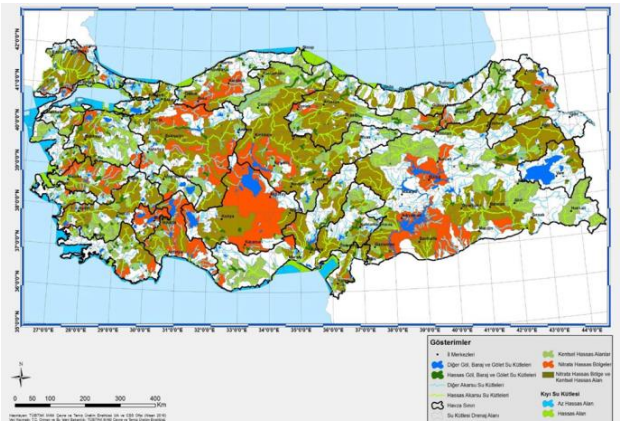


Figure 45 - Vulnerable Waters in Turkey, Urban and Nitrate Vulnerable Areas, Vulnerable Areas Map



[34] Technical Assistance for Conversion of Basin Protection Action Plans to River Basin Management Plans - Büyük Menderes River Basin Management Plan
URL:https://www.tarimorman.gov.tr/SYGM/Belgeler/Nehir%20havza%20Y%C3%96NET%C4%B0M%20Planlar%C4%B1/B%C3%9CY%C3%9CK%20MENDERES%20NEH%C4%B0R%20HAVZA%20Y%C3%96NET%C4%B0M%20PLANI.pdf

[35] Annexes to Büyük Menderes Basin Management Plans
URL:https://www.tarimorman.gov.tr/SYGM/Belgeler/Nehir%20havza%20Y%C3%96NET%C4%B0M%20Planlar%C4%B1/EK-1_%C4%B0LG%C4%B0L%C4%B0%20B%C3%96L%C3%9CMLER%20(BM).pdf

Denizli shows the characteristics of the phytogeographic regions of Mediterranean, Europe-Siberia and Iran-Turan. The province of Denizli, which has different climate zones and ecosystems, is rich in biodiversity.

Changes in temperature and precipitation regimes in Denizli province may cause changes in the phenological activities (periodic biological events such as flowering, migration, reproduction) of plants and animals in the region. These changes are expected to negatively affect important criteria such as finding food, finding a mate, and the success of survival of the offspring.[36]

Scientific data show that protected areas are an indispensable part of global struggle with climate change. Protected areas are the most important tool for the active protection of vulnerable ecosystems and species with limited distribution and habitat. The management plans of the areas under the responsibility of the General Directorate of Nature Conservation and National Parks from protected areas located in Denizli also identify the strategies and activities by examining the risks and pressures on ecosystems and biodiversity values. Existing management plans do not include measures for adaptation to climate change directly:

- Akdag Natural Park Development Revision Plan (2017)
- Denizli Çardak Beylerli Lake Wildlife Development Area Management and Development Plan (2018)
- Honaz Mountain National Park Long Term Development Plan 2009
- Acıgöl Wetland Management Plan (2016)
- Afyonkarahisar - Denizli Akdag Wildlife Development Site Management and Development Plan (2012)
- Revised Management Plan of Isikli and Gökgöl Wetland (2019-2023)

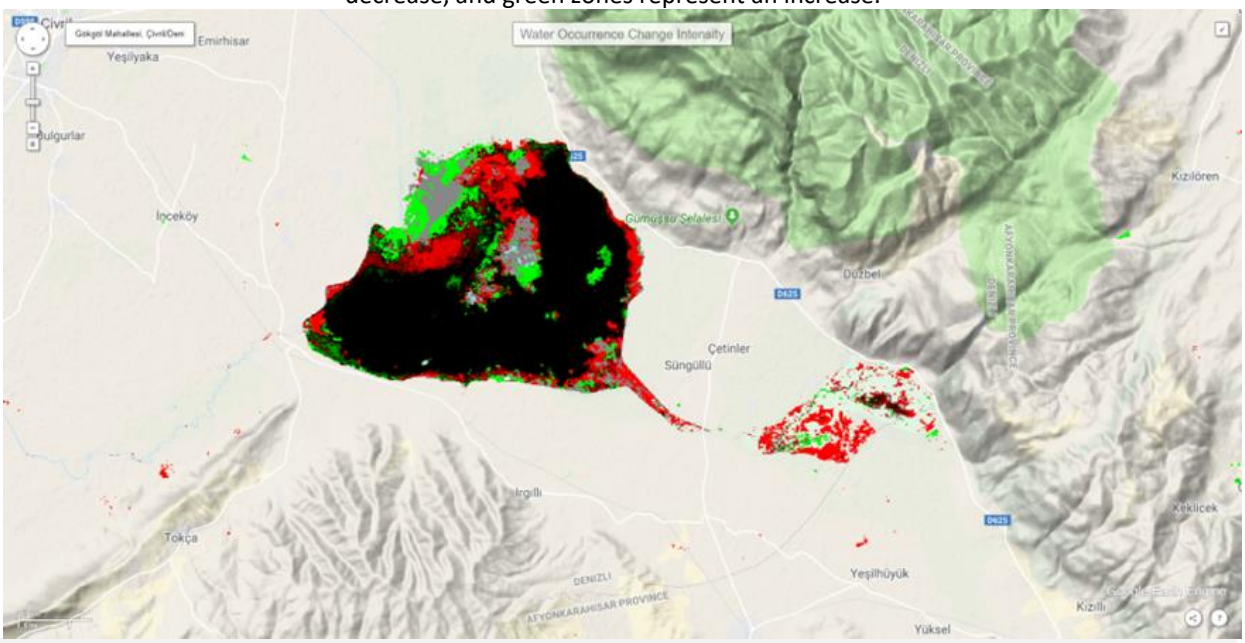
Among the most important adverse impacts on protected areas are the transformation of important habitats into agricultural and industrial areas, fire hazards, depleting water resources (wild irrigation, overgrazing, energy and industrial plants, salt production facilities), uncontrolled discharges of solid wastes and wastewater. Risks and pressures concerning protected areas are likely to increase with the impacts of climate change.

It has been reported that the amount of water has decreased in Acıgöl and Işıklı Wetlands. In Işıklı and Gökgöl Wetland, the drawing of too much water for the purpose of irrigation in the summer months leads to the living things with low tolerance move away from the environment and decrease in the diversity of species.[37]

[36] Çağatay Tavşanoğlu, 2018 Effects of climate change on ecosystems and research requirements URL:http://yunus.hacettepe.edu.tr/~ctavsan/papers/Tav%C5%9Fano%C4%9Flu_2018_iklimdegisikli%C4%9Fi_bilimutopya.pdf

[37] Seasonal Change of Macrobenthic Fauna In Isikli Lake (Denizli)

Isikli Lake and Gökgöl Wetland
The change of the water resources between the periods 1984-1989 and 2000-2015. Red zones indicate a decrease, and green zones represent an increase.

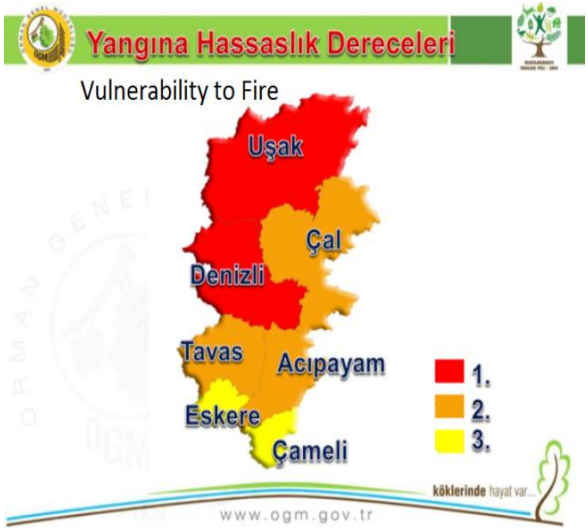


The areas under the responsibility of the Ministry of Environment and Urbanization General Directorate of Natural Assets, the other nature conservation institution in the province, are listed below.

Table 21 - Areas under the responsibility of the General Directorate of Natural Resources of the Ministry of Environment and Urbanization

Pamukkale Special Environmental Protection Area and Pamukkale (Hierapolis) - Pamukkale/Denizli (Grade 1, 2 and 3)	Keloğlan Cave Acıpayam / Denizli (Grade 2)
Yayla Lake (Buldan/Denizli (Grade 2 and 3)	Natural Cave (Cal/Denizli (Grade 2)
Güney Waterfall Güney / Denizli (Grade 2)	Kamara Travertine - Buldan/Denizli (Grade 1 and 3)
Honaz Mountain National Park - Honaz, Pamukkale, Serinhisar, Tavas / Denizli (Grade 2 and 3)	Karahayıt Red Water Travertines - Pamukkale/Denizli (Grade 2)
Kaklik Cave - Honaz / Denizli (2nd degree)	Lake Kartal - Beyağaç / Denizli (1st Degree)
Kizilhisar Cave - Serinhisar / Denizli (Grade 2)	Servergazi Türbesi - Merkezefendi /Denizli (Grade1)
Beyinli Cave - Pamukkale / Denizli (Grade 2)	

Apart from the natural sites above, Karahayit Red Water Pool - Pamukkale / Denizli (Grade 1, Atalar Mosque and Surroundings - Pamukkale/Denizli (Grade 3) and Çardak Castle and Yamuktepe Settlement - Çardak/Denizli (Grade 1) natural protected areas have been cancelled.[38] "Preparation and Implementation of Pamukkale Special Environmental Protection Area Management Plan Project" is in progress. Administrative plans concerning natural sites could not be accessed.



Long summer droughts, low relative humidity, desiccant winds, adverse terrain conditions and 775.918 ha of the forest area constituting half of the Red pine, increases the vulnerability to forest fires in the forest area under responsibility of Denizli Regional Directorate of Forests.

Sometimes large areas have been destroyed as a result of forest fires in the region. 78% of these fires have been caused by people. The fact that the calabrine pine forest areas in the altitude of 115-800 m in the region are intertwined with agriculture and settlement areas presents vulnerability in terms of forest fires.[39]

According to the records of Denizli Regional Directorate of Forestry, a total area of 453,14 ha was affected in 2017 in Denizli province and a loss of up to 15 million TL has occurred. Almost all of the fires occurred in the Calabrian Pine stands.

Within the framework of the CCAP, 13 actions were identified under 7 objectives for the agriculture and ecosystems sector. Actions set under each objective and activities to be carried out to implement these actions are presented with details below.

Objectives
Objective A1: Sustaining agricultural productivity
Objective A2: Prevention of soil erosion
Objective A3: Protection of agricultural areas from drought and floods
Objective A4: Reduction of water consumption and improvement of water quality in agricultural irrigation
Objective A5: Making livestock activities resistant to changing climate
Objective A6: Strengthening of other economic sectors in the rural areas with agriculture-based economy
Objective A7: Conservation of biological diversity

[38] https://webdosya.csb.gov.tr/db/denizli/menu/8tvk-sube-dikey_20190122040655.pdf
[39] http://www.cem.gov.tr/erozyon/Files/erozyon/YARDOP_Projeleri/Denizli_YARDOP_Proje_Tanitimi.pptx

Objective A1: Sustaining agricultural productivity	
Target: Increasing agricultural land resistant to climatic impacts	**Stakeholders:** Ministry of Agriculture and Forestry TAGEM (General Directorate of Agricultural Research and Policies), TKDK (Agriculture and Rural Development Support Institution), Universities, Farmers, Chamber of Agricultural Engineers, Chambers of Agriculture, Cooperatives and Associations, DSI
Action A1.1: Plant selection according to water requirement and rotation of crops	
Action A1.2: Training and support of farmers to promote the use of healthy seedlings, seeds and widespread use of domestic seed	

Action A1.1: Plant selection according to water requirement and rotation of crops	
Associated Risk	Reduced agricultural productivity and production due to extreme temperatures
Action Severity Rating:	Primary
Activities to be Conducted	▪ Determination of crop types suitable for climate and water availability in agriculture basins and offering incentives ▪ Establishment of support mechanisms dedicated to climate change adaptation activities ▪ Impact analysis of climate change on important agricultural products in the province ▪ Determination and monitoring of possible changes in agricultural yield, production and area information due to climate change ▪ Guidance for crop growers (farmers) for the development of suitable crop varieties ▪ Improvement of public investments for improving soil quality (increasing organic substance, etc.) ▪ Monitoring changes in soil organic carbon stock and carrying out studies to increase carbon stock ▪ Research on climatic impacts of crops supported under agricultural basin production and support model ▪ Planning and implementation by the Ministry of Agriculture and Forest of the appropriate product pattern to be selected in parallel with the soil structure-climate-food need by considering the local climatic conditions
Implementation Period	Short
Estimated Cost	Low
Institutions to be responsible	Ministry of Agriculture and Forestry
Relevant Stakeholders	Farmers, Chamber of Agricultural Engineers, Chambers of Agriculture, Cooperatives and Associations TAGEM, TKDK, DSI, Universities
Risks	Farmers resistance to choosing new crops, Farmers' insistence on income-generating crops which they are knowledgeable about

Action A1.2: Training and support of farmers to promote the use of healthy seedlings, seeds and widespread use of domestic seed	
Associated Risk	Product losses due to increase in agricultural pests/reduced yield Product loss due to increase in agricultural diseases
Activities to be Conducted	▪ Use of seeds suitable for the structure of the region ▪ Extension of natural fertilizer use ▪ Training and raising awareness of farmers about climate change ▪ Strengthening mechanisms for monitoring plant diseases ▪ Study of the impacts of changing climate in combating agricultural diseases and pests
Action Severity Rating:	Primary
Implementation Period	Long
Estimated Cost	Medium
Institutions to be responsible	Ministry of Agriculture and Forestry
Relevant Stakeholders	Farmers, Chamber of Agricultural Engineers, Chambers of Agriculture, Cooperatives and Associations TAGEM, TKDK, Denizli Metropolitan Municipality Department Rural Services, Universities
Risks	Lack of appropriate legislation

Objective A2: Prevention of soil erosion	
Target: Reducing the amount of eroded areas	**Stakeholders:** Ministry of Agriculture and Forestry, General Directorate of Combating Desertification and Erosion, General Directorate of Forestry, Farmers, Chamber of Agricultural Engineers, Chambers of Agriculture, Cooperatives and Associations TAGEM, TKDK, Universities
Action A2.1: Changing ploughing technique, terracing and afforestation works	

Action A2.1: Changing ploughing technique, terracing and afforestation works	
Associated Risk	Increased soil erosion due to excessive precipitation
Action Severity Rating:	Primary
Activities to be Conducted	▪ Updating the current erosion risk map ▪ Afforestation, improvement of degraded forest lands, erosion control and increasing pasture improvement

	■ Revision of the Afforestation Cooperation Protocol signed between DSI and OGM within the framework of climatic impacts ■ Surface erosion prevention techniques: ■ Increasing activities of terracing, weed strip cultivation, checked logs, brush terraces, stone walls, mulching and so on ■ Increasing the works of diversion ditches, drainage channels, dry wall thresholds, live living threshold, live bush threshold, trellis wire threshold, mix thresholds and mortar levees ■ Completion of grazing plans ■ Farmers' awareness raising about stubble fires ■ Increasing the support mechanisms for sustainable land management and climate friendly agricultural projects ■ Paying attention to the impacts of climate change on the criteria for the determination of erosion risk areas in the construction of forest management plans and silviculture practices ■ In-service training in combating erosion and desertification in local public institutions ■ Strengthening green spaces and forests around cities without damaging existing ecosystems ■ Implementation of afforestation, erosion and sediment control measures for vulnerable water bodies
Implementation Period	Short
Estimated Cost	Low
Institutions to be responsible	Ministry of Agriculture and Forestry, General Directorate of Combating Desertification and Erosion (GDoCDE), General Directorate of Forestry (GDoF),
Relevant Stakeholders	Farmers, Chamber of Agricultural Engineers, Chambers of Agriculture, Cooperatives and Associations TAGEM, TKDK, Universities
Risks	False afforestation methods in the fight against erosion

Objective A3: Protection of agricultural areas from drought and floods	
Target: Reducing areas affected by agricultural drought	**Stakeholders:** Ministry of Agriculture and Forestry, DSI, GDoF, GDoM, DSI, DESKI, Agricultural Chambers, Irrigation Unions, Farmers, TAGEM, TKDK, Cooperatives, Universities
Action A3.1: Implementation of technical and institutional measures in the fight against agricultural drought	
Action A3.2: Preservation of the natural form of Büyük Menderes river through reclamation canal works	

Action A3.1: Implementation of technical and institutional measures in the fight against agricultural drought	
Associated Risk	Inundation of fertile agricultural land as a result of floods Losses in intensive greenhouse areas due to sudden and extreme precipitation (hails etc.)
Activities to be Conducted	■ Establishment of drought monitoring and communication systems throughout the province ■ Extension of forecast and early warning systems across the province

	▪ Harmonization of drought and hydration plans ▪ Completion of the strategy and action plan for combating agricultural drought in Denizli province ▪ Procurement of financial instruments for drought risk management ▪ Review of existing strategies and action plans and regulations in terms of adaptation to climate change in the fight against drought ▪ Creating pasture management plans for dry periods ▪ Determination and monitoring of possible changes in agricultural yield, production and area information due to climate change ▪ Inclusion of agricultural drought in disaster management works and conducting necessary analyses ▪ Strengthening the capacity of the provincial drought crisis centre and preparing crisis management plans ▪ Providing trainings to woman farmers on agricultural production techniques to adapt to the impacts of climate change and/or including them in existing training activities ▪ Raising awareness and capacity of unions and cooperatives on adaptation to the impacts of climate change ▪ Raising awareness of Provincial / District Drought Damage Detection Committees, Provincial Crisis Centres and Provincial Droughts Review Committees on adaptation to the impacts of climate change ▪ Increasing the access to early warning and climate information
Action Severity Rating:	Primary
Implementation Period	Short
Estimated Cost	Medium
Institutions to be responsible	Ministry of Agriculture and Forestry, DSI, DGoF, DGoM
Relevant Stakeholders	MoAF, DSI, DESKI, Agricultural Chambers, Irrigation Unions, Farmers, TAGEM, TKDK, Cooperatives, Universities
Risks	Water storage investments encouraging more water consumption

Action A3.2: Preservation of the natural form of Büyük Menderes river through reclamation canal works	
Associated Risk	Inundation of fertile agricultural land as a result of floods Losses in intensive greenhouse areas due to sudden and extreme precipitation such as hails etc.
Activities to be Conducted	▪ Develop land use policies to reduce flood risk ▪ Improving harmony of dikes dams ▪ Extension of forecast and early warning systems ▪ Prioritizing land consolidation practices with the support of local people in flood risk areas ▪ Building existing capacity for early warning systems of flood and drought
Action Severity Rating:	Primary

Implementation Period	Short
Estimated Cost	Medium
Institutions to be responsible	Ministry of Agriculture and Forestry, DSI, DGoF, DGoM
Relevant Stakeholders	MoAF, DSI, DESKI, Agricultural Chambers, Irrigation Unions, Farmers, TAGEM, TKDK, Cooperatives, Universities
Risks	Failure to allocate sufficient budget, damage caused by new structures to ecosystems

Objective A4: Reduction of water consumption and improvement of water quality in agricultural irrigation	
Target: Reducing the amount of water used in agricultural irrigation with the technical and institutional measures to be implemented	**Stakeholders:** Ministry of Agriculture and Forestry, DSI, GDoF, GDoM, DSI, DESKI, Agricultural Chambers, Irrigation Unions, Farmers, TAGEM, TKDK, Cooperatives, Universities
Action A4.1: Changing irrigation methods and agricultural pattern	
Action A4.2: Increasing storage facilities and improving existing facilities	
Action A4.3: Increasing control of point and non-point pollution	
Action A4.4: Institutional and technical measures to reduce water consumption	

Action A4.1: Changing irrigation methods and agricultural pattern	
Associated Risk	Failure to meet increased demand for water for agricultural irrigation due to increased dry soils
Activities to be Conducted	▪ Assessment of the efficiency of existing irrigation methods ▪ Organizing trainings to make efficient irrigation techniques widespread ▪ Extension of incentives to support irrigation investments with high initial investment cost ▪ Carrying out studies to determine the social and cultural acceptance of the treated wastewater to be used in agricultural irrigation in a controlled manner. ▪ Acceleration of shift to closed circuit system in irrigation ▪ Supporting groundwater irrigation network investments transformed to closed systems ▪ Training and support to farmers on different crop cultivation ▪ Review of strategies and action plans for agricultural products and irrigated agriculture in terms of adaptation to climate change ▪ Studying the use of low quality waters in irrigation ▪ Encouraging pressurized irrigation methods on farms ▪ Transformation of groundwater irrigation projects operated by Irrigation Cooperatives into drip irrigation system ▪ Review of support policies based on water constraint ▪ Completion of water budget works on the basis of basins ▪ Activation of institutional structures in irrigation
Action Severity Rating:	Primary
Implementation Period	Medium

Estimated Cost	High
Institutions to be responsible	Ministry of Agriculture and Forestry, DSI, DGoF, DGoM
Relevant Stakeholders	MoAF, DSI, DESKI, Agricultural Chambers, Irrigation Unions, Farmers, TAGEM, TKDK, Cooperatives, Universities
Risks	Farmer resistance (drip and sprinkler system being considered to have a negative impact on production)

Action A4.2: Increasing storage facilities and improving existing facilities	
Associated Risk	Failure to meet increased demand for water for agricultural irrigation due to increased dry soils
Activities to be Conducted	▪ Increasing reservoirs used in agricultural irrigation ▪ Accumulation of rain water for use as irrigation water ▪ Modernization of water transmission canals ▪ Maintenance and renewal investments of water storage and transmission canals on a timely basis ▪ Improvement of land use techniques to increase water conservation in soil ▪ Rehabilitation of networks in irrigation facilities
Action Severity Rating:	Primary
Implementation Period	Short
Estimated Cost	High
Institutions to be responsible	Ministry of Agriculture and Forestry, DSI, DGoF, DGoM
Relevant Stakeholders	MoAF, DSI, DESKI, Agricultural Chambers, Irrigation Unions, Cooperatives, Universities
Risks	Competition in the use of water between different sectors

Action A4.3: Increasing control of point and non-point pollution	
Associated Risk	The impacts of agricultural and industrial pollution being more impactive with decreasing amount of water in water resources
Activities to be Conducted	▪ Reducing the use of chemical fertilizers and concentrating on such applications as organic agriculture and permaculture ▪ Prevention of fugitive discharges
Action Severity Rating:	Primary
Implementation Period	Medium
Estimated Cost	High
Institutions to be responsible	Ministry of Agriculture and Forestry, DESKI, Ministry of Environment and Urbanization,

Relevant Stakeholders	Industrial operators, Chambers of Agriculture, Farmers, Universities
Risks	Failure to full implementation and lack of legislation

Action A4.4: Institutional and technical measures to reduce water consumption	
Associated Risk	Reduced surface and groundwater due to increased temperature and drought
Action Severity Rating:	Primary
Activities to be Conducted	▪ Control of urbanization and prevention of illegal drilling ▪ Increasing the green areas in the cities and xeriscaping ▪ Review of industrial and agricultural irrigation fees
Implementation Period	Short
Estimated Cost	Low
Institutions to be responsible	DSI, Municipalities, DESKI
Relevant Stakeholders	GEKA, Mukhtars (Ministry of Interior)
Risks	

Objective A5: Making livestock activities resistant to changing climate	
Target: Preventing damage to animal husbandry from extreme climate events	**Stakeholders:** Ministry of Agriculture and Forestry Farmers, Chambers of Agriculture, TAGEM, TKDK, Cooperatives
Action T5.1: Locally appropriate animal husbandry	

Action A5.1: Locally appropriate animal husbandry	
Associated Risk	Reduction in animal husbandry efficiency due to temperature stress (reduction in reproductive efficiency, increased deaths) Reduced production of dairy products from farm animals due to temperature stress
Activities to be Conducted	▪ Ensuring efficient information transfer on livestock, animal feeding and animal health ▪ Introduction and promotion of animal husbandry and livestock management measures ▪ Conducting R&D studies to determine and monitor the impacts of climate change on cattle and ovine breeding
Action Severity Rating:	Primary
Implementation Period	Medium
Estimated Cost	Medium
Institutions to be responsible	Ministry of Agriculture and Forestry

Relevant Stakeholders	Farmers, Chambers of Agriculture, TAGEM, TKDK, Cooperatives
Risks	

Objective A6: Strengthening of other economic sectors in the rural areas with agriculture-based economy	
Target: Protection of employment in rural areas	**Stakeholders:** All public institutions and organizations GEKA, TKDK, KOSGEB
Action A6.1: Improving economic diversity in rural areas, improving superstructure and infrastructure and social structure	

Action A6.1: Improving economic diversity in rural areas, improving superstructure and infrastructure and social structure	
Associated Risk	Migration from other districts in the province and rural areas to the city centre Reduced agricultural employment
Action Severity Rating:	Primary
Activities to be Conducted	▪ Strengthening agricultural and rural development supports ▪ Increasing social facilities and educational institutions in rural areas ▪ Increasing the diversity of income sources of forest villagers ▪ Determining as a priority the economic, social and environmental impacts in the regions that will be more affected by agricultural drought due to climate change
Implementation Period	Long
Estimated Cost	Medium
Institutions to be responsible	All public institutions and organizations
Relevant Stakeholders	GEKA, TKDK, KOSGEB
Risks	

Objective A7: Conservation of biological diversity	
Target: Reducing the impact of changing climatic conditions on ecosystems and organisms	**Stakeholders:** Ministry of Agriculture and Forestry Directorate General for Nature Conservation and National Parks, Ministry of Environment and Urbanization Directorate General for Preservation of Natural Heritage, Managers of protected areas, relevant NGOs
Action A7.1: To include climate change adaptation measures in the planning, management and implementation of protected areas	
Action A7.2: Biological control (fauna production), fight against invasive species and prevention of hunting	

Action A7.1: To include climate change adaptation measures in the planning, management and implementation of protected areas	
Associated Risk	Decreased living organisms in forest ecosystems Increase in forest pests and invasive species Reduction of living organisms in aquatic ecosystems and increase in invasive species
Action Severity Rating:	Primary
Activities to be Conducted	■ Review of the status of existing protected natural areas ■ Revising existing management plans according to climate change ■ Carrying out studies to determine the impacts of climate change in the context of different ecosystems and developing decision support systems ■ Providing training on the importance of protection of forests in climate change ■ Adaptation of biodiversity and forestry policies to climate change ■ Maintenance and restoration of wetlands and peatlands ■ Ensuring the addition of climate models to the plans with sample applications in the process of preparing sectoral plans such as forest management and wetlands ■ Inclusion of climate change in the works on determining priority areas for nature protection ■ Preparing climate change adaptation plans in protected areas ■ Continuous and regular monitoring of climate change parameters in protected areas ■ Revising existing management plans according to climate change ■ Determination of the impacts of irrigation water and industrial use water on vulnerable ecosystems ■ Regulation of natural flows of streams without destroying natural ecosystems (Increasing Green Infrastructure application examples) ■ Monitoring water usage in grazing and agriculture according to wetland management plans ■ Making interviews and protocols with DSI for the provision of water from dams to lakes and wetlands ■ Implementation of monitoring programs for steppe and scrub ecosystems ■ Organizing workshops on climate change and protected area planning ■ Organizing workshops on the main ecosystems (forests, steppes, wetlands, sea and coasts etc.) and the impacts of climate change and measures to be taken ■ Preparing strategies at the provincial level for adaptation to climate change for protected areas ■ Determining the socio-economic impacts of climate change on forest villagers ■ Preparing guidance documents for the consideration of the impacts of climate change in ecosystem evaluation studies
Implementation Period	Medium
Estimated Cost	Medium
Institutions to be responsible	Ministry of Agriculture and Forestry Directorate General for Nature Conservation and National Parks, Ministry of Environment and Urbanization Directorate General for Preservation of Natural Heritage

Relevant Stakeholders	Managers of protected areas, relevant NGOs
Risks	

Action A7.2: Biological control (fauna production), fight against invasive species and prevention of hunting	
Associated Risk	Increase in forest pests and invasive species Reduction of living organisms in aquatic ecosystems and increase in invasive species Decreased living organisms in forest ecosystems
Action Severity Rating:	Primary
Activities to be Conducted	▪ To ensure the necessary infrastructure for the long-term ecological monitoring systems be established in protected areas ▪ To identify and monitor the impacts of climate change on forestry activities, forest ecosystem and species
Implementation Period	Medium
Estimated Cost	Medium
Institutions to be responsible	Ministry of Agriculture and Forestry Directorate General for Nature Conservation and National Parks, Ministry of Environment and Urbanization Directorate General for Preservation of Natural Heritage
Relevant Stakeholders	Managers of protected areas, relevant NGOs
Risks	

7.1.2. WATER AND WASTEWATER SERVICES

Water and wastewater services are identified as a fragile sector which will be affected by climate change. The amount and quality of underground and surface waters and their dependent ecosystems are expected to be affected due to the negative impacts of climate change. Adaptation actions affecting water ecosystems are presented in this section as well as in the “Agriculture and Ecosystems” section. In this section, adaptation measures for the risks to be faced by critical infrastructures in water and waste water services are discussed.

Sudden urban floods caused by heavy rainfall, river floods in Denizli province, decrease in snowfall and decrease in water resources due to drought are considered as main hazards. Information on the floods, urban floods, drought and heat waves experienced in the province of Denizli are presented in 0.

The current and future impacts are expected to be felt severely due to population density, intensive urbanization (increase of impermeable surfaces) and water intensive industrial and agricultural production.

According to DESKI data, 55.767.679 m3 water was accrued to 462.699 active subscribers in 2017. The loss/leakage rate is estimated to be over 40%. 60% of current consumption was realized in Pamukkale and Merkezefendi districts. DESKİ applies graded tariff in water costs for residents and workplaces. Water costs are lower than other metropolitan municipalities (Izmir, Manisa, Aydin and Antalya) in the region.

When the breakdown of the amount of water supplied by DESKI by the sources of water to be distributed by the drinking and utility water network is examined, 40% of the water is supplied by emerging natural water sources and 60% of it is supplied to the network by obtaining it from the deep wells that are opened in the required regions of the city.

According to the Denizli Environmental Status Report (2017), total water consumption in drinking water, domestic and industrial use in 2017 is approximately 76.000.000 m^3.

According to the municipal water statistics given in TURKSTAT 2016, the amount of water drawn by the municipalities to the drinking and utility water network is 84.252.369 m^3. About 60% of this (50.105.518 m^3) was supplied from the resources 40% (34.146.851 m^3) was supplied from wells. The amount of water distributed is 142.585.726 m^3.

The high water use in industry and agriculture in Denizli is another important point of vulnerability. In the province, there are 6 dams (energy, irrigation, drinking water and flood protection) and 14 ponds (14 for irrigation). According to 2015 data of the General Directorate of State Hydraulic Works, a total of 236.562.168 tons of water was allocated to Denizli province, of which 15% was allocated to industry, 19% to irrigation, 27% to irrigation unions and 38% to drinking and potable water sector.[40]

For Denizli province, the low level of wastewater treatment (93% of Denizli population benefits from sewerage service and 55% from Wastewater Treatment Plant (WWTP) service as of the end of 2017).

> *Textile and leather industry which is one of the industries causing industrial pollution is concentrated in Denizli and Uşak. Although there are treatment plants of many industrial facilities in Denizli, these wastewater treatment plants need to be renewed to meet the minimum irrigation water discharge criteria. Other small industrial facilities operating in the provinces in the basin do not have treatment plants or do not operate them efficiently. The most important sector causing water pollution for the province is olive oil processing plants. The fact that the number of facilities is large and that they are scattered make the solution difficult. There is also a lack of treatment plants in organized industrial zones. In most of the settlements along the basin there is a problem of lack of wastewater treatment plants. The boron element, which is found in geothermal waters , at high level, is one of the important sources of pollution in Büyük Menderes River.*[41]

It has been recorded that water resources as well as existing water and wastewater infrastructure have been seriously affected by extreme weather events with the changing climate.

[40] Büyük Menderes River Basin Draft Management Plan SEA Report
[41] Turkey Environmental Problems and Priorities Assessment Report, 2018
URL:https://webdosya.csb.gov.tr/db/ced/icerikler/cevre_sorun_2018-20180702151156.pdf

According to DESKI data, in the period 2015 - 2018 (until November), 1022 “storm water flooding and 1.561 “clogged drain” malfunction calls were made. 80% of these were the calls made by Merkezefendi and Pamukkale districts.

In the same period 8.718 calls were made for “storm drain flooding”. 71% of these calls are from Merkezefendi and Pamukkale districts. In the relevant period, the years 2016 and 2017 were the years when the malfunction calls were more intense.

Figure 46 - DESKI “Storm water Flooding” calls

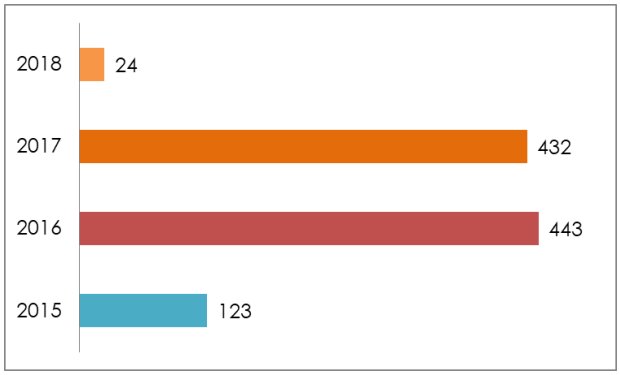
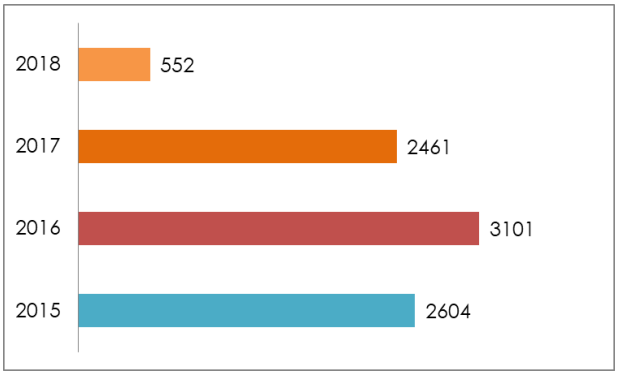


Figure 47 - DESKİ or “Storm Drain Flooding” Calls



Almost 70% of the total 279 damage assessment requests for the period 2015 - 2018 were made in 2016 and more than half of these requests came from Merkezefendi. This is followed by Pamukkale with 32%. According to DESKI data, amounts of damages for 2016, 2017 and 2018 are presented below.

Table 22 - Amounts of damages for 2016, 2017 and 2018 according to DESKI data

Year	Dwellings (TL)	Workplaces (TL)	Vehicles (TL)	Other (TL)
2016	124.762 (79 items)	22.814,44 (8 items)	7.086,5 (4 items)	-
2017	42.709,43 (22 items)	2.650 (1 items)	7.016,2 (4 items)	5.875 (2 items)
2018	105.131 (47 items)	-	-	-

Storm waters and floods in 2018 (as of October 2017) in Denizli according to the data provided by Denizli Metropolitan Municipality Fire Department are given below.

Figure 48 - Denizli Metropolitan Municipality Fire Department Storm waters Data 2018

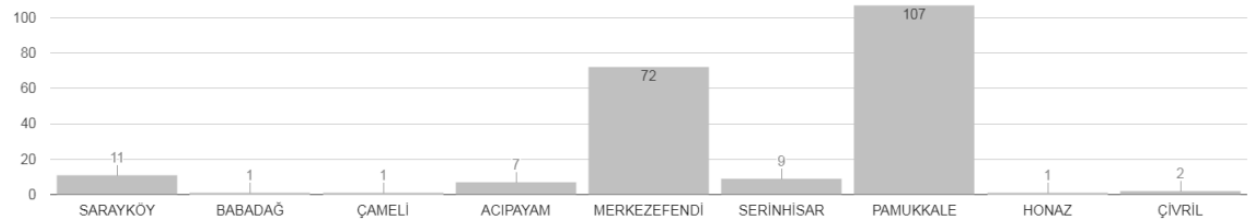
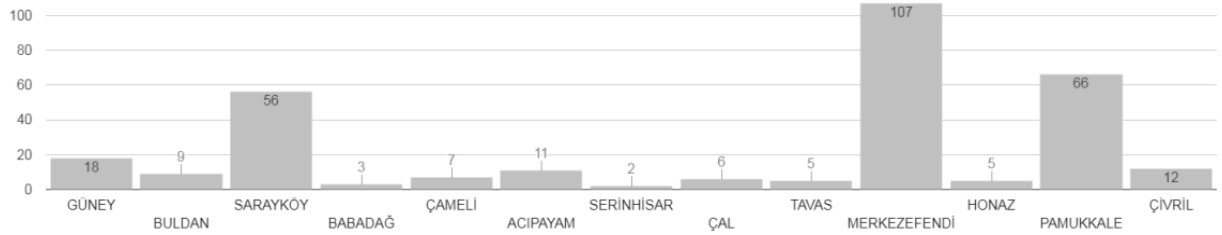


Figure 49 - Denizli Metropolitan Municipality Fire Department Floods Data 2018



The number of rainy days, which is an important factor in the normal operation of wastewater treatment plants of DESKI, is presented in the table below.

Table 23 - DESKI WWT Plants and Number of Rainy Days

Plant	Number of rainy days in 2015	Number of rainy days in 2016	Number of rainy days in 2017
Central WWTP	95	77	91
Bozkurt WWTP	-	25	37
Yesilyuva WWTP	-	20	26
Serinhisar WWTP	-	5	70
Civril WWTP	-	19 (May-December)	67
Gümüşsu WWTP	-	21 (May-December)	65
Akköy WWTP	-	3 (May-December)	32

It was recorded that Yeşilyuva WWTP was flooded on 28.05.2018 and 11.06.2018 due to flood in the canal next to the plant.

Considering the long-term impact and high costs of water and wastewater investments, the design and safety values used in the application will need to be reviewed. The relevant institutions are advised in assessing the costs of investments to go beyond the classical benefit and cost analysis to decide on the social and environmental costs of projects that are resistant to the impacts of climate change.

Floods and sudden stormwaters that may occur due to excessive climate events, impacts on water and wastewater systems and sectoral water supply problems require Denizli Metropolitan Municipality, DESKI, General Directorate of State Hydraulic Works, Ministry of Agriculture and Forestry, AFAD and the Ministry of Environment and Urbanization to implement adaptation measures.

Within the framework of the CCAP, 10 actions were identified under 3 objectives for the water and wastewater sector. Actions identified under each objective and activities to be implemented are presented with details below.

Objectives
Objective W1: To increase the resistance of existing water and sewerage infrastructure
Objective W2: Preventing floods in urban areas
Objective W3: Reduction of water consumption

Objective W1: To increase the resistance of existing water and sewerage infrastructure	
Target: To prevent damage to the infrastructure from extreme climate events with regular maintenance and technological investments	**Stakeholders:** DMM, DESKI, PDoEU, DSI, AYKOME, house owners, site managements, TOKI, construction and infrastructure companies
Action W1.1: Regular maintenance of infrastructure and sewerage systems	
Action W1.2: Increasing the impactiveness of Infrastructure Coordination Centre (AYKOME)	
Action W1.3: Making the canal systems more technological	
Action W1.4: Informing the public about wastewater and rain water	
Action W1.5: Separation of storm water and sewerage infrastructures	
Action W1.6: Revision of infrastructure systems to reduce losses in drinking water networks	

Action W1.1: Regular maintenance of infrastructure and sewerage systems	
Associated Risk	Physical damage to water and sewage systems by excessive rainfall
Action Severity Rating:	Primary
Activities to be Conducted	▪ Determination of the most damaged areas in sudden floods ▪ Increasing the number of regular maintenance of rainwater systems on the square, boulevard, streets and avenues within the boundaries of metropolitan municipality and on all roads and parks under the responsibility of municipalities. ▪ Minimization of permitted and unpermitted stormwater directed to the sewage system ▪ Making impermeable surfaces in open areas permeable by appropriate methods ▪ Providing information for vulnerable urban infrastructures
Implementation Period	Short
Estimated Cost	Low
Institutions to be responsible	DESKI, District municipalities
Relevant Stakeholders	DSI, Citizens, Site Managers
Risks	-

Action W1.2: Increasing the impactiveness of Infrastructure Coordination Centre (AYKOME)	
Associated Risk	Physical damage to water and sewage systems by excessive rainfall
Action Severity Rating:	Primary
Activities to be Conducted	▪ Inclusion of climate-resistant material standards into the standards for materials used by all organizations participating in AYKOME ▪ Increasing the capacity to identify unlicensed excavations ▪ Developing guidelines for AYKOME participants for the climate-friendly design of urban spaces and squares ▪ Implementation of good practice examples on the design of permeable surfaces (to the extent technically possible) in infrastructure works ▪ Determination of inappropriate infrastructures for severe rainfall ▪ Protection of gathering areas for disasters caused by climate change ▪ Preparing pilot projects in the context of adaptation to climate change
Implementation Period	Short
Estimated Cost	Low
Institutions to be responsible	Denizli Metropolitan Municipality, DESKI, Participants of AYKOME
Relevant Stakeholders	District Municipalities, Infrastructure Organizations, AYDEM, ENERYA, DSI
Risks	DESKI project control unit not being recognized by other institutions and lack of cooperation

Action W1.3: Making the canal systems more technological	
Associated Risk	Physical damage to water and sewage systems by excessive rainfall
Action Severity Rating:	Secondary
Activities to be Conducted	▪ Establishment of Wastewater SCADA system
Implementation Period	Long
Estimated Cost	High
Institutions to be responsible	DESKI
Relevant Stakeholders	DESKI, District municipalities
Risks	Increase in water prices

Action W1.4: Informing the public about wastewater and rain water	
Associated Risk	Physical damage to water and sewage systems by excessive rainfall
Action Severity Rating:	Primary
Activities to be Conducted	▪ Conducting awareness-raising activities on rain water management ▪ Saving water by using rain water for various needs ▪ Offering incentives for rain water use in irrigation of green areas etc. in the housing areas. ▪ Information and controls to prevent the mixing of rain water with canal waters
Implementation Period	Short
Estimated Cost	Low
Institutions to be responsible	DESKI, Provincial Directorate of Environment and Urbanization
Relevant Stakeholders	Provincial Directorate of National Education Building Inspection Units, Mukhtars, Public Housing Units of District Municipalities, Denizli Office of Provincial Mufti
Risks	

Action W1.5: Separation of storm water and sewerage infrastructures	
Associated Risk	Physical damage to water and sewage systems by excessive rainfall
Action Severity Rating:	Primary
Activities to be Conducted	▪ Separation of sewerage and rainwater collection systems in residential areas ▪ Extension of rainwater collection systems in district centres
Implementation Period	Long
Estimated Cost	High
Institutions to be responsible	DESKI, Denizli Metropolitan Municipality
Relevant Stakeholders	District Municipalities
Risks	

Action W1.6: Revision of infrastructure systems to reduce losses in drinking water networks	
Associated Risk	Disruption of clean water service in some districts due to drought Disruption of clean water service in the entire province due to drought Severity of Action
Action Severity Rating:	Primary
Activities to be Conducted	▪ Determination and renewal of end-of-life networks ▪ Determination and renewal of networks with high loss/leakage rate ▪ Increasing technical investments in order to prevent physical losses and leakages by keeping the potable water under constant observation in terms of water flow, pressure and water quality

	■ Increasing the detections using physical loss detection devices ■ Replacement of faulty and old meters ■ Establishing standards in combating physical loss and leakage ■ Entering all kinds of manufacturing (drinking water, wastewater, rainwater) performed by DESKI to the geographic information system environment and implementation of legal and technical activities.
Implementation Period	Long
Estimated Cost	High
Institutions to be responsible	DESKI, Denizli Metropolitan Municipality
Relevant Stakeholders	District Municipalities, Citizens
Risks	

Objective W2: Preventing floods in urban areas	
Target: Ensuring protection from floods and stormwaters by technical and institutional measures	**Stakeholders:** DMM, DESKI, DSI, District Municipalities
Action W2.1: Completion of stream improvement without damaging natural ecosystems	
Action W2.2: Preventing filling of developed parts of creeks	
Action W2.3: Determination of the impacts of climate change on the ruins	

Action W2.1: Completion of stream improvement without damaging natural ecosystems	
Associated Risk	Damage to physical structures due to floods in urban areas caused by sudden and excessive rainfall Reduction of water in dams
Action Severity Rating:	Primary
Activities to be Conducted	■ Model green infrastructure applications (green areas, parking areas, etc.) and stream improvement ■ Cleaning of the flood streams completed ■ Cleaning flood protection canal, drains and wastewater line more frequently ■ Extension of storm drain lines ■ Densification of storm drain cleaning activities ■ Adaptation of infrastructures to severe rainfall events ■ Fulfilment of Flood Management Plan activities in West Mediterranean, Burdur and Büyük Menderes and Basins ■ Completion of the structures (sediment-storage dams, check dams, ground sills, etc.) for upstream basin channel improvement in the places identified in the Flood Management Plan being prepared. ■ Building control structures (flood detention dams, dams) that regulate the flow regime of water in the places determined in the Flood Management Plan which is being prepared. ■ Facilities for downstream improvement (stone fortifications, flood walls, levees, derivation channels, etc.) ■ Determination and mapping of vulnerable and critical regions according to different climate change scenarios

Implementation Period	Medium
Estimated Cost	Medium
Institutions to be responsible	DSI, DESKI
Relevant Stakeholders	Denizli Metropolitan Municipality, District Municipalities
Risks	

Action W2.2: Preventing filling of developed parts of creeks	
Associated Risk	Damage to physical structures due to floods in urban areas caused by sudden and excessive rainfall
Action Severity Rating:	Primary
Activities to be Conducted	▪ Determination of inappropriate structures in the neighbourhoods affected by Büyük Menderes Stream and Çürüksu River floodplain ▪ Increasing the permeable surfaces near the flood plain
Implementation Period	Short
Estimated Cost	Low
Institutions to be responsible	Denizli Metropolitan Municipality, District Municipalities
Relevant Stakeholders	DSI, Ministry of Environment and Urbanization
Risks	

Action W2.3: Determination of the impacts of climate change on the ruins	
Associated Risk	Damage of increased floods to historical monuments in ancient regions Damage of excessive heat to historical sites in ancient regions
Action Severity Rating:	Secondary
Activities to be Conducted	▪ Inventory of works sensitive to excessive heat and/or rainfall and determination of measures ▪ Constructing the interception channels to protect the ruins from floods
Implementation Period	Long
Estimated Cost	High
Institutions to be responsible	Regional Committee for the Protection of Cultural Heritage, General Directorate of Natural Heritage
Relevant Stakeholders	DMM, Ministry of Culture and Tourism
Risks	Partial or complete closure of archaeological sites for a temporary period

Objective W3: Reduction of water consumption	
Target: Reducing water consumption per capita in provincial and district centres throughout Denizli province	**Stakeholders:** DESKI, Denizli Metropolitan Municipality, District Municipalities, Ministry of National Education, Citizens, Denizli Provincial Mufti
Action W3.1: Carrying out training and awareness-raising activities related to water saving	

Action W3.1: Carrying out training and awareness-raising activities related to water saving	
Associated Risk	Disruption of clean water service in some districts due to drought Disruption of clean water service in the entire province due to drought Severity of Action
Action Severity Rating:	Primary
Activities to be Conducted	▪ Providing trainings on "Water saving, water use, collection and treatment of wastewater" for kindergarten, primary and secondary school students ▪ Distribution of informative documents on water saving in public transport, schools and places of worship ▪ Determining the vulnerability of groundwater to climate change and sharing it with the public ▪ Offering incentives for rain water use in irrigation of green areas etc. in the housing areas. ▪ Encouraging the use of low-consumption household items
Implementation Period	Short
Estimated Cost	Low
Institutions to be responsible	DESKI, Denizli Metropolitan Municipality, District Municipalities
Relevant Stakeholders	Ministry of National Education, Citizens, Denizli Provincial Mufti
Risks	

7.1.3. TRANSPORTATION

Approximately 60% (677.230.000,00 TL) of the allocation of 970.206.000,00 TL in 2018 budget estimates of Denizli Metropolitan Municipality for the strategic objectives envisaged in the plan, is allocated for the strategic target of the creation of the well-arranged and usable public areas and a safe and fast transportation network in the whole city in line with the evolving needs of Denizli.

The floods caused by excessive heat waves and rainfall affect the road and rail transportation infrastructure, the people and services that use these modes of transportation. These impacts started to be observed both in the city centre and in intercity roads.

The increasing frequency and intensity of precipitation will directly affect road traffic and the delivery of services using these roads. Temporary pooling seen also in Denizli may cause dangerous driving conditions. Temporary pooling as a result of excessive rainfall reduces the life span of roads and

pavements and increases the maintenance costs. Increased frequency and intensity of precipitation may also delay construction times and road repairs. In addition, high temperatures can lead to overheating of the vehicles and damage to the tires. In addition to the failure of the vehicles due to extreme cold weather, there are also impacts due to icing on the bridges and roads.

Denizli Metropolitan Municipality Transportation Master Plan (Draft), which will draw the transportation road map of Denizli, and Denizli Land Use Plan, which will be directly connected with transportation services, contain long-term decisions due to their nature. The level of addressing strategic and technical decisions in these two plans from the perspective of adaptation to the impacts of climate change will also directly affect the success of the fight against climate change risks. Taking into account that the public transport rates in the city centre are not at the desired level and that the road-oriented urban development options are dominant, it is essential to look at the design of the transportation infrastructure and the selection of materials to be used with a climate lens.

Within the framework of the CCAP, 5 actions were identified under 3 objectives for the transportation sector. Actions identified under each objective and activities to be implemented are presented with details below.

Objectives
Objective T1: Preventing excessive rainfall from damaging the railway and road transport network infrastructure
Objective T2: Design of highways in accordance with extreme hot and cold climate conditions
Objective T3: Personnel and vehicles in public transport system on roads are resistant to climate change

Objective T1: Preventing excessive rainfall from damaging the railway and road transport network infrastructure	
Target: Reduction of service interruptions and damage in railway transport as a result of extreme weather events	**Stakeholders:** DMM Ulaşım A.Ş., General Directorate of Highways, TCDD, Ministry of Transport and Infrastructure, AFAD
Action T1: Increasing inspections and maintenance according to meteorological data	
Action T2: Increasing the number of vehicles and personnel employed in responses	

Action T1.1: Increasing inspections and maintenance according to meteorological data	
Associated Risk	Transportation infrastructure damaged by excessive rainfall
Action Severity Rating:	Primary
Activities to be Conducted	▪ Carry out analysis of vulnerability for road and rail networks and related structures for climate change impacts ▪ Establishment of monitoring system for monitoring railway infrastructure and determination of impacts of climate change and monitoring with sufficient number of personnel ▪ Harmonization of drainage of road and rail network against severe rainfall events ▪ Extension of maintenance and controls for impacts of falling trees etc.
Implementation Period	Short
Estimated Cost	Medium

Institutions to be responsible	DMM Ulaşım A.Ş., General Directorate of Highways and General Directorate of Meteorology, TCDD
Relevant Stakeholders	District Municipalities,
Risks	Occurrence of unpredictable natural disasters

Action T1.2: Increasing the number of vehicles and personnel employed in responses	
Associated Risk	Excessive rainfall causes damage to road transportation infrastructure Extreme heat damage to the highway Extreme cold and icing, accident risk and adverse impacts on vehicle traffic Disruption of transportation by landslides due to excessive rainfall and snowstorm Disruption of transportation by closed roads due to excessive snowfall and inaccessible village roads.
Action Severity Rating:	Primary
Activities to be Conducted	▪ Development of early warning systems ▪ Strengthening the technical infrastructure of the response teams in the province
Implementation Period	Medium
Estimated Cost	Medium
Institutions to be responsible	Denizli Metropolitan Municipality, District Municipalities, General Directorate of Highways
Relevant Stakeholders	Fire Department, AFAD, Ministry of Health, General Directorate of Forestry
Risks	Employment, lack of budget

Objective T2: Design of highways in accordance with extreme hot and cold climate conditions	
Target: To prevent damage to the infrastructure from extreme climate events with regular maintenance and technological investments	**Stakeholders:** Ministry of Transport and Infrastructure, DMM Ulaşım A.Ş., General Directorate of Highways
Action U2.1: To use materials suitable for extreme hot and cold climates on highways	

Action T2.1: To use materials suitable for extreme hot and cold climates on highways	
Associated Risk	Excessive rainfall causes damage to road transportation infrastructure Extreme heat damage to the highway Extreme cold and icing, accident risk and adverse impacts on vehicle traffic Disruption of transportation by landslides due to excessive rainfall and snowstorm Disruption of transportation by closed roads due to excessive snowfall and inaccessible village roads.
Action Severity Rating:	Primary
Activities to be Conducted	▪ Make road pavements compatible with climate change ▪ Making roads that are resistant to heavy rainfall and making drains compatible ▪ Studying road materials that are more resistant to rapid changes in hot or cold weather to reduce repair costs, improve safety and improve road surfaces

Implementation Period	Long
Estimated Cost	High
Institutions to be responsible	General Directorate of Highways, Denizli Metropolitan Municipality, District Municipalities
Relevant Stakeholders	Private Sector
Risks	Loss of prestige, user victimization, lack of budget, lack of technical team

Objective T3: Personnel and vehicles in public transport system on roads are resistant to climate change	
Target: Reducing the level of the impact of extreme climate events on staff and vehicles in the public transport system	**Stakeholders:** DMM Ulaşım A.Ş., UKOME
Action T3.1: Reducing the impact on public transport drivers and public transport users	
Action T3.2: Regular maintenance and inspection of public transport vehicles	

Action T3.1: Reducing the impact on public transport drivers and public transport users	
Associated Risk	Extreme heat has a negative impact on vehicle drivers Psychological and physiological impacts of air conditioning systems on public transport
Action Severity Rating:	Secondary
Activities to be Conducted	▪ Providing regular training and psychological support to all drivers throughout the province ▪ Shortening overtime in extreme hot weather ▪ Improvement of cooling systems in public transport ▪ Increased comfort in public transport stops (more shade area and street afforestation)
Implementation Period	Short
Estimated Cost	Low
Institutions to be responsible	General Directorate of Security, Denizli Metropolitan Municipality, Ulaşım A.Ş., UKOME
Relevant Stakeholders	Private Sector (Bus Companies), Chamber of Drivers, District Municipalities, Provincial Health Directorate, Turkish Psychologists Association
Risks	Unchecked training results

Action T3.2: Regular maintenance and inspection of public transport vehicles	
Associated Risk	Psychological and physiological impacts of air conditioning systems on public transport
Action Severity Rating:	Primary
Activities to be Conducted	▪ Improvement of cooling systems in public transport ▪ Addition of vehicles that are resistant to extreme hot and cold weather to the fleet ▪ Taking care to operate new public transportation vehicles in extremely hot weather

Implementation Period	Short
Estimated Cost	Medium
Institutions to be responsible	Ulaşım A.Ş., Denizli Metropolitan Municipality, District Municipalities, UKOME
Relevant Stakeholders	Private Sector, Authorized Service Stations
Risks	Failure to use original parts, maintenance by unauthorized persons (other than Authorized Service Stations)

7.1.4. INDUSTRY

The impacts of climate change in Denizli on the industry have not been studied much in the current academic or private sector reporting. It has been recorded, on the other hand, that the impacts of extreme climate events in the recent past on the industrial production have started to be seen directly or indirectly.

Extremely hot weather reduces the productivity of the employees and sudden floods and stormwater caused by heavy rainfall directly affect the industrial production. To give an example of indirect impact, drought and floods experienced in agricultural production are reflected as raw material shortage to the agricultural and food and beverage manufacturing industry processing plant and animal products. The cuts in transportation lines and energy infrastructure are other significant indirect impacts .

Denizli has come to the forefront as an industrial centre. It has been the leading city in Turkey particularly in exported textile products. In addition, it ranks the 4th after Antalya, Istanbul and Muğla in the list of provinces attracting the highest number of tourists during 12 months together with domestic and foreign tourism . Agriculture and forestry activities in Denizli also constitute a significant added value.

Denizli constitutes 1,2% of the GDP of Turkey with a per capita GDP of $ 24.772.[42] In 2017, the amount of exports increased by 11,44 per cent compared to the previous year and was realized as 2.678.341 dollars. 5 companies in cable/copper industry, 2 in textile and apparel industry, 2 in food and feed industry, 2 in rolling industry and 1 in energy sector listed among the top 500 companies according to Istanbul Chamber of Industry 2016 data. According to the data of Denizli Governorate, textile sector constituted 45% of Denizli's exports in 2015.[43]

Total employment according to 2018 data (Compulsory -4A with Service Contract) is 190.116 persons. Nearly 40% of these employees are employed in the manufacturing sector. It is followed by wholesale and retail trade; repair of motor vehicles and motorcycles (13,8%) and construction (11,5%) sectors. **45.167 people working in the textile sector**, under the heading of manufacturing sector, account for

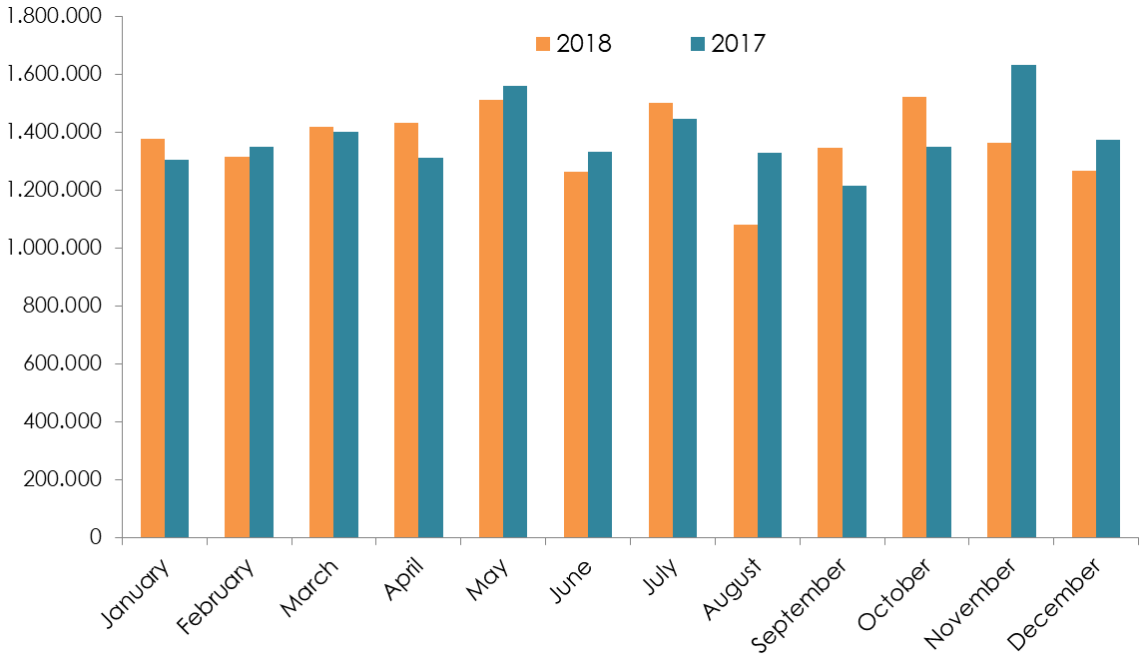
[42] TurkStat, 2014. Gross Domestic Product on Province Basis, 2004-2014, Turkey Statistical Institute. URL: http://www.tuik.gov.tr/PreHaberBultenleri.do?id=24920
[43] Denizli Governorate, Textile Sector, http://www.denizli.gov.tr/tekstil-sektoru

approximately 24% of all employees in the province and 36% of the female labour force is in the textile sector.[44]

16,6 million m^3 of water was consumed in 2017 and approximately 16,5 million m^3 of water was consumed in 2018 by the Organized Industrial Zone of Denizli. Approximately 75% of the products produced in Denizli Organized Industrial Zone, which accounts for approximately 25% of Denizli exports, belong to textile sector. Water consumption is very significant especially in paint and finishing plants.

The impact of this upward trend on limited water resources is expected to be more visible along with climate change. From 2004 to 2018, consumption of tap water has increased by approximately 40%. Water used in industry is directly dependent on the presence of groundwater.

Figure 50 - Tap Water Consumption of Denizli Organized Industrial Zone in 2017 and 2018[45]



Within the framework of the CCAP, 3 actions were identified under 2 objectives for the industry sector. Actions identified under each objective and activities to be implemented are presented with details below.

Objectives
Objective I1: Ensuring efficient water use in industry
Objective I2: Ensuring sustainability in industrial production

[44] It was compiled by Denizli Chamber of Industry. Data Source: SSI Provincial Directorate, General Directorate of SSI.
[45] http://www.dosb.org.tr/154/176/istatistik-bilgiler/kullanma-suyu-tuketimleri/

Objective I1: Ensuring efficient water use in industry	
Target: Reduction of water used in industry	**Stakeholders:** Ministry of Industry and Technology, OIZs, Firms, GEKA
Action I1.1: Increasing investments in new technologies enabling the use of rain water, reuse of wastewater and saving wate	

Action I1.1: Increasing investments in new technologies enabling the use of rain water, reuse of wastewater and saving water	
Associated Risk	Interruptions in production in water-intensive industrial activities due to shortage of water Decline in production caused by disruption in industrial use of water due to drought Disruption of clean water service in some districts due to drought Disruption of clean water service in the entire province due to drought Severity of Action
Action Severity Rating:	Primary
Activities to be Conducted	▪ Harvesting rain water and using in the facility ▪ Providing incentives for the reuse of wastewater in the industrial sector ▪ Providing grants for companies investing in technological systems to monitor water loss and leakage ▪ Licensing and inspection of unlicensed well use ▪ Organizing roundtable meetings for sharing experiences of companies in the same sector ▪ Making meetings where inter-sectoral experiences will be shared ▪ Establishing guidelines for the preparation of climate change adaptation projects specific to selected sectors
Implementation Period	Short-Medium
Estimated Cost	High
Institutions to be responsible	Ministry of Industry and Technology, OIZs, Firms, GEKA
Relevant Stakeholders	Universities, banks, credit institutions
Risks	Treatment of harvested rainwater, analysis and storage of water

Objective I2: Ensuring sustainability in industrial production	
Target: Reducing the negative consequences of extreme climate events in industrial production	**Stakeholders:** Ministry of Industry and Technology, Ministry of Agriculture and Forestry, GEKA, Chambers of Industry and Trade
Action I2.1: Conducting projects that support production in agricultural areas that provide raw materials to industry	
Action I2.2: Taking measures to increase industrial employment	

Action I2.1: Conducting projects that support production in agricultural areas that provide raw materials to industry	
Associated Risk	Decrease in production in textile industry due to lack of raw materials from agriculture Decrease in production in food industry due to lack of raw materials from agriculture
Action Severity Rating:	Secondary
Activities to be Conducted	▪ Organizing projects to increase raw material production in agricultural areas ▪ Providing support for water saving
Implementation Period	Long
Estimated Cost	Low
Institutions to be responsible	Ministry of Agriculture and Forestry, Ministry of Industry and Technology, Ministry of Family, Labour and Social Services, GEKA, Agricultural Chambers, Agricultural Credit Cooperatives
Relevant Stakeholders	Companies, farmers
Risks	High costs

Action I2.2: Taking measures to increase industrial employment	
Associated Risk	Migration from the province as a result of the decline in industrial production
Action Severity Rating:	Primary
Activities to be Conducted	▪ Designing and supporting the workforce by institutions such as ISKUR ▪ Support such as tax deduction that will increase employment in industry. ▪ Realization of joint projects with the insurance sector to better analyse and prepare for climate change risks ▪ Carrying out training and awareness raising activities for the assessment of climate change risks and emergency planning
Implementation Period	Short
Estimated Cost	High
Institutions to be responsible	Ministry of Industry and Technology, Ministry of Family, Labour and Social Services, Ministry of Treasury and Finance,
Relevant Stakeholders	Chambers of Industry and Trade, Ministry of Agriculture and Forestry, GEKA
Risks	Cost, lack of qualified staff

7.1.5. ENERGY

According to the data of Licensed Electricity Production Distribution in Denizli province (EMRA, 2018), 11% of the produced energy is produced in hydroelectric power plants, 18% in geothermal power generation plants and 70% in thermal power plants. Production in solar and wind energy is very small.

It is likely that the impact of the drought to be created by climate change in the snow and rainfall regimes will cause water resources and the hydroelectric power plants will be affected. There are also risks in access to the cooling water used in large quantities in thermal power plants. In addition to the above, it is expected that the number of cases (damage, landslides, floods, etc.) that directly and indirectly affect the energy infrastructure as a result of excessive heat and excessive rainfall will increase. The load to arise in the electricity grid due to the increase in the demand for cooling of the hot air, which increases with the influence of the urban heat island in the city centre, poses a risk.

Within the framework of the CCAP, 2 actions were identified under 2 objectives for the energy services sector. Actions identified under each objective and activities to be implemented are presented with details below.

Objectives
Objective E.1: Protection of power infrastructure against climatic hazards
Objective E.2: Reduction of overloads on the power grid

Objective E.1: Protection of power infrastructure against climatic hazards	
Target: Reducing the impact level of energy infrastructure by extreme climate events	**Stakeholders:** DSI, Denizli Metropolitan Municipality, Electricity generation and distribution companies
Action E1.1: Taking measures for the climatic hazards to which the energy infrastructure will be exposed	

Action E1.1: Taking measures for the climatic hazards to which the energy infrastructure will be exposed	
Associated Risk	Loss of energy infrastructure and power outages due to the floods
Action Severity Rating:	Primary
Activities to be Conducted	▪ Regular maintenance and repair of high-voltage power lines ▪ Monitoring of land subsidence ▪ Direction of flood waters in a controlled manner ▪ Establishment of power plants in safe areas taking into account natural disasters ▪ Using thickest power cable cross sections and ensuring resistance to strong winds ▪ Use of more efficient cooling systems in power plants and stations ▪ Establishment of emergency water connections for cooling systems of power plants in summer drought ▪ Improvement of stormwater systems in central power plants to protect against excessive rainfall and better removal of rainwater ▪ Evaluation of the impacts of different climate change scenarios on water resources and energy generation facilities connected to air-cooled systems
Implementation Period	Short
Estimated Cost	Low
Institutions to be responsible	DSI, electricity generation and distribution companies, Denizli Metropolitan Municipality,
Relevant Stakeholders	DESKI, AFAD
Risks	

Objective E2: Reduction of excess load on the energy grid	
Target: Reducing the impact level of energy infrastructure by extreme climate events	**Stakeholders:** DSI, Denizli Metropolitan Municipality, Electricity generation and distribution companies
Action E2.1: Enabling energy saving and energy optimization applications	

Action E2.1: Enabling energy saving and energy optimization applications	
Associated Risk	The heavy load to the electricity grid for cooling purposes due to the urban heat island which will occur as a result of the exacerbation of hot weather
Action Severity Rating:	Primary
Activities to be Conducted	▪ Increasing the thermal insulation systems in existing buildings and using energy efficient cooling systems, reducing the mass consumption by building energy efficient buildings. ▪ Determination of the additional energy need caused by climate change on a regional and sectoral basis ▪ Supporting energy savings in cooling systems ▪ Optimization of energy infrastructure (with a focus on network) ▪ Optimization of energy infrastructure (with a focus on storage)
Implementation Period	Long
Estimated Cost	High
Institutions to be responsible	Power generation and distribution organizations, DSI, Denizli Metropolitan Municipality
Relevant Stakeholders	Municipalities, private sector, contractors, citizens,
Risks	Individuals do not prefer energy efficient products

7.1.6. PUBLIC HEALTH

Under the CCAP, the above sections cover the actions directly related to public health within different areas of adaptation action. However, the "public health" sector could not be studied by a separate group since the participant representation in public health was not provided during the workshops. This section will cover the impacts of climate change on public health which are not mentioned in the areas of adaptation action mentioned above and suggested actions for them.

As in the whole world, the parts of the society that bear the least responsibility for climate change, but that will be most affected from its results are the poor and the disadvantaged. This makes it compulsory to take the principles of "environmental justice" or "climate justice" into the agenda of decision-makers in the fight against climate change in terms of social justice and ethics. How to determine adaptation policies and actions and who they will prioritize will be at the heart of the "climate justice" debate. It will not be possible to speak of "climate justice" without the elimination of social and economic injustices.[46]

[46] 10 Stops for Climate Justice Struggle (2017), Ecology Collective

"Emergency incidents" that stop or interrupt the normal life and activities of the whole or certain parts of the society and which require emergency response are experienced for natural and unnatural reasons. Emergency events due to climate change are generally classified as meteorological disasters. The fight against climate change impacts, namely climate change risk management, can be divided into two stages: the "risk reduction" phase and the "crisis management phase" in which the hazard occurred prior to the occurrence of the climate hazard. This section summarizes the adaptation measures for both phases.

The impacts of climate change do not affect all citizens in the same way. Floods that occur as a result of heavy rains, or extreme hot days will cause greater negative impacts and difficulties on certain vulnerable groups. Among these groups are people living in areas with low environmental quality (green area and air quality), people with low socio-economic status. The reasons for these difficulties can be the lack of economic resources, sheltering in old and unhealthy conditions, living alone or lack of communication sources (such as lack of language, illiteracy, no mobile phone etc.) to receive warnings.

The most important disaster in Denizli is earthquake in terms of its impacts, followed by floods and landslides follow. These disasters are expected to have a higher level of exposure to vulnerable groups (elderly, children, disabled, etc.).

Table 24 - Primary disasters in Denizli and secondary disasters following them

Primary Disaster/Secondary Disaster	Earthquake	Landslide	Epidemic	Mass Population Movements	Transport Accidents	Fire	Industrial Accidents	Extreme Heating / Drought	Flood	Mine Accident
Earthquake										
Landslide										
Mass Population Movements										
Transport Accidents										
Fire										
Industrial Accidents										
Extreme Heating / Drought										
Flood										
Snow, Avalanche, Icing and Extreme Cold										
Storm/Cyclone										
Mine Accident										

Table 25 - Breakdown of the Handicapped (July 2017)

TYPE OF HANDICAP	NUMBER OF PEOPLE
Hearing impaired	2.036
Speech handicapped	2.036
Orthopedically handicapped	2.278
Mentally retarded	6.316
Mentally handicapped	5.096
Disability of chronic illness	2.694
Unknown	7.143
TOTAL	25.563

Especially urban areas with a dense population and connected with complex economic relations network are highly vulnerable to the negative impacts of climate change.

More than half of the population of Denizli (63%) live in two districts in the urban city centre and this number is increasing. On the other hand, in the period of 2007-2018 11%: the number of people aged 65 and over increased by 42% (from 77 thousand to 115 thousand).

City centre is at greater risk than rural areas due to climate change impacts due to high population, the intensity of economic activities, the presence of critical infrastructures (electricity lines, water and wastewater networks, hazardous industrial facilities). For example, the size of the risks is increasing due to the excess of impermeable surfaces (residential areas and roads) that prevent rain enter the soil in the

urban areas in the event of the heavy rainfall and density of people and properties. Impermeable surfaces prevent rain from reaching the soil and cause the “urban heat island impact”, by storing heat in cities.

The development of the settlements in Denizli (1990-2012) is presented in the following figures.

Figure 51 - Development of Areas of Settlements in Denizli Province (1990-2012)[47]

Residential areas in 1990 | Residential areas in 2012 | Districts of Denizli

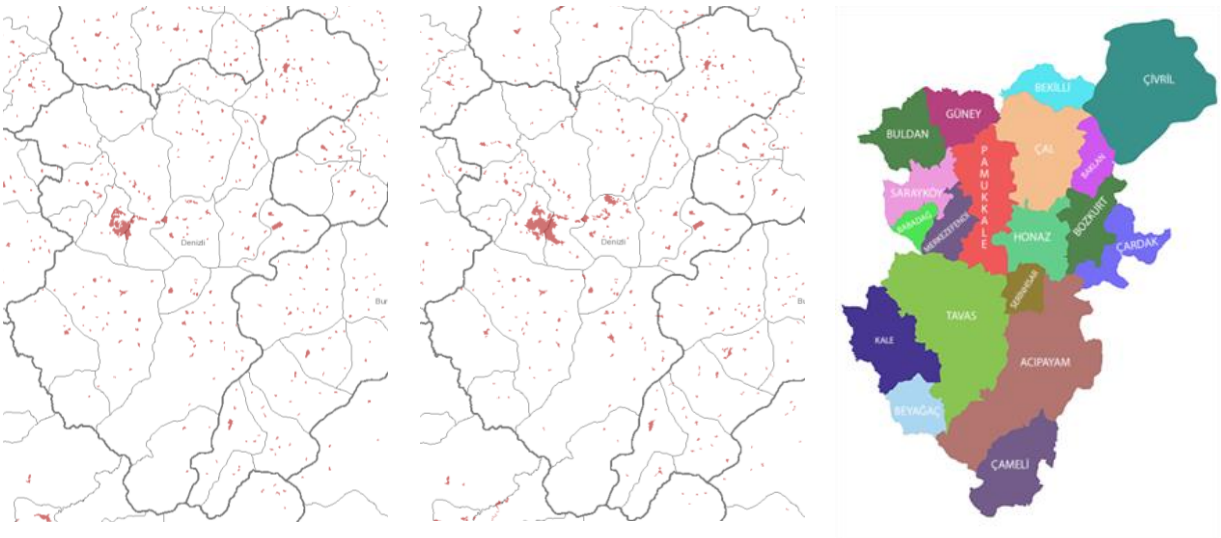
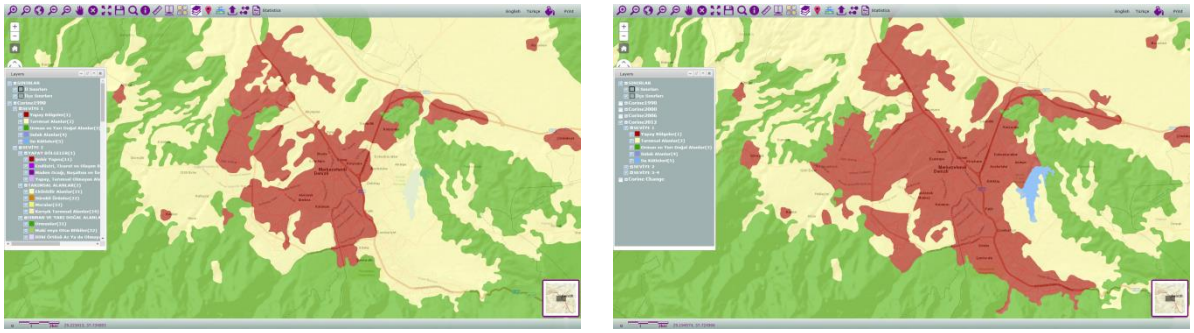


Figure 52 - Development of Areas of Settlements in Central Denizli (1990-2012)[48]

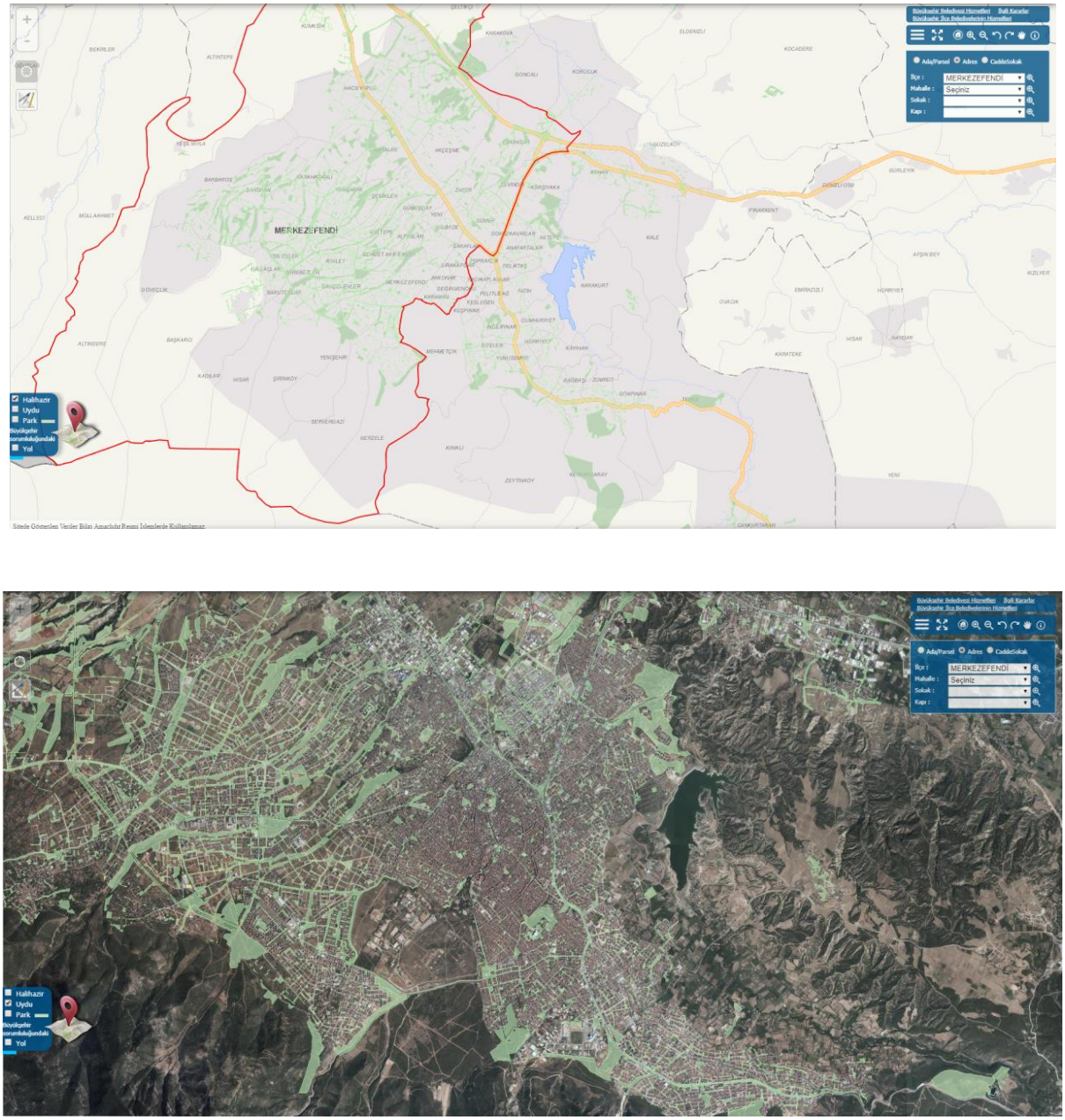
Central Denizli Residential Areas in 1990 | Central Denizli Residential Areas in 2012



Although the land in Denizli province is rich in forest, the green area in the city centre is very low in some regions. Distance to access to the nearest green area in these areas may be above the standards.

[47] http://corine.tarimorman.gov.tr/corine
[48] http://corine.tarimorman.gov.tr/corine

Figure 53 - Distribution of Green Areas in Denizli Central Districts[49]



Climate change affects the air pollution directly by affecting such meteorological variables as temperature, precipitation, wind speed and wind direction etc. These variables affect the development, chemical transformation, transport, distribution and storage of air pollutants. In particular, Ozone (O_3) and particulate matter (especially those with a diameter of 2,5 microns or smaller-PM2,5) will be affected

[49] https://adres.denizli.bel.tr/sorumluluk/

by climate change. Climate change can also increase natural particulate matter resources by creating a fire generating weather condition, increasing dust storms, affecting the production and propagation of aero-allergens such as pollen and molds.

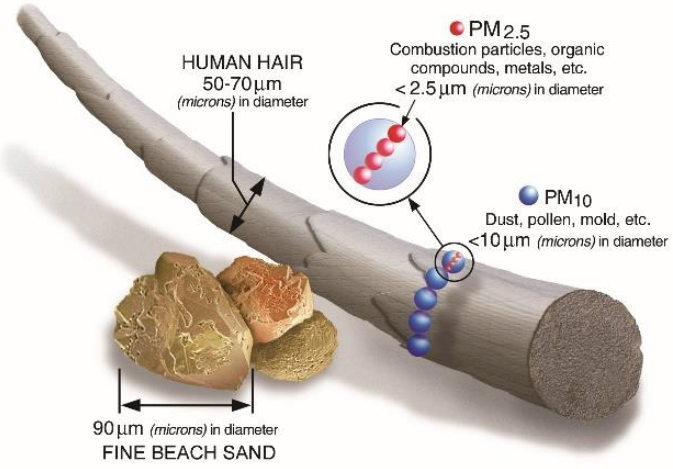
Air pollution is directly related to cardiovascular diseases, stroke and respiratory diseases which are the biggest cause of death in Turkey and the world.[50] Scientific studies show that **climate change will make the impacts of air pollution on human health more serious**.[51]

Widespread use of low quality fuel used in domestic heating and industry, unauthorized incineration of substances not suitable for incineration, dust pollution arising during mining activities, emissions from traffic (exhaust) cause air pollution in Denizli province.[52]

Health Cost due to Air Pollution[53]

Although the causes and amount of air pollution vary from region to region, the most common causes of pollution in urban areas are: the use of fossil fuels in power plants and domestic heating, the use of motor vehicles, industrial production and waste incineration processes.[54]

- Every year 32 thousand people lose life in Turkey due to air pollution;
- Tobacco dependence and air pollution cause the development of lung cancer;
- Some 30,000 people in Turkey are diagnosed with lung cancer each year;
- Lung cancer is the most common cause of death in all cancer deaths in Turkey;
- 44 deaths per hundred thousand deaths in Turkey are caused by air pollution;
- Use of fossil fuels in Turkey accounts for 2.876 premature deaths , 4.311 hospitalization and 7.976.070 days passed as patient;
- The use of fossil fuel has a health cost of over 3 billion Euros per year, except for deaths and disabilities.



[50] http://toraks.org.tr/subNews.aspx?sub=203&notice=3326
[51] Climate change, air pollution and human health in Sydney, Australia: A review of the literature http://iopscience.iop.org/article/10.1088/1748-9326/aac02a/meta
[52] Turkey Environmental Problems and Priorities Assessment Report - 2016 data URL: http://webdosya.csb.gov.tr/db/ced/icerikler/cevre_sorun_2018-20180702151156.pdf
[53] http://toraks.org.tr/subNews.aspx?sub=203&notice=3326
[54] http://toraks.org.tr/subNews.aspx?sub=203&notice=4311

Assessment of Air Quality in Denizli City Centre

According to the results of air quality index of PM10 values for winter average (6-month average between March 2016 and March 2016) and Summer average (6- month average from April to September 2016), it is seen that Denizli Bayramyeri is in the class "3- vulnerable" in both periods.

When PM and SO_2 measurements performed between 2007 and 2014 are analysed, it is observed that PM-SO_2 values are higher in the Denizli-1 air monitoring measurement station than in the other stations.

Locations where pollution is highest are Sümer, Dokuzkavaklar, Anafartalar, Topraklık, Deliktaş, Sevindik neighbourhoods. Excesses are experienced especially in winter. Air circulation in the province of Denizli is prevented due to its location in the form of a bowl valley in a depression level surrounded by mountains on three sides. Especially meteorological events such as fog and inversion in the winter months increase the excess. There are industrial facilities adjacent to the city centre, intertwined with residential areas. These facilities are mainly rolling mills, foundries and textile sizing and dyeing facilities. These facilities use coal for 12 months. In addition, the tightness of the settlement, narrow and inadequate roads increase the amount of pollution. The traffic density of the main road passing through the city centre contributes to this.

Within the framework of the CCAP, 3 actions were identified under 3 objectives for the energy services sector. Actions identified under each objective and activities to be implemented are presented with details below.

Objective P1: Making people more resistant to the impacts of climate change	
Target: Reducing the number of people affected by climate change	**Stakeholders:** - Ministry of Health, Provincial Directorate of Health, Ministry of National Education, Provincial Directorate, AFAD, DMM, DESKI, Public institutions
Action P1.1: Organizing training and awareness-raising activities for adaptation to climate change	
Action P1.2: Taking measures for public health	
Action P1.3: Implementation of urban planning and green space management practices	

Table 26 - Adaptation Actions for Public Health

Action Group	Activities to be Conducted	Institutions in Charge
Organizing training and awareness-raising activities for adaptation to climate change	▪ Conducting awareness-raising activities in order to get protected at social and individual level from problems brought by climate change on the health ▪ To raise public awareness for more impactive protection from the negative impacts of climate change on health ▪ Providing training on health risks related to climate change to the staff of primary health care (community health and family health centre) ▪ Inclusion of adaptation to climate change in the curriculum ▪ Development of managerial capacities of managers and staff of group quarters (dormitories, nurseries, nursing homes etc.) in order to intervene in respond to weather events ▪ Climate training in adult education centres ▪ Integrating adaptation to climate change into internal training programs	- Ministry of Health, Provincial Directorate for Health - Ministry of Education, Provincial Directorate - AFAD - DMM, DESKI - Public institutions
Taking measures for public health	▪ Provision of refrigeration areas by municipalities or related public institutions in the weeks of extremely high temperatures (using renewable energy sources if possible) ▪ Developing methods for healthy and safe use of indoor cooling systems and efforts to reduce the adverse impacts of climate change ▪ Conducting works to prevent extreme weather events from adversely affecting the health of people with chronic diseases, handicapped, new-borns, elderly and other vulnerable groups ▪ Determination of diseases caused by climate change (fight against waterborne diseases and foodborne diseases) ▪ Studying and monitoring the relationship between infectious diseases and climate change ▪ Strengthening the institutional infrastructure for the monitoring of diseases in Turkey as a result of climate change and / or increasing the intra-institutional and inter-institutional cooperation. ▪ Reviewing the current air pollution quality monitoring works by taking “climate change” into consideration and updating the relevant interventions. ▪ Planning allergic sensitive areas	▪ Ministry of Health, Provincial Directorate for Health ▪ Ministry of Education, Provincial Directorate ▪ AFAD ▪ DMM, DESKI ▪ Public institutions

Action Group	Activities to be Conducted	Institutions in Charge
	▪ Enrichment of temperature resistant food and beverage facilities ▪ Making working hours and work starting times flexible ▪ Determination of response areas for identification and prevention of threats to employee health ▪ Establishment of reinforcement structures and information programs that enable the improvement of physical fitness of persons ▪ Review of aged care programs for adaptation to climate change ▪ Developing hospital programs for adaptation to climate change ▪ Strengthening the early warning system ▪ Providing suitable housing conditions for those affected by extreme weather events ▪ Addition of diseases related to climate change to early warning system and follow-up on case basis ▪ Reorganization of services and working hours of facilities according to the frequency of days above 35ºC	
Implementation of urban planning and green space management practices	▪ Increasing the resistance of green areas in cities ▪ Implementation of projects on climate-friendly design of the urban land ▪ Creation of sufficient green and open areas and systematic greening of roofs and façades ▪ Inclusion of school gardens in green area management ▪ Protection of gathering areas for disasters caused by climate change ▪ Inclusion of sustainable rain harvesting methods in the investments of relevant units ▪ Implementation of climate change adaptation actions in urban agriculture and vegetable fields ▪ Municipalities and other public institutions to implement improvement and infrastructure arrangements in residential areas rather than household-level economic assistance in poverty reduction ▪ Extension of drinking water fountains ▪ Establishment of shower and swimming pool facilities for very hot weather	▪ Ministry of Health, Provincial Directorate for Health ▪ Ministry of Education, Provincial Directorate ▪ AFAD ▪ DMM, DESKI ▪ Public institutions

8. COMPLIANCE WITH THE MAIN STRATEGY AND ACTION PLANS

The strategic plans, action plans and reports at the national, regional and local level, which are currently in force, have been taken into account in the compilation of the actions and activities presented in Section 6 and Section 7 for the action areas covered by the CCAP. The relationship between these documents and the action plan is presented in Table 27 and Table 28.

Table 27 - Compliance of Reduction Actions with Main Strategy and Action Plans

Reduction Action Areas	Local Strategy and Planning					
	DBBSP	DUAP	DNIP	DESKISP	DESKIPP	DGYH
Buildings			■			■
Transportation	■	■	■			■
Waste/Wastewater	■		■	■	■	■
Energy			■	■	■	■
Industry			■			■
Agriculture and Livestock	■	■	■			■

Reduction Action Areas	National and Regional Strategy and Planning										
	NEUKB	IDES	AACP	EVEP	YEEP	SSB	AYEP	AAEP	GDSBEP	AUSSB	GEBP
Buildings	■	■	■	■	■						■
Transportation	■	■	■	■	■					■	■
Waste/ Wastewater	■	■	■	■	■	■	■	■	■		■
Energy	■	■	■	■	■	■	■	■	■		■
Industry	■	■	■	■	■	■	■	■	■		■
Agriculture and Livestock	■	■	■		■	■				■	■

Table 28 - Compliance of Adaptation Actions with Main Strategy and Action Plans

Adaptation Action Areas	Local Strategy and Planning									
	DBBSP	DUAP	DNIP	DESKISP	DESKIPP	YEP	DTMP	DAMP	HKEP	THEP
Water and Wastewater	■			■	■		■	■	■	
Transportation	■	■	■					■		■
Agriculture and Ecosystems			■	■	■	■	■	■	■	
Industry			■				■		■	■
Energy								■		■

Adaptation Action Areas	National and Regional Strategy and Planning												
	IDES	AACP	USEP	EVEP	YEEP	SSB	AAEP	HKEP	SPEP	KYSBEP	EMEP	DSITEP	BMHKEP
Water and Wastewater													
Transport													
Agriculture and Ecosystems													
Industry													
Energy													

Local Documents

- Denizli Metropolitan Municipality Strategic Plan (**DBBSP**) (2015-2019)
- Denizli Metropolitan Municipality Transportation Master Plan (Draft) (**DUAP**)
- Denizli Master Plan (**DNIP**) (2018)
- DESKİ Performance Program (**DESKIPP**) (2018)
- DESKİ Strategic Plan (**DESKISP**) (2015-2019)
- Denizli's Road to the Future Map (**DGYH**) (2010-2023)
- Denizli Province Nature Tourism Master Plan (**DTMP**) (2013-2023)
- Fire Action Plans (**YEP**) (Honaz Mountain National Park and Akdag Natural Park) (2014)
- Denizli Provincial Disaster Response Plan and Annexes (**DAMP**) (2018)
- Denizli Clean Air Action Plan (**THEP)** (2015-2019)

National and Regional Documents:

- Intended National Contribution Document (**NEUKB**) (2021-2030)
- National Climate Change Strategy Document (**IDES**) (2010-2023),
- National Climate Change Action Plan (**CCAP**) (2011-2023)
- National Climate Change Adaptation Strategy and Action Plan (**USEP**) 2011-2023
- Energy Efficiency Action Plan (**EVEP**) (2017-2023)
- Renewable Energy Action Plan (**YEEP**) (2013-2023)
- Waste Management and Action Plan (**AYEP**) (2016-2023)
- Wastewater Treatment Action Plan (**AAEP**) (2017-2023)
- Recycling Strategy Document and Action Plan (**GDSBEP**) (2014-2017)
- Smart Transport Systems Strategy Document (**AUSSB**) (2014-2023) and Action Plan (2014-2016)
- Industrial Strategy Document (**RCC**) (2015-2018)
- South Aegean Region Plan (**GEBP**) (2014-2023)
- Watershed Protection Action Plans (**HKEP**) (Büyük Menderes, West Mediterranean and Burdur)
- National Program and Action Plan for Reducing the Negative Impacts of Climate Change on Health (**SPEP**)

- National Drought Management Strategy Paper and Action Plan (**KYSBEP**) 2017-2023
- Combatting Erosion Action Plan (**EMEP**) 2013-2017
- DSI Flood Action Plan (**DSITEP**) 2014-2018
- Büyük Menderes Basin Pollution Prevention Action Plan (**BMHKEP**) 2016-2023

In the light of the above information, it has been attempted to ensure that the strategies, actions and reports deemed important for the DMM are transferred to the CCAP as much as possible.

In the event of updating the aforementioned policy documents, actions and activities in the CCAP should be reviewed with the consideration of any mitigation or adaptation measures related to climate change.

9. ANALYSIS OF FORECASTS

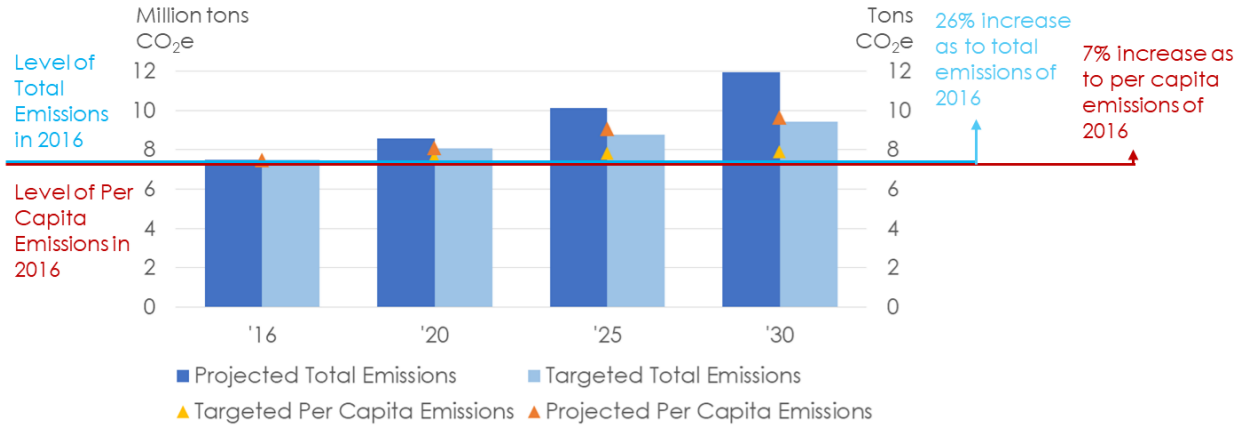
In order to make a forecast with high rate of actualization, it is important to (i) use the data of past years, and (ii) know the estimations of the main parameters. There is no past years' data calculated relevant to the period prior to this report which is the initial greenhouse gas emission inventory of Denizli. During updating of the report in the following years, there will be the opportunity of making a healthier analysis. While there are forecasts published by TurkStat regarding population -which is among the main parameters of Denizli-, no detailed estimations could be found regarding the other parameters of the inventory. For this reason, the emission forecasts of Denizli until 2030 has been calculated under 3 main scenarios considering data such as Turkey's emission data of the past years, expected increase of emission in INDC, and increase of electricity consumption of Denizli.

By the end of the study, Scenario X - Average of Past Years has been determined as the main scenario. Denizli is a city which is continuing to expand. The fact that province's population will reach to 1,1 million, which was 1 million in 2016, is present in the reports of TurkStat. In that report, it is anticipated that the population of the province would reach to 1,2 million in 2030. Significant increase is being expected in between 2016 - 2030 in the parameters relevant to greenhouse gas emission as industrial production, vehicle ownership and stock of buildings being in the first place. As per the modelling performed in the study, the emissions of Denizli for the year 2030 has been anticipated as 11,9 million tons of CO_2e. In the same year, the emissions per person are being expected to be 10,1 tons of CO_2e. A reduction target of 21% has been set for 2030. According to that, it is being anticipated to decrease the emissions per person in 2030 in Denizli to 8,0 tons of CO_2e, and to have the total emissions remain as 9,5 million tons of CO_2e. The main reason of selecting the average of past years instead of the average of INDC is the decrease of growth rate of Turkey as from the introduction of INDC. Especially in developing countries, there is a correlation between the growth rate of the country and the greenhouse gas emissions. This fact has also been observed in the emissions of Turkey. In years 2017 and 2018, the growth rate of Turkey remained below the rates which are estimated to be anticipated in INDC. Within this scope, it has been based on the emissions of past years instead of INDC.

Total emissions of Denizli and the emissions per person of Denizli are estimated to increase. In case of attaining the goal, it is being expected for Denizli's emissions per person to increase by 7%, while its total emissions would increase by 26% compared to 2016. Attaining this goal will be one of the significant means of making the growth of Denizli sustainable.

As per the Greenhouse Gas Emissions Deficiency Report published by UNEP in 2018, the targets of the states remain much lower than it is required to be. Even if Denizli makes the same reduction commitment with the national target, anticipating the province's emission increases below the country's average by updating the same as per national calculations considering the actual developments presents the goal of Denizli as a higher goal. The report of UNEP suggests all the countries to improve their goals. Along with Turkey's attempt in improving the INDC, Denizli is also expected to improve its goal.

Figure 54 - Results of 21% Emission Reduction Target for Denizli for 2030



Turkey's population increase is anticipated to continue. While this population increase is above the Turkey's average especially in Marmara Region, it is actualizing below Turkey's average in East Anatolia and Black Sea Regions. And in Aegean Region, where Denizli is also located, the population increase will be realized very close to Turkey's average. While Turkey's population is expected to increase by 18,6% from 2016 to 2030, the population increase for Denizli is anticipated as 17.8%.

When the calculation of forecasts are addressed in detail, Turkey's emissions are anticipated to be 1.175 million tons of CO_2e in 2030 as per the ordinary state scenario within the scope of INDC. Turkey's increasing population has direct impact on the increase of greenhouse gas emissions. The emissions increase as the population increases. Population is not the only factor in the increase of greenhouse gas emissions. In the calculation of increase of emissions, expected increase in consumptions per person, and accordingly increase in production are also considered in parallel to population.

Calculations have considered the increases in population and in consumption per person. Within this scope, the emissions of Denizli have been divided to three groups (see Table 29):

- Group A: Basically the emissions realized in the direction of domestic requirements such as heating, electricity usage at households, places of business and public institutions, and emissions changing directly proportional to population.
- Group B: Emissions which are basically realized in the direction of industrial production, and which don't change as directly proportional to population.
- Group C: Emissions arising from transportation, which cover both Group A and B, and which cannot be distributed to two categories due to deficient data.

Table 29 - Emission Categories of Denizli

	Group A Emissions	Group B Emissions	Group C Emissions	Total
Buildings	1.448.313			**1.448.313**
Transportation			1.731.104	**1.731.104**
Waste	78.092			**78.092**
Land	847.659	39.229		**886.887**
Industry		3.358.272		**3.358.272**
Total	2.374.063	3.397.501	1.731.104	**7.502.667**

The increase of Group A emissions has been calculated depending on the population increase of Denizli in addition to increase of emissions of Turkey arising from variables beyond population. And the increase in Group B emissions of Denizli has been calculated in proportion to increase realized as a result of both the population of Turkey and variables beyond population. Half of the Group C emissions has been calculated as emission increase of Group A, and half of it has been calculated as emission increase of Group B.

In the projection of Denizli's greenhouse gas emissions, it has been based on the national data of Turkey besides the expected population increase of Denizli, and the following 3 scenarios have been used (see Table 30):

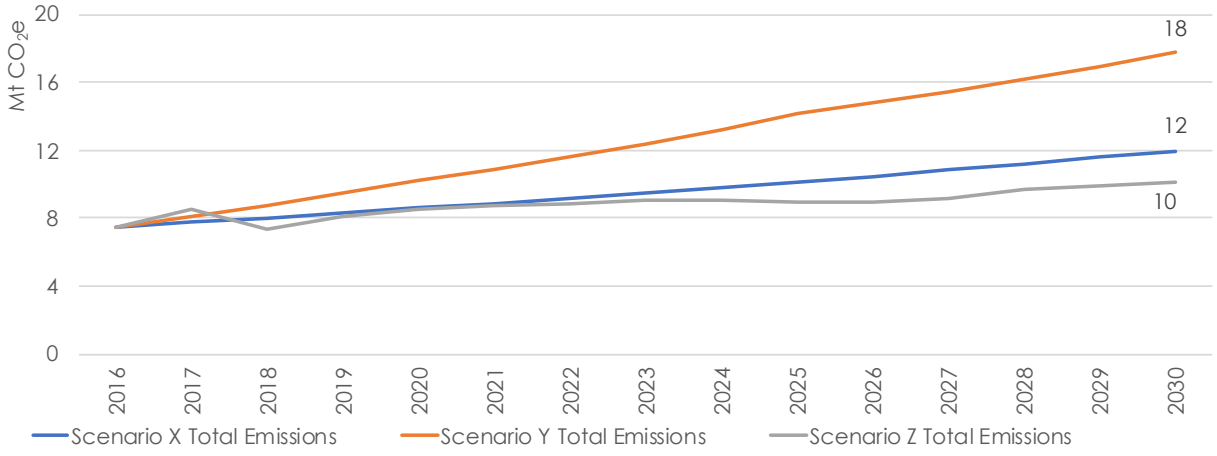
- Scenario X - Average of Past Years: Regarding the population variable, while it has been based on the projection of TurkStat regarding the population of Denizli for the period between years 2016-2025, the modelling made by REC Turkey has been used for the period between years 2025-2030. Regarding the variables beyond population, the average of emission increase rate in the past years of Turkey has been taken as basis.
- Scenario Y - INDC: Regarding the population variable, while it has been based on the projection of TurkStat regarding the population of Denizli for the period between years 2016-2025, just like Scenario X, the modelling made by REC Turkey has been used for the period between years 2025-2030. It has been based on INDC of Turkey for the variables beyond population.
- Scenario Z - Projection of Electricity Consumption in Industry: Regarding the variable population, it has been based on the projection of TurkStat regarding the population of Denizli for the period in between years 2016-2025. And for the years 2025-2030, the projection of 1:25.000 Scale Master Development Plan Population Increase of Denizli Province has been taken as basis. For the variables beyond population, the modelling made by REC Turkey has been used.

Table 30 - Scenarios and Dependent Variables

	Population (2016-2025)	Population (2025-2030)	Variables Beyond Population
Scenario X	TurkStat	REC Turkey	Average of Past Years
Scenario Y	TurkStat	REC Turkey	INDC
Scenario Z	TurkStat	1:25.000 Scale Master Development Plan of Denizli Province	REC Turkey

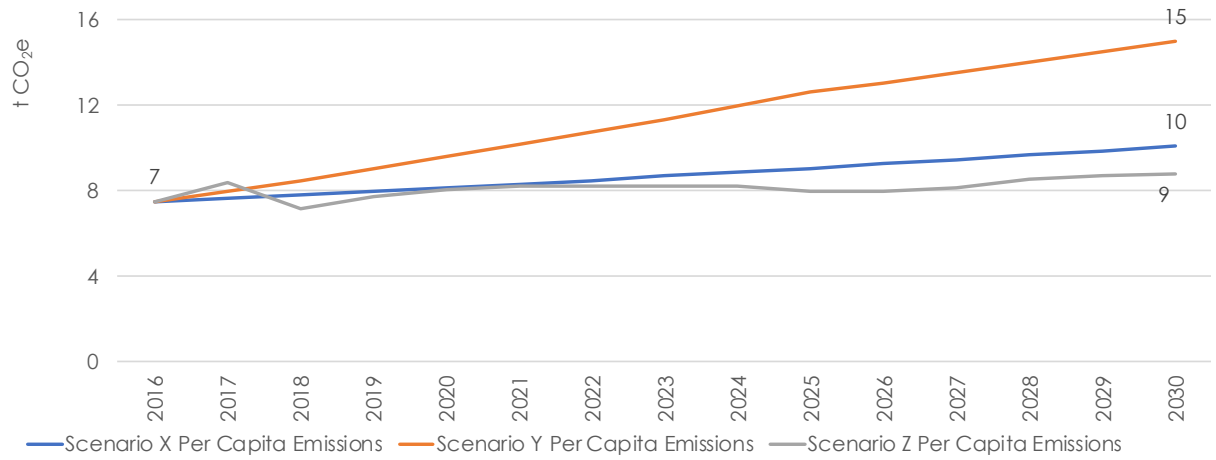
As per the analyses of scenarios, total emissions of Denizli will increase in year 2030 compared to year 2016 by 59% according to Scenario X, by 137% according to Scenario Y, and by 35% according to Scenario Z. In this respect, while Scenario X reflects the average scenario, Scenario Y indicates the pessimistic cases, and Scenario Z indicates the optimistic cases. In the case of not implementing the required actions in the sense of reduction, while Scenario X anticipates 12 million tons of CO_2e as average value for the greenhouse gas emissions of Denizli, the other two scenarios anticipate 10 and 18 million tons of CO_2e (see Figure 55).

Figure 55 - Projection of Total Greenhouse Gas Emissions of Denizli as per the Scenarios



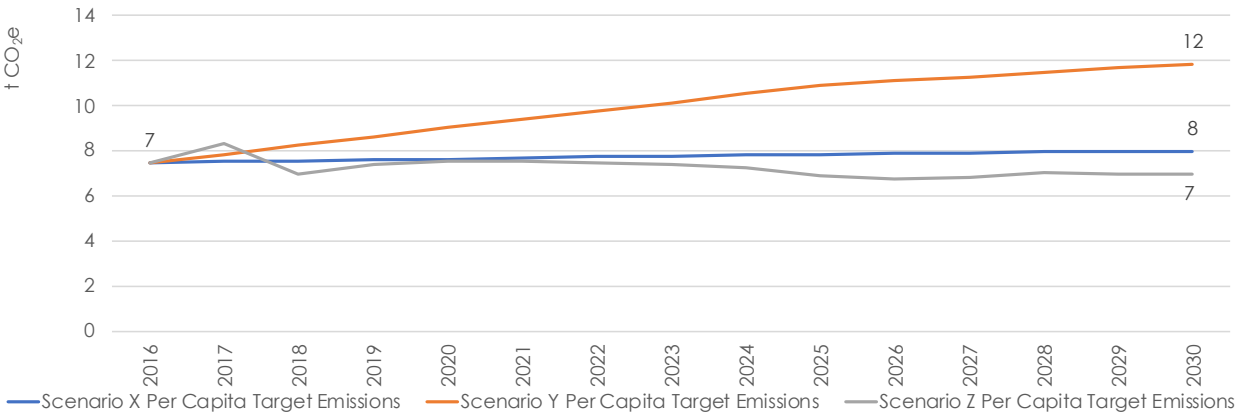
The projection for the year 2030 for the emissions per person has been shown in Figure 56 as per the scenarios. While Scenario X has anticipates 16 tons/person of CO_2e, Scenario Y and Z have anticipated 23 and 21 tons/person respectively.

Figure 56 - Projection of Greenhouse Gas Emissions per Person of Denizli as per the Scenarios



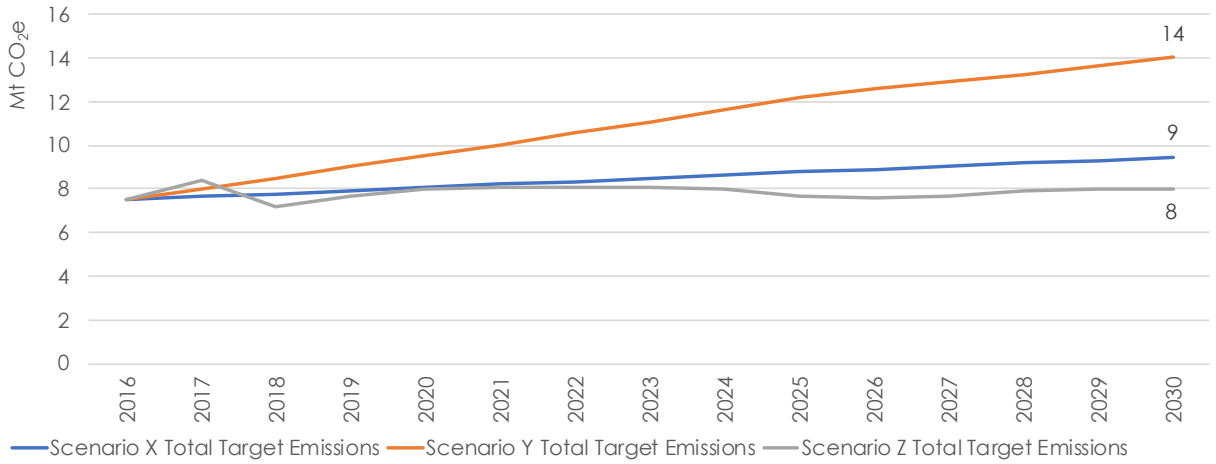
In the direction of the goal of 21% reduction in emissions per person in the year 2030, targeted emissions per person of each scenario have been given in Figure 57. According to these results, it has been anticipated that while the emissions per person will increase by 7% in year 2030 as per Scenario X in case of taking the required reduction measures in Denizli, that it will increase by 59% as per Scenario Y, and that it will decrease by 7% as per Scenario Z.

Figure 57 - Reduction Targets of Greenhouse Gas Emissions per Person of Denizli as per the Scenarios



In case of taking the measures within the scope of CCAP, the increase amounts to be actualized in total emissions compared to year 2016 has been calculated to be 26% as per Scenario X, 87% as per Scenario Y, and as 7% as per Scenario Z (see Figure 58).

Figure 58 - Reduction Targets as per the Scenarios Regarding the Total Greenhouse Gas Emissions of Denizli



The comparison regarding the results of the scenarios and the impacts of mitigation goal has been given in Table 31.

Table 31 - Change in Emissions per Person and Total Emissions as per the Scenarios (2016-2030)

	Projection (2016-2030)		21% Reduction Target (2016-2030)	
	Change of Total Emission	**Change of Emission per Person**	**Change of Total Emission**	**Change of Emission per Person**
Scenario X	59%	35%	26%	7%
Scenario Y	137%	101%	87%	59%
Scenario Z	35%	18%	7%	-7%

Detailed tables covering the comparison of projections and reduction targets of the scenarios, and the annual emissions have been given in ANNEX 5.

ANNEXES

ANNEX 1 - INTERNATIONAL CLIMATE CHANGE POLICIES

United Nations Framework Convention on Climate Change (UNFCCC)

International society gathered in 1992 in Rio at the Earth Summit in order to solve the increasing environmental problems. One of the most significant gains of that summit was the adoption of United Nations Framework Convention on Climate Change (UNFCCC). UNFCCC anticipated for each state to tackle with climate change through common but differentiated efforts according to their capabilities and abilities within the framework of their historical responsibilities (UNFCCC, 1992).

Classification was made for the determination of the responsibilities of the states regarding the issues of mitigation and adaptation[55]. Within the scope of the convention, the states are covered under 3 main classes. Annex-I covers the industrialized states which have historical responsibility, and which are anticipated to realize mitigation. These are the states included in European Union (EU), Organisation for Economic Co-operation and Development (OECD), and the previous Eastern Block. And the states of Annex-II are the rich ones which are anticipated to support the developing states especially on the issue of adaptation by the transfer of money and technology, and which have financial responsibility. These states have been determined as the member states of EU and OECD. And the states beyond Annex-I consist of ones which are the party to the convention, but which don't have the reduction and financial responsibility. As the responsibilities of the states form within the scope of classes included in the annexes of the convention, this approach has started to be referred as annexes system in literature (UNFCCC, 1992).

Kyoto Protocol

Kyoto Protocol is the initial concrete step in order to attain the objectives of UNFCCC. The protocol, which was accepted in 1997, was possible to come into force in 2005, 8 years after its adoption. As the main objective of the protocol, it was accepted to reduce the total greenhouse gas emissions of the states of Annex-I by 5.2% from the level of year 1990 between the years 2008 and 2012. This objective emerged not as a result of scientific criteria, but as a result of negotiations among the states. Each state of Annex-I was anticipated to make a different contribution for this total objective. In other words, the goal of 5.2% was set not as a goal that each state is obliged to attain, but as a goal planned to be attained in total by the emissions of all the states of Annex-I through higher mitigation of some states (8% by EU states, 7%

[55] Struggle with climate change has two steps: mitigation and adaptation. Taking under control the human sourced greenhouse gas emissions causing climate change, measures for mitigation and constraining of the same are being classified as mitigation, and struggling with the effects of climate incidences (risks), and strengthening, developing and implementing strategies in order to avail and manage the effects are being classified as adaptation.

by USA etc.) and lower reduction -or reduction from increase- of some (0% by Russia, 8% by Australia etc.) (UNFCCC, 1998).

Adopted by great expectations, Kyoto Protocol could provide limited contribution to struggle with climate change. The disapproval of the protocol by USA, which is responsible for the highest emission of the period, significantly limited the impact of the protocol. The enforcement of the protocol was delayed by 8 years due to disapproval of USA. Moreover, the protocol was imposing an obligation only on the states of Annex-I. Developing countries such as China, India etc., generating high emission, were not liable for reduction of emission as being out of the Annex.

Despite that, it is possible to address the Kyoto Protocol as a pioneer step. The states accepted for the first time to take concrete steps regarding the issue of climate change. The protocol has developed very innovative approaches, and has established the mechanism of carbon trade.

The Process of Copenhagen and After

The inability of Kyoto Protocol to provide the expected emission mitigation brought up to the agenda the drafting of an extensive convention which would impose goals on all the states. By this convention, it was anticipated to continue with the mitigations without slowing down in 2013 and in the following period after the expiry of the implementation period of Kyoto Protocol. For the required mitigation of emissions, measures which would ensure the mitigation of rapidly increasing emissions of developing countries were also taken in the agenda. The states that gathered in Copenhagen in 2009 (COP 15) left without being able to reach an agreement on a binding convention despite long lasting negotiations. A reconciliation text was published as the output of Copenhagen. This text, which wasn't legally binding, invited the states to keep the global temperature increase below 2°C.

The inability of the states to reach an agreement at the Copenhagen Conference brought to the agenda the question of whether the struggle with climate change came to an end. Although referred to as failure in general, the Copenhagen process actually has to be accepted as a significant step directing the world to Paris Convention. In Copenhagen, contrary to Kyoto Protocol, the states covered and not covered by the Annex carried out a negotiation process in real terms. One of the mishaps of Copenhagen Conference is its organization without overcoming the impacts of the economic crisis of 2008.

Following Copenhagen, it was agreed at Doha (COP 18) to extend the commitment period of Kyoto Protocol until 2020 (Kyoto Protocol 2nd Commitment Period). The support to that second period decreased more[56].

Paris Convention

The inability of Kyoto Protocol to provide the required mitigation and the inability to reach an agreement also in Copenhagen decreased the expectations for a new climate convention for a while. The increase of

[56] The sufficient number of state parties and emission limit required for the enforcement of the second period of Kyoto Protocol have yet to be reached.

greenhouse gas emissions without slowing down, and scientific data published by IPCC played a significant role in recalling and understanding the emergency and significance of a convention which would limit the greenhouse gas emissions.

Preparations Prior to Paris

The increasing continuation of greenhouse gas emissions enabled the states to substantially take the new climate convention into the agenda at COP meetings. The negotiators focused on developing a model which would enable non repetition of the failure of Copenhagen Conference. Within this scope, it was accepted to set the goals of states not from top to bottom at the table of negotiation, but from bottom to top as being determined nationally by the states. The most significant step taken within this scope was inviting the state parties to submit INDC (Intended Nationally Determined Contribution) at the Warsaw Conference which was held in 2013. This approach, which was highly criticized in that period, is actually the cornerstone of the acceptance of Paris Convention. The agreement of USA and China, which was ensured in 2014 as a result of the American policies, that changed under the management of Obama, also provided significant contribution to the process.

The approach of INDC gained recognition by the state parties. Active operation of the secretariat of UNFCCC, its well communication and cooperation with the state parties in the process ensured the receipt of statements of about 180 states. This created a great difference compared to Copenhagen. Imposing the goals of the states to the states themselves by the INDC accelerated the undertaking processes of the governments. While the rapid sharing of the presented INDC with the world strengthened the transparency of the process, it also increased the pressure on the governments.

Paris Agreement

The states, that gathered in Paris in December 2015 (COP21), reached an agreement on the most extensive international agreement of history. Paris Agreement suggested as a clear goal to increase the efforts of keeping the increase of temperature much below 2°C, and if possible below 1.5°C. The concept of carbon Budget, considered in order to attain that goal, requires the global emissions to decrease to negative values in the long term.

Paris Agreement, unlike the Kyoto Protocol, imposes responsibility on all developed and developing states. The Agreement is established on Nationally Determined Contributions (NDC) which would enable the states to be able to act by common but differentiated responsibilities in the direction of plans that they determine as per their own capacities[57]. Within the scope of the Agreement, the developed countries are expected to lead the efforts of mitigation of greenhouse gas emissions considering their historical responsibilities on the struggle with climate change. And the mitigation efforts of developing countries will be encouraged in time. Within this scope, climate finance mechanism will be formed which is

[57] Intended Nationally Determined Contributions (INDC), submitted by the party states prior to agreemenr, are being deemed as Nationally Determined Contributions (NDC) by reaching an agreement.

anticipated annually to be 100 billion dollars after 2020. This will be the base price, and it will be sustained as updated as per the concrete requirement analyses as from 2025.

Paris Convention is of the nature of a great message for the governments, local administrations, and private sector. After that, the impact of climate will be necessarily required to be considered on all the significant economic decisions.

The Agreement should not be considered to be sufficient in struggle with climate change only by itself. In order to attain the goal of 1.5°C, and even 2°C, there is more way to go. UNEP emphasizes that even if the governments fulfil their liabilities in the NDC presented by them within the scope of Paris Convention that it will not be possible to limit the global temperature increase by 2°C (UNEP, 2016). In this respect, it is required for the states, and of course for the private sector to take significant steps.

We can summarize the significant outputs of the Paris Convention as follows:

- Paris Convention anticipates a specific global temperature goal unlike the Kyoto Protocol. The decision arising as a result of the negotiations was in the direction of keeping the increase much below 2°C by the end of the century, and sustaining the efforts in order to be able to ensure 1.5°C.
- Unlike the Kyoto Protocol, Paris Agreement imposes responsibility on all the states. The Agreement is established on Nationally Determined Contributions (NDC) which would enable the states to be able to act by common but differentiated responsibilities in the direction of plans that they determine as per their own capacities. Within the scope of the Agreement, the developed countries are expected to lead the efforts of mitigation of greenhouse gas emissions considering their historical responsibilities on the struggle with climate change. Developing countries will be encouraged in their efforts to strengthen in time.
- The concept of Carbon Budget, which is not included in Kyoto Protocol, but which is considered in Paris Agreement, is strengthening the efforts of determining peak year for the emissions. According to this calculation, it is required to use only one third of the total carbon budget in order to keep the committed temperature increase, because two thirds of it has already been used. In this sense, it is expected for the states to attain the peak emission values quickly as much as possible, and to tend to mitigation in order to not consume the total global carbon budget. Thus it is intended to establish a balance between human sourced emissions and capacity of sink areas as from 2050.
- With the Agreement, it has become an obligation for the developed countries to provide funds to developing countries for their material burdens that they would spend in struggle with climate change. And the other states will be able to provide financial aid if they wish on a volunteer basis. There will be a climate financing resource which will be formed with the purpose of increasing the capacities of struggling of states that are affected from climate change the most and that have the lowest capacity to struggle with the same, reinforcing the adaptation measures, and developing the other measures that they may require. In this resource, defined with the name of Green Climate Fund, it is anticipated to annually collect 100 billion dollars from developed countries as from year 2020. This will be the base price, and it will be sustained as updated as per the concrete requirement analyses as from 2025.

- In the current state, the INDCs are able to keep the temperature increase of earth only slightly below 3°C. At the summit, it was decided to assess the goals of all the parties in 2023 considering their goals in total, and to make it subject to re-assessment process in each following 5 years. It is intended for the results of these assessments to guide the states in making their goals more assertive.
- The requirement of covering the damages and losses of states, which are the most vulnerable against the negative impacts of climate change, is recognized within the scope of Paris Agreement, but the route to a legal process in the direction of indemnification of such losses is not open, and how the mechanism will operate is ambiguous.

The most significant problem of the Paris Agreement will come to the forefront as the issue of execution of the Agreement. Even if the Paris Agreement is defined as legally binding, there is no specific execution mechanism for the implementation of the Agreement and the NDC. In the following period, it is possible to strengthen the monitoring, reporting and verification (MRV) mechanism. The most significant sanction will be "revealing" the states which don't keep their words as a result of a process operating transparently. This state is also important for private sector besides the governments. The scandals of some automotive brands realized in the year 2015 relevant to exhaust nitrogen oxide emission values made a big blow on the value of brands besides the penalties that they encountered.

For the Agreement to come into force, it was required for the Agreement to be signed by the governments representing at least 55% of the greenhouse gas emissions, or by at least 55 state parties. The Agreement was opened for signature in New York by the beginning of 2016, and it entered into force within one year following its acceptance on November 4, 2016 after the rapid completion of required signature and national approval processes. Considering that the enforcement of Kyoto Protocol -which had much less emission reduction target- took 8 years, the Paris Agreement attained a great success.

The election of Trump in November 2016 as the president of USA slowed down this wind of success of Paris Agreement. It is expected for USA -which is the second state of the world responsible for the highest emission, and which is required to be a significant supporter of climate funds to be provided to developing countries- to review its climate policies under the administration of Trump, and to consider the mitigation policies more negatively.

Paris Agreement is of the nature of a great message for the governments, local administrations, and private sector. After that, the impact of climate will be necessarily required to be considered on all the significant economic decisions. And this will create a multiplier impact. The Re-De operations will accelerate, and tendency to investments with high environmental performance will increase. Carbon tax and carbon pricing will be on our agenda. Most important of all, the way of renewable energy will be opened than ever before. The researches are already indicating that the cheapest energy source will be the sun in 15 years. Accordingly, expecting the occurrence of leaps in technology will not be a dream. In the following process, we can also expect that the cities will come to the forefront more on the issues of mitigation of emissions and adaptation.

ANNEX 2 - BASIC DOCUMENTS REGARDING THE CLIMATE POLICIES OF TURKEY

National Documents

- Law no 4990 on Assent of Accession to United Nations Framework Convention on Climate Change
- http://www.resmigazete.gov.tr/eskiler/2003/10/20031021.htm#7
- Law no 5836 on Assent of Accession to Kyoto Protocol Relevant to United Nations Framework Convention on Climate Change
- http://www.resmigazete.gov.tr/eskiler/2009/02/20090217-1.htm
- National Climate Change Strategy Document 2010 - 2023
  http://webdosya.csb.gov.tr/db/iklim/banner/banner592.pdf
- Climate Change National Action Plan 2011 - 2023
- http://webdosya.csb.gov.tr/db/iklim/banner/banner591.pdf
- Turkey's Climate Change Adaptation Strategy, and Action Plan 2011 - 2023
  http://webdosya.csb.gov.tr/db/iklim/editordosya/uyum_stratejisi_eylem_plani_TR.pdf

National Documents presented to UNFCCC

- National Greenhouse Gas Emission Inventory Reports
- http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/10116.php
- Turkey's National Communication on Climate Change under the UNFCCC
  - First Communication:
  - http://iklim.cob.gov.tr/iklim/Files/bildirim1.pdf
  - Fifth Communication (covering the Communications 2, 3 and 4):
    http://idub.csb.gov.tr/images/files/Turkiye-Iklim-Degisikligi-5-Bildirimi.pdf
  - Sixth Notice:
    https://webdosya.csb.gov.tr/db/destek/editordosya/Turkiye_Iklim_Degisikligi_Altinci_Ulusal_Bildirimi.pdf
- Two-Year Reports of Turkey within the Scope of UNFCCC
  - First and Second Biennial Reports:
    http://unfccc.int/files/national_reports/biennial_reports_and_iar/submitted_biennial_reports/application/pdf/1428795_turkey-br3-1-tur.br3.english.pdf
  - Third Biennial Report:
    http://unfccc.int/files/national_reports/biennial_reports_and_iar/submitted_biennial_reports/application/pdf/1428795_turkey-br3-1-tur.br3.english.pdf
- Turkey's Intended Nationally Determined Contributions
  http://www4.unfccc.int/Submissions/INDC/Published%20Documents/Turkey/1/The_INDC_of_TURKEY_v.15.19.30.pdf

ANNEX 3 - EMISSION FACTORS

National and international emission factors have been used in the process of drafting the inventory. For these factors, the updated guides of 2018 National Inventory Communication, and 2006 IPCC National Greenhouse Gas Inventory have been used. The emission factors used at the stage reached in the study are listed in table 32.

Table 32 - Emission Factors Used in the Study

Source of Emission	Type of Fuel	Unit	Emission Factor		
			CO_2	CH_4	N_2O
Solid Fuel (Residential)	Hard Coal	kg/TJ	99520	300	1,5
Gas Fuel (Residential)	Natural Gas	kg/TJ	56040	5	0,1
Liquid Fuel (Residential)	Fuel Oil	kg/TJ	67860	25	8
Gas Fuel (Commercial / Institutional)	Natural Gas	kg/TJ	56040	5	0,1
Solid Fuel (Industry)	Hard Coal	kg/TJ	98225	9,7	1,45
Gas Fuel (Industry)	Natural Gas	kg/TJ	56040	1	0,1
Electricity Consumption	Electric	kg/kWh	0,4906	0,00033	0,000015
Gasoline (Highway)	Gasoline	kg/TJ	69300	25	8
Diesel Oil (Highway)	Diesel Oil	kg/TJ	73430	3,9	3,9
Diesel Oil (Railway)	Diesel Oil	kg/TJ	73430	4,15	28,6
Gas Fuel (Highway)	LPG	kg/TJ	63067	62	0,2
Jet Kerosene (Aviation)	Jet Kerosene	kg/TJ	71500	0,5	2
Regularly Stored Solid Waste		kg/kg		0,0058	
Composting		kg/kg		0,0040	0,0002
Waste Water (Dissolved Carbon)		kg/kg DC		0,075	
Waste Water (Nitrogen)		kg/kg N			0,005
Fertilizer (Nitrogen)		kg/kg N			0,01
Cattle (enteric fermentation)		kg/head		60,73	
Buffalo (enteric fermentation)		kg/head		55	
Sheep (enteric fermentation)		kg/head		5,1	
Goat (enteric fermentation)		kg/head		5	
Camel (enteric fermentation)		kg/head		46	
Horse (enteric fermentation)		kg/head		18	
Donkey (enteric fermentation)		kg/head		10	
Poultry (enteric fermentation)		kg/head			
Cattle (manure management)		kg/head		8,06	0,45
Buffalo (manure management)		kg/head		1,44	0,57
Sheep (manure management)		kg/head		0,12	
Goat (manure management)		kg/head		0,15	0,05
Camel (manure management)		kg/head		1,89	
Horse (manure management)		kg/head		1,35	0,13
Donkey (manure management)		kg/head		0,73	0,07
Poultry (manure management)		kg/head		0,02	0,0008

ANNEX 4 - CIRIS GENERAL ASSESSMENT TABLE

OVERVIEW (GPC CHAPTER 4.4, TABLE 4.2, PAGE 41)

NAME OF CITY:	Denizli, Turkey	**POPULATION:**	1.005.687
LEVEL:	BASIC+	**LAND AREA (km2):**	11.868
INVENTORY YEAR:	2016	**GDP (US$ million):**	11.086

CIRIS

GHG Emissions Source (By Sector)		Total GHGs (metric tonnes CO2e)					
		Scope 1	Scope 2	Scope 3	BASIC	BASIC+	BASIC+ S3
STATIONARY ENERGY	Energy use (all emissions except I.4.4)	1.635.897	1.649.444		3.285.341	3.285.341	3.285.341
	Energy generation supplied to the grid (I.4.4)	2.083.447					
TRANSPORTATION	(all II emissions)	1.729.770	1.333		1.731.104	1.731.104	1.731.104
WASTE	Waste generated in the city (III.X.1 and III.X.2)	78.092			78.092	78.092	78.092
	Waste generated outside city (III.X.3)						
IPPU	(all IV emissions)	1.560.472				1.560.472	1.560.472
AFOLU	(all V emissions)	847.659				847.659	847.659
OTHER SCOPE 3	(all VI emissions)						
TOTAL		7.935.337	1.650.777		5.094.537	7.502.667	7.502.667

GPC ref No.	GHG Emissions Source (By Sector and Sub-sector)	Total GHGs (metric tonnes CO_2e)			
		Scope 1	Scope 2	Scope 3	Total
I	STATIONARY ENERGY				
I.1	Residential buildings	673.050	317.639	NE	990.689
I.2	Commercial and institutional buildings and facilities	80.703	376.921	NE	457.623
I.3	Manufacturing industries and construction	882.145	915.655	NE	1.797.800
I.4.1/2/3	Energy industries	IE	IE	NE	
I.4.4	Energy generation supplied to the grid	2.083.447			
I.5	Agriculture, forestry and fishing activities	IE	39.229	NE	39.229
I.6	Non-specified sources	NE	NE	NE	
I.7	Fugitive emissions from mining, processing, storage, and transportation of coal	NE			
I.8	Fugitive emissions from oil and natural gas systems	NE			
SUB-TOTAL	(city induced framework only)	1.635.897	1.649.444		3.285.341
II	TRANSPORTATION				
II.1	On-road transportation	1.713.552	NE	NE	1.713.552
II.2	Railways	4.820	1.333	NE	6.154
II.3	Waterborne navigation	NO	NO	NO	
II.4	Aviation	11.397	NE	NE	11.397
II.5	Off-road transportation	IE	NE	NE	
SUB-TOTAL	(city induced framework only)	1.729.770	1.333		1.731.104
III	WASTE				
III.1.1/2	Solid waste generated in the city	60.825		NO	60.825
III.2.1/2	Biological waste generated in the city	736		NO	736
III.3.1/2	Incinerated and burned waste generated in the city	NO		NO	
III.4.1/2	Wastewater generated in the city	16.531		NO	16.531
III.1.3	Solid waste generated outside the city	NO			
III.2.3	Biological waste generated outside the city	NO			
III.3.3	Incinerated and burned waste generated outside city	NO			
III.4.3	Wastewater generated outside the city	NO			
SUB-TOTAL	(city induced framework only)	78.092			78.092
IV	INDUSTRIAL PROCESSES and PRODUCT USES				
IV.1	Emissions from industrial processes occurring in the city boundary	1.560.472			1.560.472
IV.2	Emissions from product use occurring within the city boundary	NE			
SUB-TOTAL	(city induced framework only)	1.560.472			1.560.472
V	AGRICULTURE, FORESTRY and OTHER LAND USE				
V.1	Emissions from livestock	588.075			588.075
V.2	Emissions from land	NE			
V.3	Emissions from aggregate sources and non-CO2 emission sources on land	259.583			259.583
SUB-TOTAL	(city induced framework only)	847.659			847.659
VI	OTHER SCOPE 3				
VI.1	Other Scope 3			NE	
TOTAL	(city induced framework only)	5.851.890	1.650.777		7.502.667

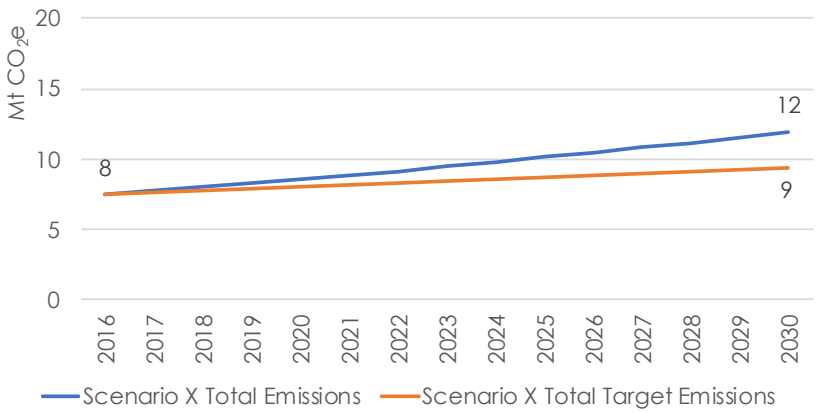
ANNEX 5 - CHANGE OF EMISSIONS

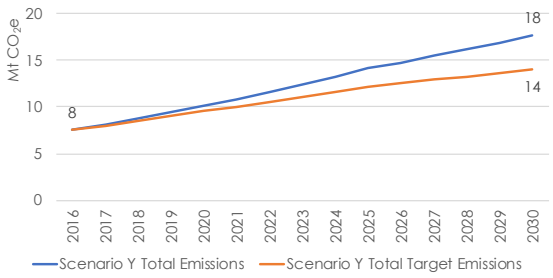
Change of Total Emissions as per Scenarios, and Reduction Target

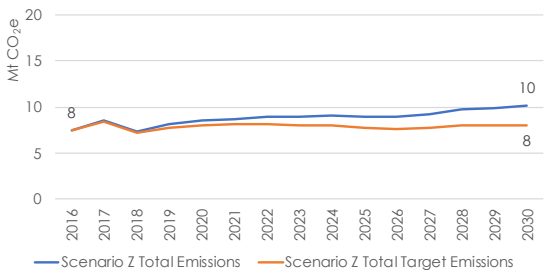
Table 33 - Denizli's Total Emission Projection as per Scenarios

	Scenario X		Scenario Y		Scenario Z	
Year	Total Emission	Total Targeted Emission	Total Emission	Total Targeted Emission	Total Emission	Total Targeted Emission
2016	7,502,667	7,502,667	7,502,667	7,502,667	7,502,667	7,502,667
2017	7,759,237	7,642,848	8,099,083	7,977,597	8,558,020	8,429.650
2018	8,021,171	7,780,536	8,739,354	8,477,173	7,379,010	7,157,640
2019	8,294,133	7,920,897	9,432,587	9,008,121	8,072,029	7,708,787
2020	8,576,100	8,061,534	10,180,490	9,569,661	8,494,932	7,985,237
2021	8,867,513	8,202,449	10,870,108	10,054,850	8,735,978	8,080,780
2022	9,168,952	8,343,746	11,606,565	10,561,974	8,876,361	8,077,488
2023	9,480,731	8,485,254	12,393,004	11,091,739	9,003,606	8,058,227
2024	9,803,363	8,626,959	13,232,968	11,645,012	9,072,296	7,983,620
2025	10,137,232	8,768,706	14,130,091	12,222,528	8,901,002	7,699,366
2026	10,468,447	8,898,180	14,780,626	12,563,532	8,958,669	7,614,868
2027	10,820,695	9,035,280	15,471,674	12,918,848	9,199,861	7,681,884
2028	11,184,694	9,171,449	16,195,018	13,279,915	9,698,391	7,952,680
2029	11,560,856	9,306,489	16,952,193	13,646,515	9,912,509	7,979,569
2030	11,949,606	9,440,189	17,744,804	14,018,395	10,126,277	7,999,759

Figure 59 - Denizli's Total Greenhouse Gas Emissions as per Scenarios and Reduction Target





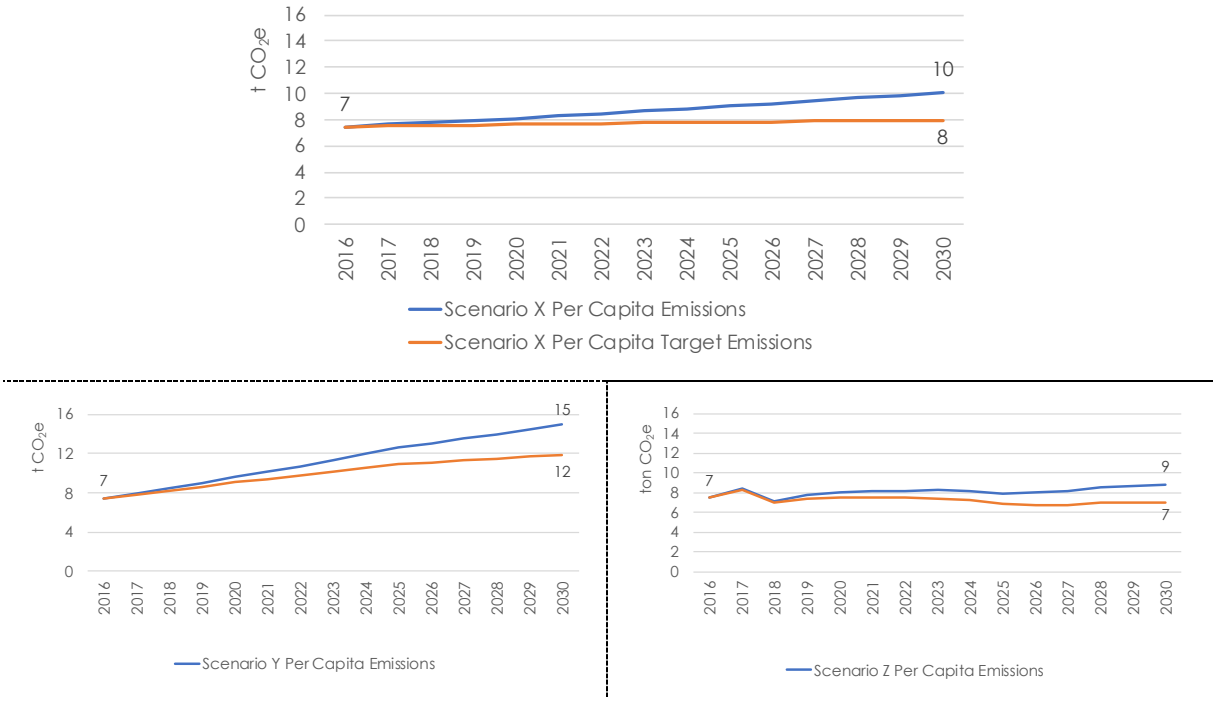


Change of Emissions per Person as per Scenarios, and Reduction Target

Table 34 - Denizli's Emission Projection per Person as per Scenarios

	Scenario X		Scenario Y		Scenario Z	
Year	Emission per Person	Targeted Emission per Person	Emission per Person	Targeted Emission per Person	Emission per Person	Targeted Emission per Person
2016	7	7	7	7	7	7
2017	8	8	8	8	8	8
2018	8	8	8	8	7	7
2019	8	8	9	9	8	7
2020	8	8	10	9	8	8
2021	8	8	10	9	8	8
2022	8	8	11	10	8	7
2023	9	8	11	10	8	7
2024	9	8	12	11	8	7
2025	9	8	13	11	8	7
2026	9	8	13	11	8	7
2027	9	8	13	11	8	7
2028	10	8	14	11	9	7
2029	10	8	14	12	9	7
2030	10	8	15	12	9	7

Figure 60 - Denizli's Greenhouse Gas Emissions per Person as per Scenarios and Reduction Target



ANNEX 6 - CLIMATE CHANGE MODELS, AND SCENARIOS

In this section, the forecasts for the impacts of climate change on Denizli, and general information relevant to models and scenarios considered in risk analysis etc. studies have been presented.

6.1. Climate Models

In order to anticipate the expected impacts of climate change, computer assisted **models**, being the mathematical projection of the components of climate system -which are also considering the past observations- and of the interaction among them, are used.

The most up-to-date models used extensively in the modelling studies of climate system are known as **General Circulation Model (GCM),** and **Global Climate Model.** GCM simulates the climate as to cover the air and water flows in atmosphere and/or oceans, and also the heat transfer.

Besides the GCMs, there is **Regional Climate Model (RCM)** which has similar task with the GCMs, but which is operated for a limited area of the world. As they cover a smaller area, the RCMs may be operated more quickly and with higher resolution compared to GCMs. A model having high resolution has smaller cells, and for that reason it may generate more detailed climate information for a specific area.

RCMs are means to "minimizing" the global climate information to local scale. This means receipt of information provided by a GCM or by large scale observations, and its implementation on a specific area.

> The scientists convert the physical principles -that the climate system and its components are subject to- to computer codes line-by-line. Generally the global climate models have a computer code of a length consisting of 18,000 pages. The models may be in different formats. As there may be models covering a specific area of the world or the climate system, models may be produced for the whole planet in a manner covering the atmosphere, oceans, glaciers and lands.[58]

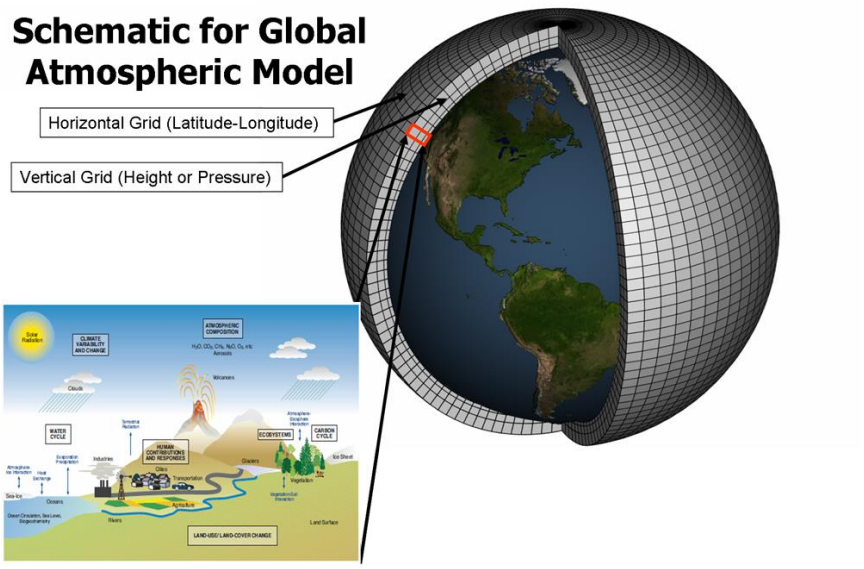
In order to run these models, super computers with great processor power are required. Due to complexity of climate system, and due to the requirement of very high processor power, the climate models are unable to make calculation for each m^3 of the climate system. Instead, global climate model divides the world to a number of boxes, namely to grids. The global model may have dozens of layers along the height and depth of the atmosphere and oceans.

The size of these grids is known as the **model's resolution**. The models having low resolution generally have grids with a resolution (size) of 100kmX100km. The models with high resolution will have smaller grids. While the models with high resolution are able to provide more detailed climate information for a specific area, the running of these models lasts for a longer period as they require more calculations. The following picture shows what these grids look like in three dimensions. Then the model calculates the

[58] How the Climate Models Operate? Carbon Brief, URL: https://www.carbonbrief.org/qa-how-do-climate-models-work

status of climate system at each grid based on factors such as temperature, air pressure, humidity and wind speed.

Figure 61 - Schematic representation of global atmosphere model[59]

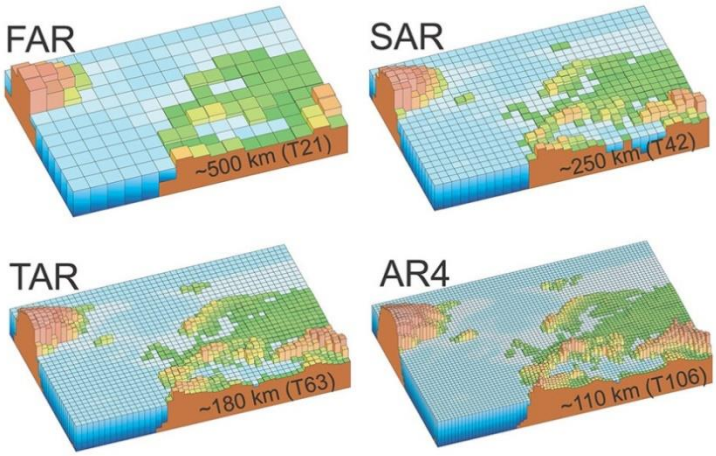


For the time detail of the models, there is a similar limit relevant to resolution. The frequency of calculation of the state of climate system is subject to difficulties as in the spatial resolution of the models (While modelling the changes in the following hundred years minute by minute require operations of more than 50 million for each grid, modelling day by day requires much less operations).

In the real world time is continuous, but it is required to divide the time in pieces in order to make the calculations of a model manageable. Although minimizing the time intervals in the model increases the details relevant to the climate system, it increases the calculations in the running of the model.

[59] How do Climate Models Work? Carbon Brief, URL: https://www.carbonbrief.org/qa-how-do-climate-models-work

Figure 62 - Development of the resolution of the models used in IPCC assessment reports[60]



In brief, a climate model may ensure the whole climate system to be represented with intervals of 30 minutes along tens and even hundreds of years.

6.2. Climate Scenarios

The basic inputs in climate models are known as **external factors** which may cause change in the amount of solar energy kept by the world. These external factors are called as "**constraints**". These are the amount of solar energy reaching the world, long-lasting greenhouse gases (CO_2, CH_4, N_2O and halocarbons), and aerosols. Generally these individual constraints are run in the model along with the best estimations of the past observations, or along with the inputs of future emission scenarios.[61]

What are the IPCC Climate Scenarios?

In the climate change modelling studies, many factors are considered while trying to estimate how the future temperature increase will affect the climate change. And the amount of future greenhouse gas emissions is the main one among them. The developments of technology, changes in energy production and land usage, global and regional economic conditions, and population increase are also significant inputs in climate models.[62]

The future greenhouse gas emissions will arise as a result of complex and dynamic systems just like today. Different emission amounts will create different impacts on the systems of the planet. Alternative scenarios for the future prepared through the consideration of many factors such as demographic tendencies, socio-economic development, developments in technology are prepared in order to decrease uncertainties regarding climate change in some respect, and in order to be able to discuss the possible measures. As it is very risky to determine the possible impacts, and the adaptation and mitigation measures of climate change as per a single scenario, alternative future scenarios are formed considering the best and worst possibilities, the options in between, and the developed scientific climate models. Within the scope of SRES (Special Report on Emission Scenarios) in the

[60] How the Climate Models Operate? Carbon Brief, URL: https://www.carbonbrief.org/qa-how-do-climate-models-work
[61] How the Climate Models Operate? Carbon Brief, URL:https://www.carbonbrief.org/qa-how-do-climate-models-work
[62] http://denning.atmos.colostate.edu/ats760/Readings/RCP_Guide.pdf

IPCC assessment reports (up to fifth), more than 40 different scenarios -which are open to public and science world, and which are developed in a participative manner- were used, and alternative futures possible to arise were presented to the decision makers in the direction of different conditions, developments and options. And under IPCC 5th Assessment Report, 4 alternative courses of events have been defined until the end of the century under the heading of RCP (Representative Concentration Pathways). These are RCP2.6, RCP4.5, RCP6.0 and RCP8.5.

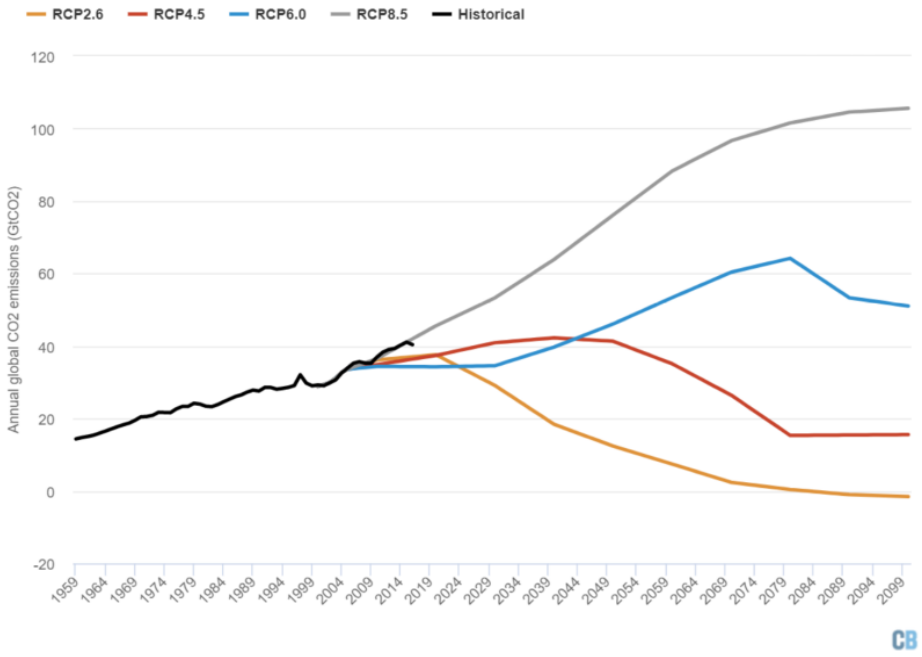
Majority of the current climate models have adopted the approach of the scenario called "**Representative Concentration Pathways (RCP)**" defining the future possible emission accumulation scenarios which forms also the basis of the IPCC 5th Assessment Report. Different emission scenarios cause different results in the radiative equilibrium of the world. In this approach, 4 different future emission scenarios have been defined.[63]

- **RCP 8.5: The emissions continue to increase at today's rate:** By 2100, increase in radiative constraint at an amount of 8,5W/m^2, and temperature increase of 4,3°C (3,2-5,4°C) compared to the average of 1850-1900, and 1.370 CO_2e
- **RCP 6.0: The emissions increase until 2080, and decrease after that date:** By 2100, increase in radiative constraint at an amount of 6,0W/m^2, and temperature increase of 2,8°C (2,0-3,7°C) compared to the average of 1850-1900, and 850 CO_2e
- **RCP 4.5: The emissions are fixed as the half of today's amount by 2080:** By 2100, increase in radiative constraint at an amount of 4,5W/m^2, and temperature increase of 2,4°C (1,7-3,2°C) compared to the average of 1850-1900, and 650 CO_2e
- **RCP 2.6: The emissions decrease by half by 2050:** By 2100, increase in radiative constraint at an amount of 2,6W/m^2, and temperature increase of 1,6°C (0,9-3,2°C) compared to the average of 1850-1900, and 490 CO_2e

In the policies implemented according to the **RCP4.5** scenario, which is considered in the risk analysis study, the concentration of CO_2 is fixed by the midst of the century, but the temperatures are unable to be balanced prior to 2100. These policies cover transition to low carbon energy technologies, and commissioning of carbon capture and storage. In RCP4.5, it is possible to have up to 650 CO_2e, and for the global temperatures to be 2-3°C above the levels prior to industry by 2100. **RCP8.5**, which is another scenario considered in the risk analysis study, is the scenario of "relatively high greenhouse gas emissions" caused by the rapid population increase, high energy demand, dominance of fossil fuels and lack of climate change policies. This scenario is the one having the highest CO_2 increase among the four RCPs. The RCP8.5 scenario has been considered as the "worst case scenario".

[63] The next generation of scenarios for climate change research and assessment https://www.nature.com/articles/nature08823/tables/1

Figure 63 - The future course of CO_2 emissions as per the scenarios used in the IPCC 5th assessment report[64]



The models are run for these different "Representative Concentration Pathways", and the projections are obtained. In other words, climate change models operate by the acceptance of different scenarios in the future for the accumulation of greenhouse gases in the atmosphere. The future concentrations of greenhouse gas emissions, being among the basic factors of climate system on radiative constraint, depend on the change of use of technology, energy and lands in the following century.

6.3. Global and Regional Climate Change Models

6.3.1. CMIP5 - Coupled Model Intercomparison Project Phase 5

Global models under Coupled Model Intercomparison Project Phase 5 (**CMIP5**), prepared by the World Climate Research Program (WCRP), are run along with the IPCC Climate Scenarios developed by IPCC. **CMIP6** will be used in the 6th Assessment Report of IPCC.

Projection	Scenario	General Circulation Model	Reference Period	Projection Period	Resolution
CMIP5	RCP2.6 RCP4.5 RCP6.0 RCP8.5	More than 40	1971-2000	2013-2040 2041-2070 2071-2099	~100km

[64] https://www.carbonbrief.org/analysis-four-years-left-one-point-five-carbon-budget

7.3.2. CORDEX - Coordinated Regional Climate Downscaling Experiment

The products of Coordinated Regional Climate Downscaling Experiment (CORDEX), which are supported by the **World Climate Research Program** (WCRP), have been used in order to generate high resolution climate projections to be used in the regional climate change adaptation and impact assessment studies.

Projection	Scenario	General Circulation Model (GCM)	Reference Period	Projection Period	Resolution
CORDEX	RCP2.6 RCP4.5 RCP8.5	19-26 different RCM - GCM combination simulation	1989-2008	2006-2100	~12,5km and ~50km

7.3.3. WorldClim

WorldClim data have been obtained by statistically increasing the resolution of outputs of 18 of the models used under CMIP5. It reveals results very similar to the outputs of CMIP5.

Projection	Scenario	General Circulation Model (GCM)	Reference Period	Projection Period	Resolution
WorldClim	RCP2.6 RCP4.5 RCP6.0 RCP8.5	18 models selected among the CMIP5 models	1989-2008	2041-2060 2061-2080	~1km

7.3.4. Regional Climate Models Used for Turkey

There two different projection studies developed by Turkish State Meteorological Service (MGM) and GDWM for Turkey at regional scale. The information regarding these has been presented in the following table.

Table 35 - Regional Climate Models Used for Turkey

Projection	Scenario	General Circulation Model	Regional Circulation Model	Reference Period	Projection Period	Resolution
MGM	RCP4.5, RCP8.5	HadGEM2-ES	RegCM 4.3	1971-2000	2016-2100	20km
MGM	RCP4.5, RCP8.5	MPI-ESM-MR	RegCM 4.3	1971-2000	2016-2100	20km
MGM	RCP4.5, RCP8.5	GFDL-ESM2M	RegCM 4.3	1971-2000	2016-2100	20km
GDWM	RCP4.5, RCP8.5	HadGEM2-ES	RegCM 4.3	1971-2000	2015-2100	10km
GDWM	RCP4.5, RCP8.5	MPI-ESM-MR	RegCM 4.3	1971-2000	2015-2100	10km
GDWM	RCP4.5, RCP8.5	CNRM-CM5.1	RegCM 4.3	1971-2000	2015-2100	10km

ANNEX 7 - PAST AND CURRENT CLIMATIC IMPACTS

The climatic changes and impacts occurring in the recent past and today at the scale of Denizli Province may provide clues relevant to changes which may occur in the future. For instance, determination of where the damage and exposure occurs under extreme precipitation, and determination of significant infrastructures, assets and vulnerable societies facilitates understanding the possible risks which may occur in the future. In addition to this, it also gives an idea regarding the coping capacity of the city against negative incidences arising as a result of the dangers of extreme weather events.

> Natural events such as flood, avalanche, lightning, typhoon, snowstorm, twister, drought etc. arising from extreme changes in meteorological parameters such as temperature, precipitation, humidity, pressure etc. are defined as meteorological disasters by the impacts they cause.[65]

7.1. Overflows, Floods and Landslides

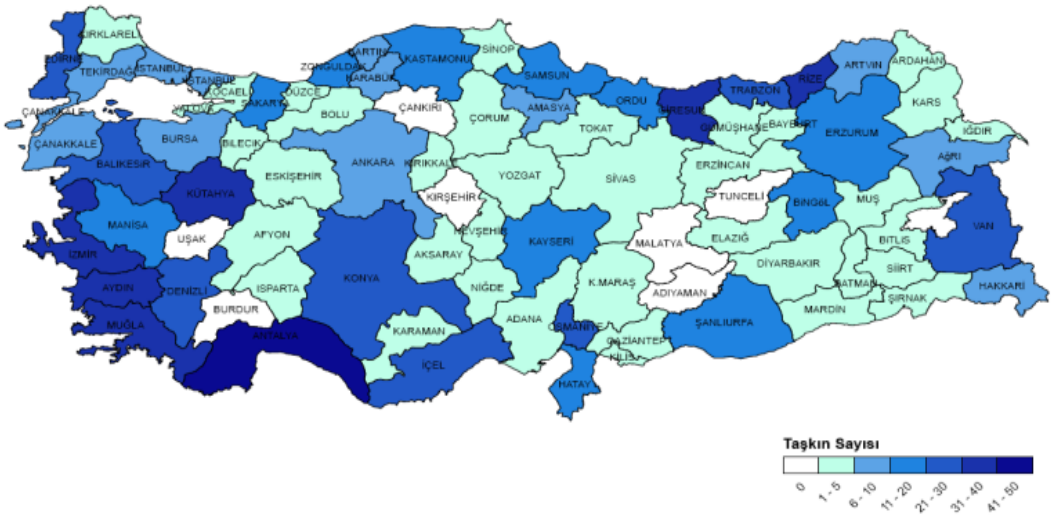
With the climate change, increase is observed in the severity and frequency of severe precipitation. That increase is expected to become more apparent in the following century. It is possible for the loss of lives, economic and environmental damages of the floods and urban stormwater to increase as a result of severe precipitation at locations where sufficient measures are not taken. The information regarding the floods and urban stormwater observed in Denizli Province has been presented below. The incidence of floods is defined as overflowing of a watercourse from its bed by various reasons, or temporarily covering of an area with water -which is dry under normal conditions- excluding the ones arising from city's sewerage system.[66]

When the distribution of floods which occurred in Turkey is examined on the basis of provinces, it is observed that the floods are intensifying in Eastern Black Sea, Mediterranean, Aegean and Thrace Regions (Province of Edirne). The number of floods, which occurred in between 2011-2014 in Denizli Province that is within the Aegean Region, has been between 31 and 40.

The main reasons of the floods are transforming the forestlands to agricultural lands without permission, removing the deep rooted trees and instead planting short rooted plants (tea, hazelnut etc.), passage structures that are built on the stream bed without permission and as against the technique, and that narrow the flow area, buildings and fillings, and covering the stream beds for long distances.[67]

[66] Turkey's Drought Assessment Report 2014, MGM, URL:https://www.mgm.gov.tr/FILES/iklim/yayinlar/2014/T%C3%BCrkiye-Kuraklik-Degerlendirmesi-2014.pdf
[66] http://suyonetimi.ormansu.gov.tr/Files/brosurler/TKYDB%20BROSUR%20AS%20YEN.pdf
[67]

Figure 64 - Distribution of Floods by Provinces in the Period of 2001-2014 (DSI)



According to the data obtained from the General Directorate of State Hydraulic Works (DSI), the floods which occurred in Denizli Province between 1960 and 2018 has been summarized in the following table.

Table 36 - Floods in Denizli Province (1960-2018)

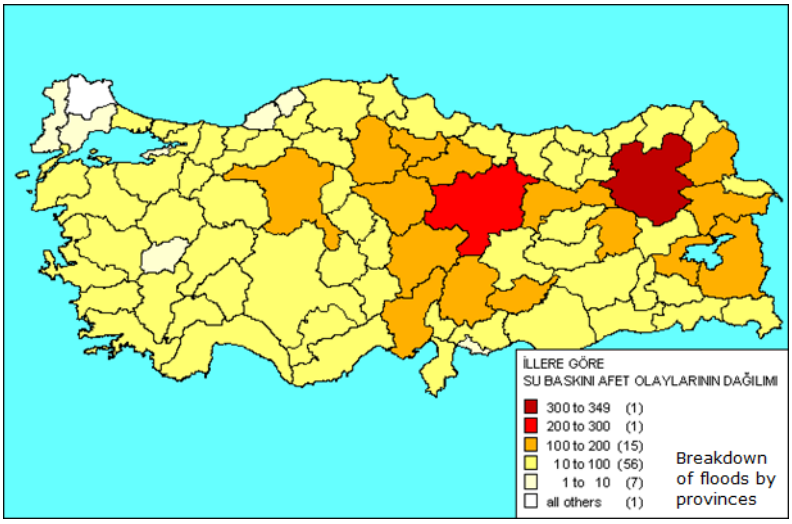
Year	Event	District	District	Cause of incidence	Number of deaths	Number of injured	Number of affected buildings / workplaces	Affected agricultural lands (ha)
02/09/2002	Floods	Çivril	Kıralan	Excessive precipitation	-	-	15	-
23/08/1999	Floods	Denizli	Merkez	Excessive precipitation	-	-	2	150
05/08/1999	Floods	Acıpayam	Yazır	Excessive precipitation	-	-	-	400
18/07/1999	Floods	Honaz	Pınarkent	Excessive precipitation	-	-	-	750
18/07/1999	Floods	Korucuk	Çürüksu	Excessive precipitation	-	-	8	300
10/08/1997	Floods	Çivril	Yukarıçapak	Excessive precipitation	2	-	1	100
08/07/1995	Floods	Denizli	Merkez	Excessive precipitation	-	-	200	-
08/07/1995	Floods	Bozkurt	Tutluca	Excessive precipitation	-	-	1	400
02/08/1991	Floods	Çivril	Gümüşsu	Excessive precipitation	-	-	-	300

26/07/1991	Floods	Çameli	Belevi	Excessive precipitation	-	-	18	150
28/07/1989	Floods	Acıpayam	Yazır	Excessive precipitation	-	-	-	650
08/08/1988	Floods	Serinhisar	Merkez	Excessive precipitation	-	-	-	200
12/06/1988	Floods	Serinhisar	İlçe merkezi	Excessive precipitation	-	-	-	-
17/06/1985	Floods	Honaz	Kaklık	Excessive precipitation	-	-	-	800
06/09/1983	Floods	Tavas	Konak	Excessive precipitation	-	-	50	-
15/12/1979	Floods	Acıpayam	Dereköy	Excessive precipitation	-	-	-	600
01/07/1979	Floods	Acıpayam	Yeşilyuva	Excessive precipitation	1	-	50	-
20/02/1978	Floods	Acıpayam	Sırçalık	Excessive precipitation	-	-	-	400
01/02/1978	Floods	Tavas	Altınova - Gali	Excessive precipitation	-	-	60	150
20/11/1975	Floods	Çivril	Kıralan	Excessive precipitation	-	-	8	-
09/05/1975	Floods	Tavas	Pınarlar	Excessive precipitation	-	-	-	3500
02/08/1969	Floods	Çal	Boğaziçi	Excessive precipitation	-	-	20	100
11/12/1968	Floods	Tavas	Altınova - Killik	Excessive precipitation	-	-	30	500
02/07/1965	Floods	Tavas	Bahçeköy	Excessive precipitation	-	-	70	-
17/06/1964	Floods	Çivril	Beydilli	Excessive precipitation	18	41	33	520
14/07/1960	Floods	Çivril	Irgıllı	Excessive precipitation	-	-	10	100

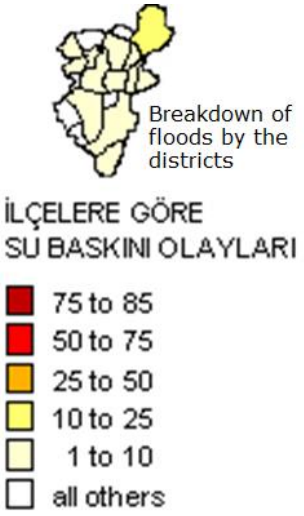
Büyük Menderes River and Dalaman Brook in the Denizli Province form floods at severe precipitation in winter months.

Figure 65 - Distribution of stormwaters by provinces and districts

Breakdown of floods by provinces



Breakdown of floods by the districts of Denizli



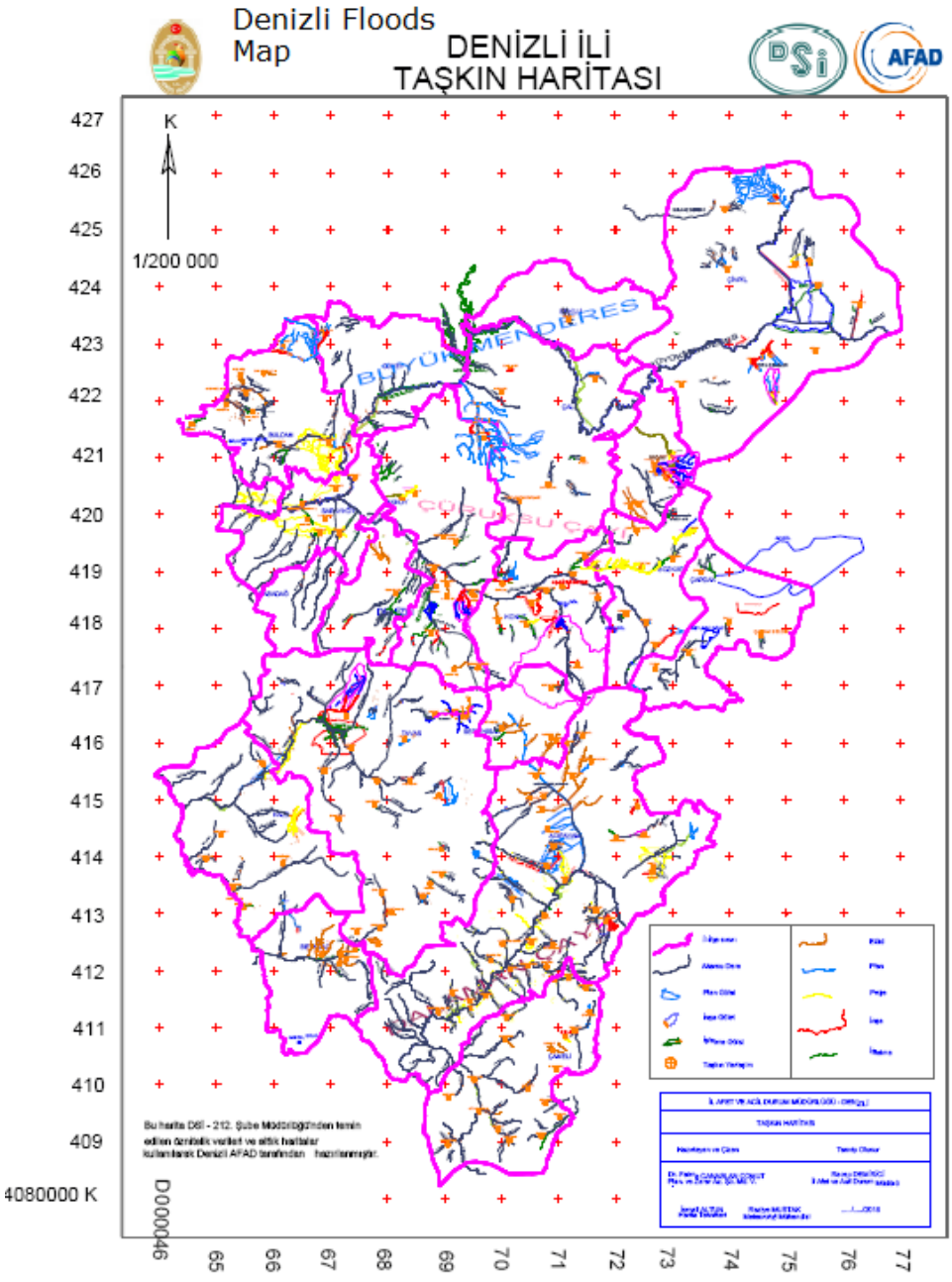
Water flows occur in rainy seasons and on days when sudden rain occurs along the Zindan Stream, Koru Stream and Domuz Stream at the west of local development zone of the Municipality of Denizli.

Although Büyük Menderes River is cut by channels, dams and dykes, it causes floods at villages such as A. Mahmutlar during severe precipitation, and thousands of decares of land are flooded. DSI tries to protect the villages within Büyük Menderes Basin through reclamation operations.

Dalaman Brook causes floods which affect the settlements of Denizli. Although under control by channels and dykes, flood occurs under very severe precipitation. The greatest impact of Dalaman Brook and its branches is the erosions that they cause at the area of Çameli.[68]

[68] Governorate of Denizli, Provincial Disaster and Emergency Directorate, Denizli Provincial Disaster Response Plan,2018

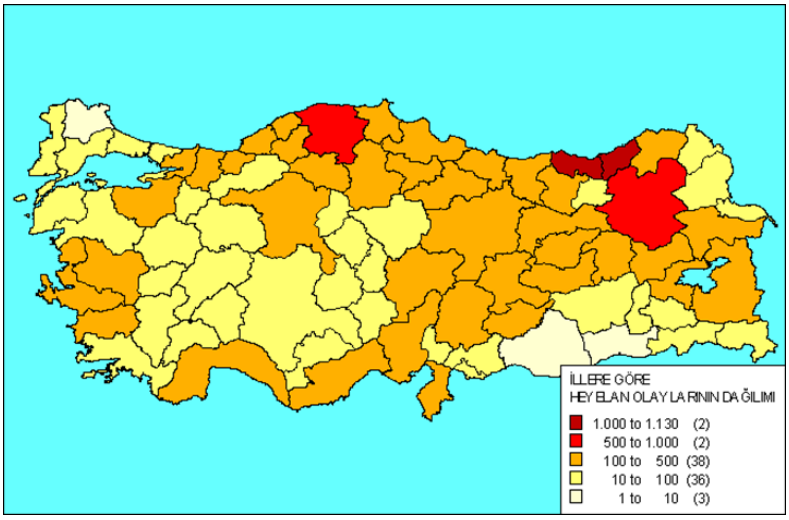
Figure 66 - Floods Map of Denizli Province



The landslide disaster, that is observed the most following earthquake in the Denizli Province, occurs at the districts of Babadag, Cameli, Buldan and Civril, and at their villages. Precipitation and non-discharged waters are impactive on slides.

Figure 67 - Breakdown of landslides by provinces and districts

Breakdown of landslides by provinces



Breakdown of landslides by districts of Denizli

According to the data obtained from Denizli Provincial Disaster and Emergency Directorate (AFAD), the disasters impactive and inimpactive on general life in Denizli Province between the years 1962 and 2015 have been summarized in the following table.

Table 37 - Disasters impactive on general life according to the data of AFAD (1962-2016)

AMB Date	Date of Report	Type of Disaster	District	Village / District	Number of Disaster Victims
20/09/2016	10/07/2015	LANDSLIDE	HONAZ	AKBAŞ	17
05/05/2014	23/01/2014	LANDSLIDE	KALE	DEMİRCİLER	1
25/06/2012	25/01/2012	LANDSLIDE	KALE	DEMİRCİLER	19
12/10/2009	16/04/2009	LANDSLIDE	BULDAN	GİRNE	29+3
29/06/2009	23/02/2009	LANDSLIDE	BABADAĞ	GÜNDOĞDU, GAZİ	8
06/02/2007	19/09/2006	LANDSLIDE	BABADAĞ	GÜNDOĞDU	486
30/04/1979	30/04/1979	SETTLEMENT	MERKEZ	GÖZLER	62
24/09/1968	19/01/1968	LANDSLIDE	BULDAN	BURSA,GÜROLUK	137
17/07/1962		LANDSLIDE	TAVAS	DELİLER (AKYAR)	65
17/07/1962		LANDSLIDE	BULDAN	DÜZALAN	8
17/07/1962		LANDSLIDE	ÇİVRİL	REŞADİYE	40
17/07/1962		LANDSLIDE	BABADAĞ	BEKİRLER	37
17/07/1962		LANDSLIDE	ACIPAYAM	BADEMLİ	21
17/07/1962	31/08/1959	ROCK FALL	BULDAN	NARLIDERE	274
17/07/1962		LANDSLIDE	KALE	MERKEZ/TABEA	377
17/07/1962		LANDSLIDE	TAVAS	ORTAKÖY	62

Table 38 - Disasters inimpactive on general life according to the data of AFAD (1962-2015)

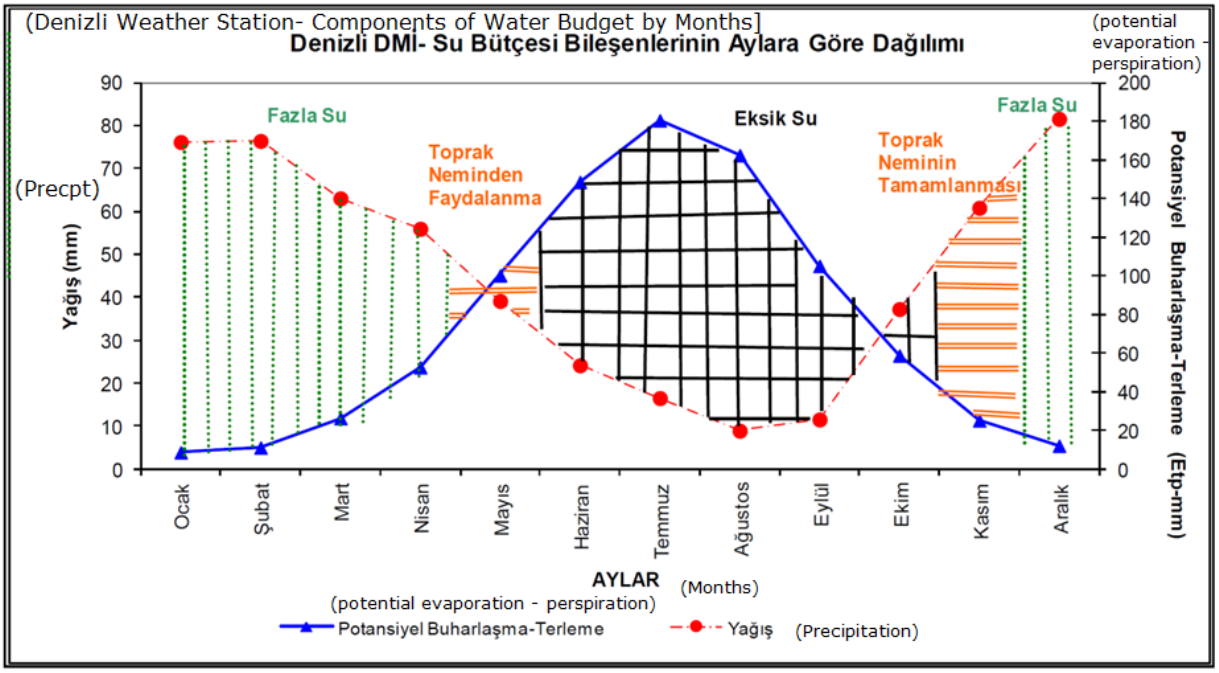
Date of Report	AMB Date	Type of Disaster	District	Village / District	Number of Disaster Victims
22/10/2015	19/09/2016	LANDSLIDE	KALE	ÇAKIRBAĞ	9
31/07/2015	19/09/2016	LANDSLIDE	ÇAMELİ	KOLAK	7
16/05/20-14	02/03/2015	LANDSLIDE	ÇAMELİ	EMECİK/YAYLACIK	2
24/04/2014	02/03/2015	LANDSLIDE	BABADAĞ	DEMİRLİ	2
20/08/2008	16/02/2009	ROCK FALL	ÇAMELİ	KIZILYAKA/KALAYCI	2
21/04/2008	18/08/2008	LANDSLIDE	BULDAN	GİRNE	9
25/07/2003	13/01/2004	LANDSLIDE	KALE	ÇAKIRBAĞ	5
07/01/2003	06/09/2004	LANDSLIDE	BULDAN	BÖLMEKAYA	0
10/02/2000	03/09/2001	ROCK FALL	MERKEZ	KÜÇÜKDERE	9
10/02/2000	19/03/2000	LANDSLIDE	BABADAĞ	KIRANYER	4
09/07/1999	05/06/2000	LANDSLIDE	ÇAMELİ	AKPINAR/BOYALI	3
02/05/1999	03/09/2001	LANDSLIDE	ÇAMELİ	EMECİK/OSMANLAR	9
30/03/1995	12/03/1997	ROCK FALL	ACIPAYAM	GÖLCÜK	
19/08/1993	20/12/1993	LANDSLIDE	ACIPAYAM	HİSAR/YUKARI	1
06/09/1991	17/09/1992	LANDSLIDE	BABADAĞ	AHILLI	4
15/05/1991	17/09/1992	ROCK FALL	ÇAMELİ	SOFULAR/ELMALI	2
12/04/1989	03/03/1990	ROCK FALL	ACIPAYAM	KARAİSMAİLLER/İNCİ	6
16/07/1984	01/09/1986	LANDSLIDE	ÇİVRİL	AKDAĞ	3
13/07/1984	01/09/1986	ROCK FALL	ÇİVRİL	DÜZBEL	24
05/11/1968	29/01/1969	FLOOD	ÇARDAK	SARAY,ÇINAR	377
05/04/1967	06/11/1967	FLOOD	ÇARDAK	MERKEZ	25
23/09/1966	08/04/1968	LANDSLIDE	ÇİVRİL	AŞAĞIÇAPAK	16
1964	14/11/1964	FLOOD	SARAYKÖY	UYANIK	120
12/09/1964	27/03/1965	FLOOD	ÇİVRİL	BEYDİLLİ	51
12/09/1964	27/03/1965	FLOOD	ÇİVRİL	ÇÖTEL	36
31/10/1963	30/03/1964	LANDSLIDE	BULDAN	ÇATAK	60
28/10/1963	30/03/1964	LANDSLIDE	KALE	ÇAKIRBAĞ	19

7.2. Drought, Waves of Heat and Cold Air

The United Nations Convention to Combat Desertification defines **drought** as the naturally occurring phenomenon that exists when precipitation has been significantly below normal recorded levels, causing serious hydrological imbalances that adversely affect land and water resources. Agricultural drought, meteorological drought and hydrological drought are the 3 main drought types.

According to the data of Denizli meteorology station, while there is surplus of water in December-January-February-March-April, it is observed that the increasing evaporation amount is partially covered from precipitation and partially from the humidity of soil -in case of suitability of the units- depending on the decrease of precipitation in May and high heat input due to high temperature, that lack of water occurs in terms of water budget in June-July-August-September-October which are very arid in the region, and that the humidity of soil is complemented in November.

Figure 68 - Distribution of Components of Water Budget as per Months (Denizli State Meteorological Service Meteorology Station)



Wave of Hot Air

The occurrence of average daily maximum temperature over 5°C for many years along 5 consecutive days is called as Wave of Hot Air, and the occurrence of average daily minimum temperature below 5°C for many years along 5 consecutive days is called as Wave of Cold Air.[69]

[69] Assessment of Year 2017 of Natural Disasters of Meteorological Character, MGM, URL: https://www.mgm.gov.tr/FILES/genel/kitaplar/2017MeteorolojikAfetlerDegerlendirmesi.pdf

Figure 69 - Stations Where Waves of Hot and Cold Air were Observed in 2017

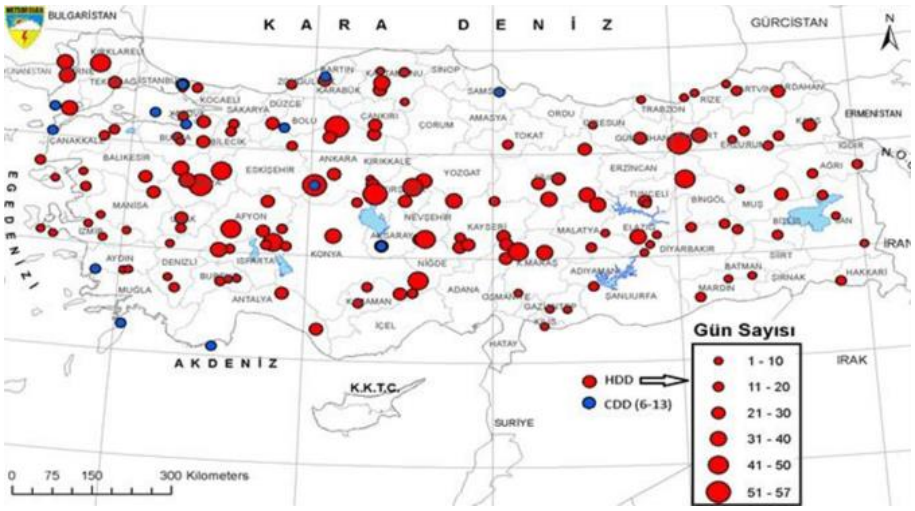
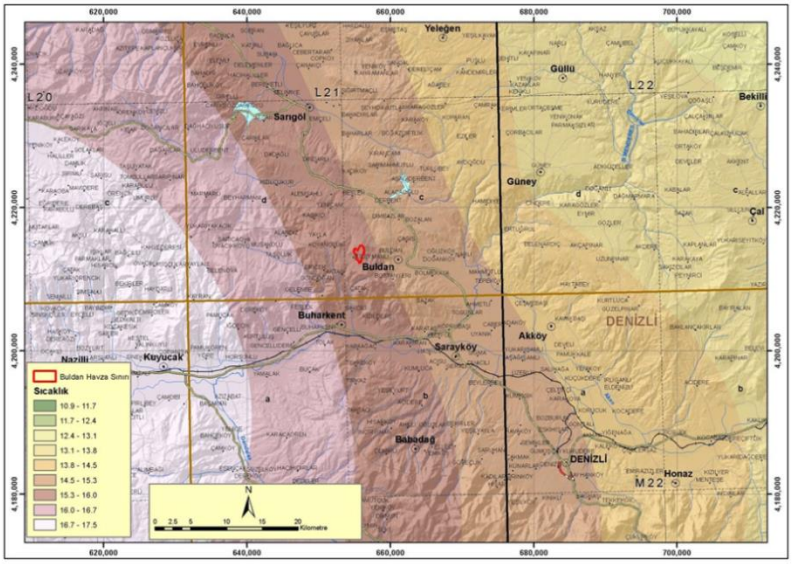


Figure 70 - Areal Temperature Map of Centre of Denizli Province and Its Vicinity



7.3. Meteorological Events Affecting the Agriculture Sector

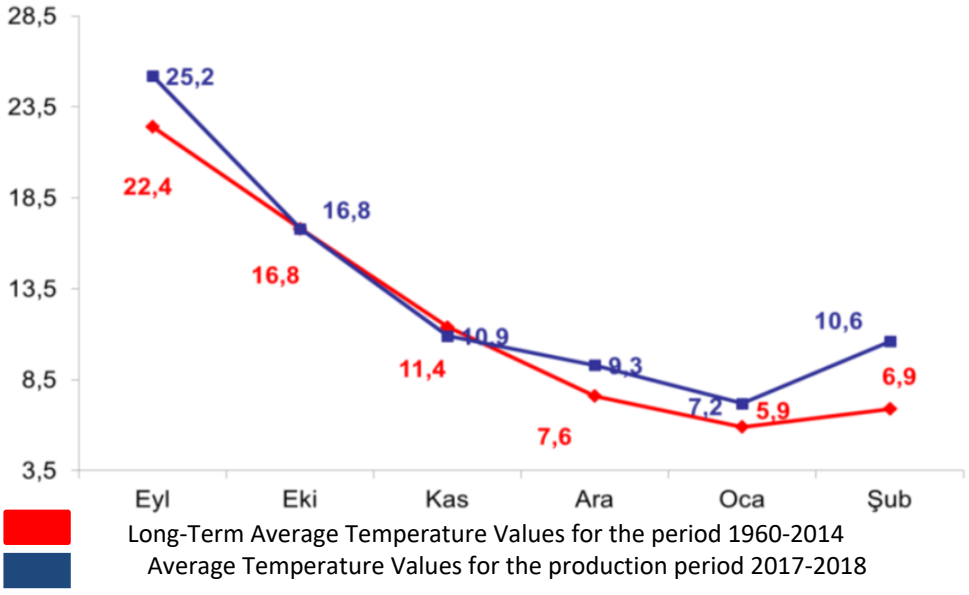
Agriculture sector is one of the most significant sectors that is rapidly expanding in Denizli Province. While the gross revenue obtained from agriculture was 741.513.287 TL in 2002, it increased to 7.304.399.000 TL with an increase of 885% in year 2017. In this section, records regarding the impacts of meteorological incidences such as agricultural drought, hail, excessive flood and wind etc. have been presented.

Agricultural Drought

Agricultural Drought is the state of lack of sufficient humidity in the root area of the plant for it to grow. Agricultural drought occurs when there is no sufficient humidity in soil in a critical period when a specific plant requires water along the period of its growth. In case of agricultural drought, it has an impact significantly decreasing the yield of products even if the soil is saturated in its depths. High temperatures, low relative humidity and drying winds cause to increase the impacts of scarcity of precipitation.[70]

As seen in the following figure, while the temperature average of many years between September and February is 11,8°C, the average temperature in the same period between 2017 and 2018 is 13,3°C. According to the average temperature of many years, a difference of 1,5°C is observed in the average temperature in the period 2017-2018. As this state is varying as per the type of plant, it brings forward the phenology by 20 days for the year 2018. For this reason, it has been determined that the risk of fruit trees to be affected from the early frosts of spring due to early blooming of them is high. When the data of the recent four years in the Denizli Province are examined, the risk of occurrence of late frosts of spring between April 20 and 25 is very high.

Figure 71 - Long-Term Average Temperature Values (°C) of Denizli Province (1960-2014), and values between 2017-2018 (September - February)

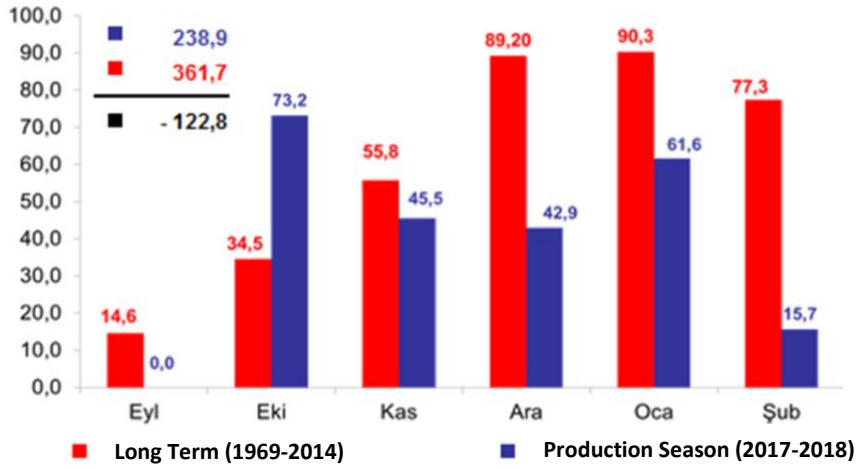


[70] http://suyonetimi.ormansu.gov.tr/Libraries/su/Kurakl%C4%B1k_Y%C3%B6netimi_%C5%9Eube_Sunumu.sflb.ashx

Late frosts of spring is the most dangerous climatic incidence causing great damage in terms of fruit growing. Although the late slight frosts damage only the product, the severe frosts occurring after the early awakening frostbite the flowers and gemmas, and they also damage the tiny and even thick branches of the trees. As the fruit trees that wake up early in the referred period will be in the period of flower and small fruits in phenological terms, impairment of them is inevitable. It is known that the rates of damage have direct relation with the location of the land, topographic structure of the land, direction and vector of the land, the farmer's maintenance, nutrition, fertilization, pruning, irrigation, chemical and hormone usage, and product load of the previous year.

In the period of 1960-2014, total precipitation amount is 361,7 mm per meter square. Total precipitation in the same period of years 2017-2018 actualized as 238,9 mm per meter square. It is observed that 122 mm precipitation per square, in other words 35% less precipitation occurred as long-term average.

Figure 72 - Long-Term Average Monthly Precipitation Amount (Kg/m^2) of Denizli Province (1960-2014) and between 2017-2018 (September - February)



While the long-term period 1960-2014 during month January actualized as 90,3 kg/m^2, 61,6 kg/m^2 precipitation occurred in January 2018 as one third less than the long-term average. As the result of having 42,5 kg/m2 less precipitation compared to the long-term average in months October, November, December and January, low tillering and growth retardation were determined in the districts of Acıpayam, Serinhisar, Bozkurt and Çardak by February 12, 2018.

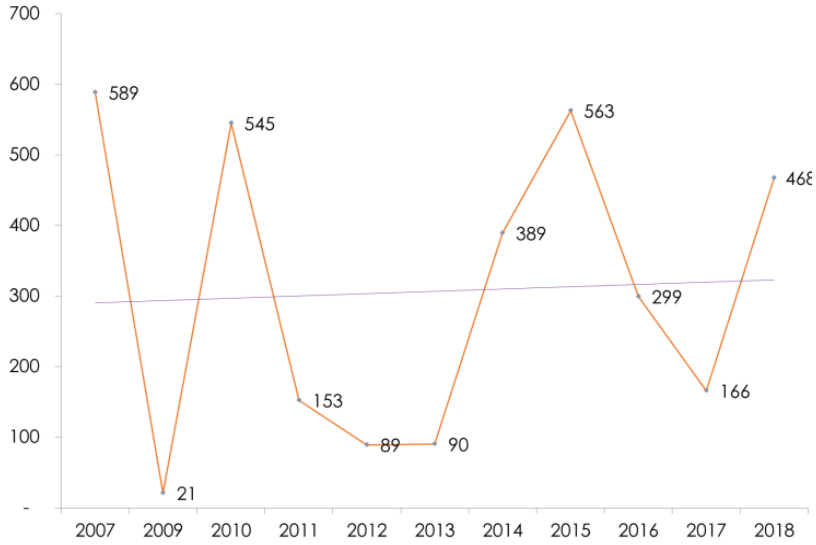
Meteorological Incidences Affecting the Agricultural Lands

According to the data of Denizli Provincial Directorate of Agriculture and Forestry, an area of 337.200 hectares was affected in total in the period of 2009-2018 (2008 excluded), and a damage of 354 million TL occurred.

All the damages in the year 2007 arose from drought, nearly all of them in the year 2009 arose from hail, nearly all of them in the year 2010 arose from excessive precipitation and hail, all of them in the year 2011 arose from excessive precipitation and hail, 80% of them in the year 2012 from frost and 20% of them in the year 2012 from hail - storm, 74% of them in the year 2013 from hail and 26% of them in the year 2013 from storm and frost, 74% of them in the year 2014 from drought and 14% of them in the year 2014 from hail - flood, 73% of them in the year 2015 from frost and cold and 19% of them in the year 2015 from hail

- flood, 77% of them in the year 2016 from drought and 14% of them in the year 2016 from frost, 95% of them in the year 2017 from hail - flood, hail and hail - storm, and finally 93% of them in the year 2018 from hail - flood and hail - flood - storm.

Figure 73 - Sizes of agricultural areas (km^2) affected by disasters arising in the period of 2009-2018



34% of the total damage (119,5 million TRY) as a result of hail - flood and drought incidences affecting the agricultural areas in Denizli Province occurred in the year 2018. When the damages in that year are examined as per the affected products, the damages on vineyard products form about 31% of all the damage.

Table 39 - Impacts arising as a result of meteorological incidences affecting the agricultural areas in year 2018

District	Cause of Incidence	Incidence	Affected Agricultural Land	Damage (TL)
Çameli	HAIL	Damage and fruit drop	1.828	2.716.070
Acıpayam	HAIL-FLOOD	Damage and fruit drop	**121.369**	**28.159.227**
Baklan	HAIL-FLOOD	Damage and fruit drop	7.630	2.810.000
Babadağ	HAIL-FLOOD	Damage and fruit drop	28	30.500
Bekilli	HAIL-FLOOD	Damage and fruit drop	6.365	1.332.726
Beyağaç	HAIL-FLOOD	Damage and fruit drop	4.271	27.855
Bozkurt	HAIL-FLOOD	Damage and fruit drop	3.828	1.193.800
Buldan	HAIL-FLOOD	Damage and fruit drop	**29.913**	**29.345.910**
Çal	HAIL-FLOOD	Damage and fruit drop	65.630	3.138.000
Çardak	HAIL-FLOOD	Damage and fruit drop	2.800	438.000
Çivril	HAIL-FLOOD	Damage and fruit drop	695	724.250
Güney	HAIL-FLOOD	Damage and fruit drop	22.390	4.205.980

District	Cause of Incidence	Incidence	Affected Agricultural Land	Damage (TL)
Honaz	HAIL-FLOOD	Damage and fruit drop	8.250	2.544.000
Kale	HAIL-FLOOD	Damage and fruit drop	8.711	1.853.560
Serinhisar	HAIL-FLOOD	Damage and fruit drop	210	575.000
Tavas	HAIL-FLOOD	Damage and fruit drop	**97.725**	**24.046.850**
Merkezefendi	HAIL-FLOOD-STORM	Damage and fruit drop	7.500	602.750
Pamukkale	HAIL-FLOOD-STORM	Damage and fruit drop	9.300	1.533.300
Sarayköy	HAIL-FLOOD-STORM	Damage and fruit drop	11.730	8.037.500
Baklan	DROUGHT	Insufficiency of precipitation in spring	11.750	1.645.000
Bekilli	DROUGHT	Insufficiency of precipitation in spring	1.995	135.421
Bozkurt	DROUGHT	Insufficiency of precipitation in spring	27.750	3.330.000
Çardak	DROUGHT	Insufficiency of precipitation in spring	16.038	1.074.546

The hail-flood incidences which occurred at Buldan, Acıpayam and Tavas correspond to more than half of the affected agricultural land, and they correspond to about 70% of all damage which occurred in the year 2018. The areas affected by drought have a size of about 12%, and they correspond to 5% of the total damage.

7.4. Processes Affecting the Ecosystems of Forest

According to the records of Denizli Regional Directorate of Forestry, the data regarding the size of growing stock / forest land that are damaged, and that are grouped separately as being due to snow, wind, landslide, flood and drought in the period of 1987-2017 in the area of Denizli Province are presented in the following table.

Table 40 - Forest lands affected by Snow, Wind, Landslide and Drought

Year	Incidence	Operation Directorate	Type of Affected Stand	Size of affected forest (ha)
2008	Snow	Çameli	Various	0,2
	Wind	Acıpayam-Çameli	Various	186,9
	Drought	Tavas	Various	67,5
2009	Wind	Acıpayam-Çal-Çameli-Denizli	Various	608.8
	Snow	Çal-Çameli-Denizli	Various	2.426,0
	Drought	Acıpayam-Denizli	Various	842,0
2010	Wind	Denizli	Various	45,5
	Snow	Acıpayam-Eskere-Tavas-Denizli	Various	3.052,1
	Drought	Denizli-Eskere	Various	105,0
2011	Wind	Çal	Various	16,2

Year	Incidence	Operation Directorate	Type of Affected Stand	Size of affected forest (ha)
	Snow	Çal-Denizli	Various	197,6
	Drought	Denizli	Various	295,5
2012	Wind	Acıpayam-Denizli	Various	298,0
	Snow	Acıpayam-Çal-Çameli-Eskere-Tavas-Denizli	Various	3.423,4
2013	Wind	Eskere	Various	11,5
	Snow	Çal-Denizli-Eskere	Various	243,2
2015	Wind	Çameli	Various	0,5
	Snow	Acıpayam-Çal-Tavas-Denizli	Various	2.535,8
	Landslide	Denizli	Various	1,3
	Drought	Çameli	Various	0,1
2016	Wind	Denizli	Various	86,3
2017	Wind	Eskere	Various	4,5
	Snow	Tavas	Various	85

Forest Damages

According to the records of Denizli Regional Directorate of Forestry, the size of growing stock / forest land damaged due to forest pests in the area of Denizli Province (1987-2017)

Table 41 - Size of growing stock / forest land damaged due to forest pest in the area of Denizli Province

Year	Name of Pest	Operation Directorate	Type of Affected Stand	Size of affected forest (ha)
2009	Bark Beetle	Tavas	Various	4.7
2013	Bark Beetle	Çal-Eskere	Various	0.5
2014	Bark Beetle	Çal	Various	26.8
2016	Bark Beetle	Acıpayam-Eskere	Various	41.7
2017	Bark Beetle	Denizli	Various	38.0

Forest Fires

According to Unit Activity Report for the year 2012 of Denizli Regional Directorate of Forestry, 392 fires occurred in the period 2008-2012, and an area of 597 hectares was affected. Again in the period of 2008 - 2012, the total area affected from storm and beetles is 65.169 ha. According to the records of Denizli Regional Directorate of Forestry, 265 fires affecting a total area of **663,05 ha**, and causing **22 million TL** damage occurred in the period of 2013-2017 in the area of Denizli Province. 6 fires affecting more than 10 hectares were recorded among the arising fires.

Fire of Sarayköy

Among these fires, the fire that arose on July 3, 2017 at Sarayköy has been the most significant fire by the area it affected and by the amount of damage. An area of 408 hectares was affected in total, causing a damage of about 12 million TL.

When the causes of fires are considered, the causes of 162 of them are unknown, the causes of 38 of them were lightning, the causes of 13 of them were stubble, and the causes of 36 of them were various (cigarette, picnic fire, accident etc.). More than half of the fires concentrated at the districts of **Pamukkale**, **Sarayköy Tavas** and **Cal**. When the stands where the fires occurred are examined, Calabrian Pine Stands with a rate of above 70%, and Black pine Stands with a rate of 15-20% rank as the first two.

ANNEX 8 - CLIMATE PROJECTIONS OF DENİZLİ

8.1. Method

Denizli Climate Change Risk Analysis, that is prepared within the scope of the project, verifies also for Denizli the most basic finding determined for the cities in international and national reports:

- Climate change further increases the socio-economic (irregular urbanization, land requirement, food safety, potable water need, water demand management etc.) and environmental (loss of habitat, decrease in biological diversity, forest fires etc.) pressures encountered in the current state.

Climate projections of different scenarios for Denizli has been obtained from the database formed by the data generated on the basis of basins within the scope of Impact of Climate Change on Water Resources Project of Ministry of Agriculture and Forestry General Directorate of Water Management (GDWM).

The methods and means used have been summarized below:

- HadGEM2-ES model, and RCP4.5 and RCP8.5 scenarios has been used while obtaining the climate projections of Denizli Province.
- In the risk analysis study, the results for Büyük Menderes Basin have been taken into account.
- For the projections, the results of period of 2015-2044, and of 2045-2074 have been used.
- While the scenario RCP4.5 envisages more measures compared to the current state, and slowing down the increase rate of greenhouse gases in the atmosphere, RCP8.5 envisages the course of increase of greenhouse gases of the current state and accordingly more temperature increase.
- For the periods of 2015-2044 and 2045-2074, for which the assessments have been made, the course of the same economic, political and social indicators (growth, technology, political goals, legislation, population, consumption amounts etc.) have been deemed as similar.
- The reference period of the relevant model projections is 1970-2000.

Climate change for Denizli will bring along the following changes in temperature and precipitation regimes in the periods of 2015-2044 (near future period) and 2045-2074 (far future period):

- Increase in all the projection regarding the average temperatures of Denizli;
- Increase for all the periods regarding the number of extremely hot days;
- Increase in the number of heat waves;
- Increase in the severity of precipitation;
- Variation of precipitation within the year will be continuing, decrease in precipitation in summer;
- Increase in drought indicators.

It is expected for the semi-arid and semi-humid climate of Denizli to show a change towards arid climate.

8.2. Temperature Projections

The results of the following projections are the outputs considering the HadGEM2-ES model, and RCP4.5 and RCP8.5 scenarios:

- As in the whole country, **average temperatures** are increasing also in Denizli. The increase of temperature will occur the most in summer months (above 4°C).
- In the best and worst case scenarios, Denizli's **annual average temperature** is expected to increase by 1,8°C - 2°C in the period of 2015 - 2044, and by 2,6°C - 3,4°C in the period of 2045 - 2074 (average of the period of 1971-200 is 14,4°C).
- Denizli's **summer season average temperature** is expected to increase by 2,0°C - 2,3°C in the period of 2015 - 2044, and by 3,6°C - 6,3°C in the period of 2075-2100 (average of the period of 1971-2000 is 24,1°C).
- Denizli's **winter season average temperature** is expected to increase by 1,5°C - 1,6°C in the period of 2015 - 2044, and by 2,4°C - 4,0°C in the period of 2075-2100 (average of the period of 1971-2000 is 5.4°C).
- T**emperature increase** in Denizli is anticipated to reach to 2,4°C in **winter season**, and to 6,3°C in **summer season**.
- Along with the increase of temperatures, while the degree of **maximum temperatures** will be increasing, the frequency and period of very hot days are also expected to increase. In the best and worst case scenario, annual average maximum temperature is expected to increase by 1,8°C - 2,1°C in the period of 2015 - 2044, and by 3,2°C - 5,3°C in the period of 2075-2100 (average of the period of 1971-2000 is 20,8°C).
- Increase is expected in all the periods for the number of **summer days 25** (days on which maximum temperature is >25°C), **hot nights** (days on which Tmin>minimum 90%), **hot days** (days on which Tmax>maximum 90%), and **summer days 35** (days on which maximum temperature is >35°C).
- The number of days on which **wave of hot air** occurs is ecpected to be 29-41 days in the period of 2015 - 2044, and 72-142 days in the period of 2045 - 2074 (average of the period of 1971 - 2000 is 6 days).

Denizli's Temperature Projections for the RCP 4.5 and RCP8.5 Scenarios

Figure 74 - Change of Monthly Average Temperatures, Periods of 2015-2044 and 2045-2074 (for RCP4.5 and RCP8.5 Scenarios)

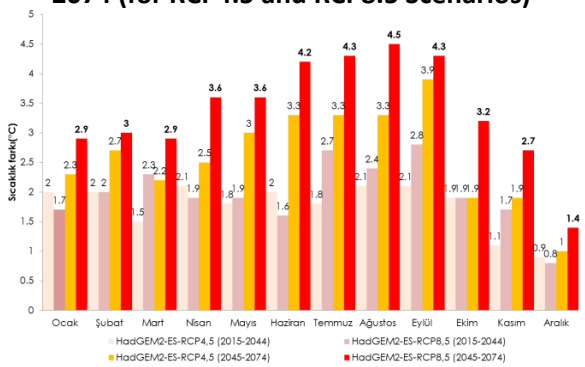


Figure 75 - Change of Annual Average Temperatures, Periods of 2015-2044 and 2045-2074 (for RCP4.5 and RCP8.5 Scenarios)

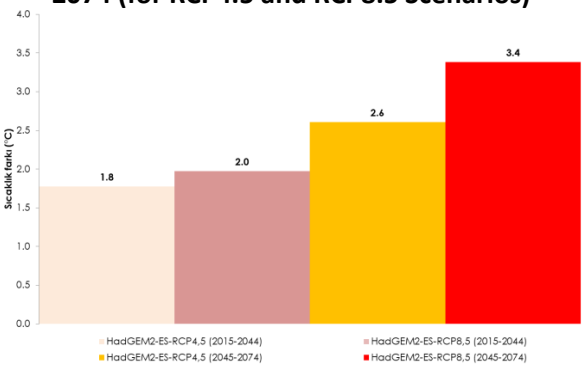
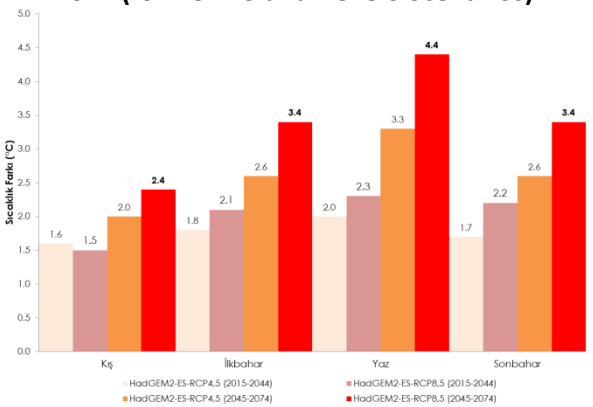


Figure 77 - Change of Seasonal Maximum Average Temperatures, Periods of 2015-2044

Figure 76 - Change of Seasonal Average Temperatures, Periods of 2015-2044 and 2045-2074 (for RCP4.5 and RCP8.5 Scenarios)



and 2045-2074 (for RCP4.5 and RCP8.5 Scenarios)

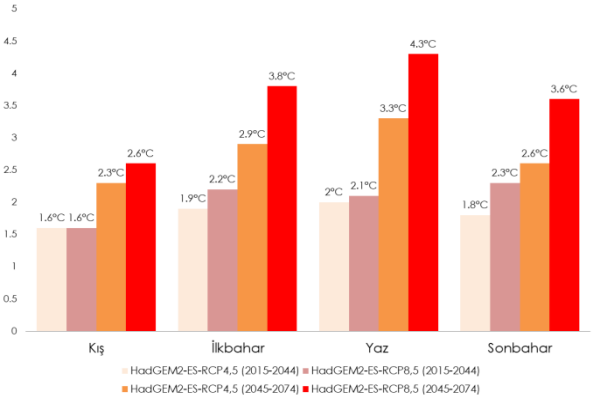
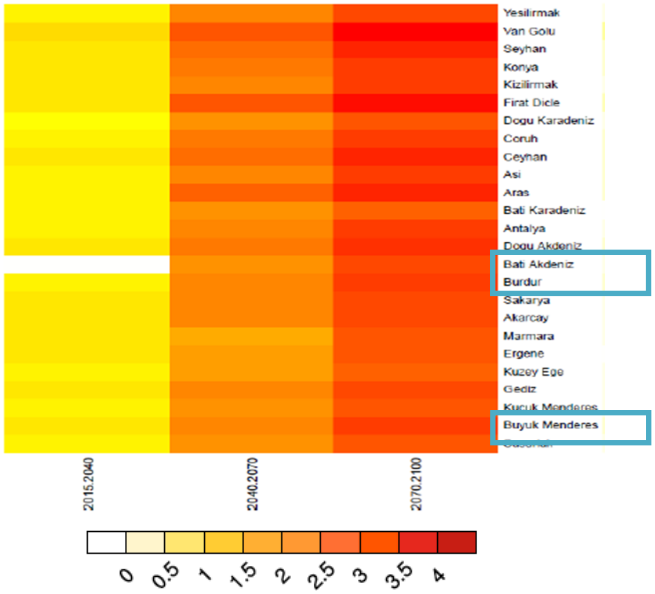


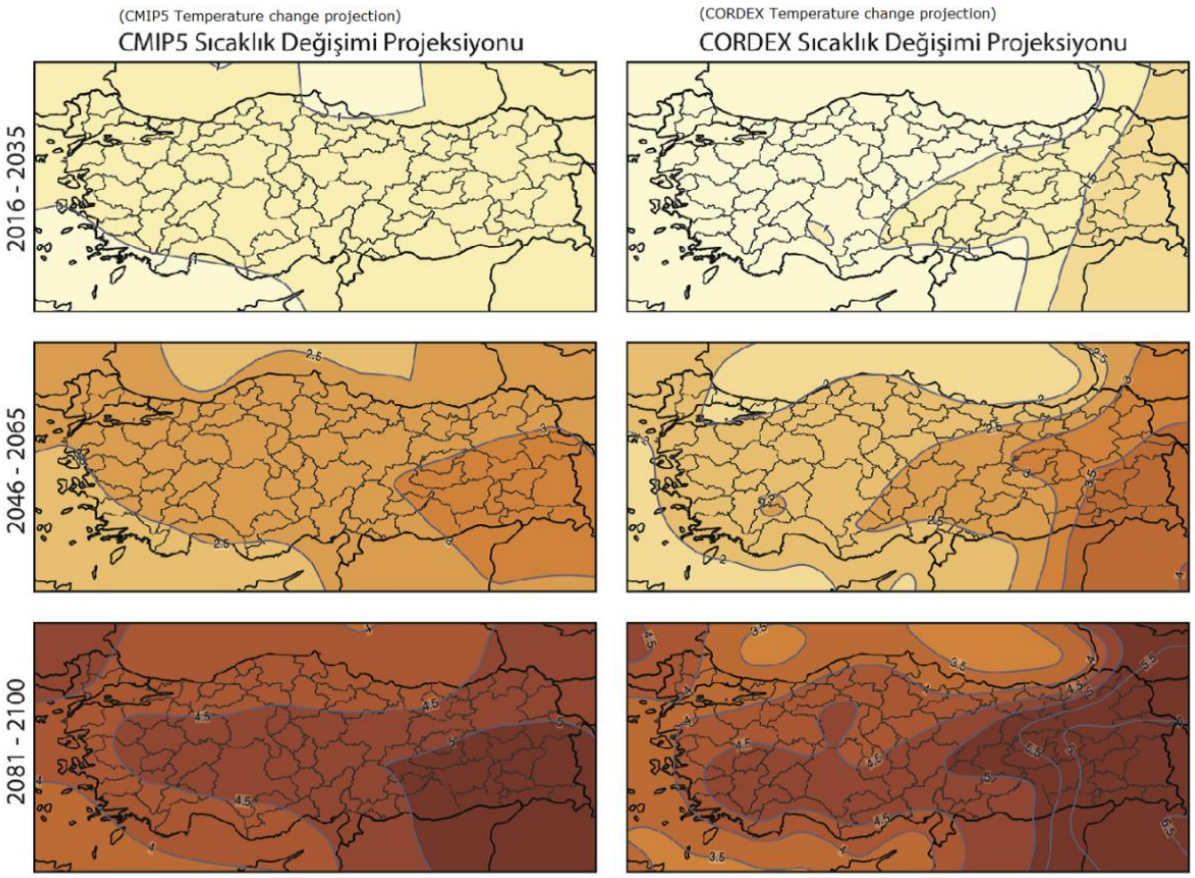
Figure 78 - Average Temperature Anomaly Values for 30 Years on the Basis of Basins as per HadGEM2-ES Model RCP4.5 Scenario



Average Temperature Anomaly Values for 30 Years on the Basis of Basins as per HadGEM2-ES Model RCP4.5 Scenario show increase in all the periods (periods of 2015-2040, 2040-2070 and 2070-2100) at Büyük Menderes, West Mediterranean, Burdur and Gediz Basins where the Denizli Province extends.

The temperature increase at Büyük Menderes Basin becomes distinctive in the period of 2015 - 2040.

Figure 79 - Temperature change anticipated for Turkey by the CMIP5 and CORDEX experiments as per RCP8.5 scenario



8.3. Precipitation Projections

For all the models in Turkey, tendency of decrease is observed in the total precipitation towards the end of the century in the RCP4.5 and RCP8.5 scenarios. This decrease becomes distinctive as from 2050s. While the course of aridification tendency is slower in the RCP4.5 scenario, it is faster in the RCP8.5 scenario. Irregularity in precipitation regime also becomes distinctive in Denizli Province.

The results of the following projections are the outputs considering the HadGEM2-ES model, and RCP4.5 and RCP8.5 scenarios:

- In Denizli, decrease in precipitation is anticipated especially in the period after year 2045.
- Decrease of precipitation will occur in the summer season the most (decrease with a rate of 27-37%).
- While Denizli continues to preserve its periodical natural course in which the precipitation is high and low within the year, it is anticipated for the total precipitation within the year to decrease after year 2045.
- Decrease will occur in total snow cover.

- In the best and worst case scenarios, a decrease at an amount of 32.2mm-59.3mm is expected regarding the annual total precipitation average of Denizli in the period of 2045 - 2074 (the average of the period of 1971 - 2000 is 592.4mm).
- In the best and worst case scenarios, a decrease at an amount of 20.7mm-21.4mm is expected regarding the annual total winter precipitation average of Denizli in the period of 2045 - 2074 (the average of the period of 1971 - 2000 is 267.6mm).
- In the best and worst case scenario, a decrease at an amount of 12.3mm-1mm is expected regarding the annual total summer precipitation average of Denizli in the period of 2015 - 2044, at an amount of 10.9mm-14.1mm in the period of 2045 - 2074, and at an amount of 15.1mm-13.2mm in the period of 2075 - 2100 (the average of the period of 1971 - 2000 is 40.6mm).
- The number of consecutive arid days (consecutive days on which precipitation is <1mm) is expected to be 89-86 days in the period of 2015 - 2044, 92-97 days in the period of 2045 - 2074, and 95-93 days in the period of 2075 - 2100.
- And the number of days on which severe precipitation occurs (days on which precipitation is >=10mm) is expected to decrease for all the periods (average of the period of 1971 - 2000 is 19 days).
- Snow water equivalent tends to decrease towards the end of the century. Decrease will occur in total snow cover.

Denizli's Precipitation Projections for the RCP4.5 and RCP8.5 Scenarios

Figure 80 - Annual Average Precipitation Difference, Periods of 2015-2044 and 2045-2074 (for RCP4.5 and RCP8.5 Scenarios)

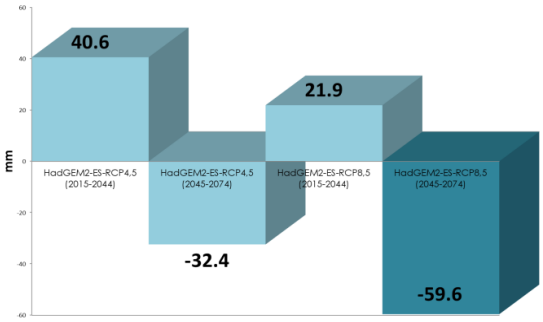


Figure 81 - Annual Average Seasonal Precipitation Difference Rate, Periods of 2015-2044 and 2045-2074 (for RCP4.5 and RCP8.5 Scenarios)

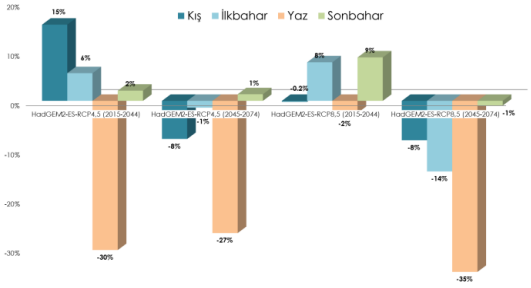
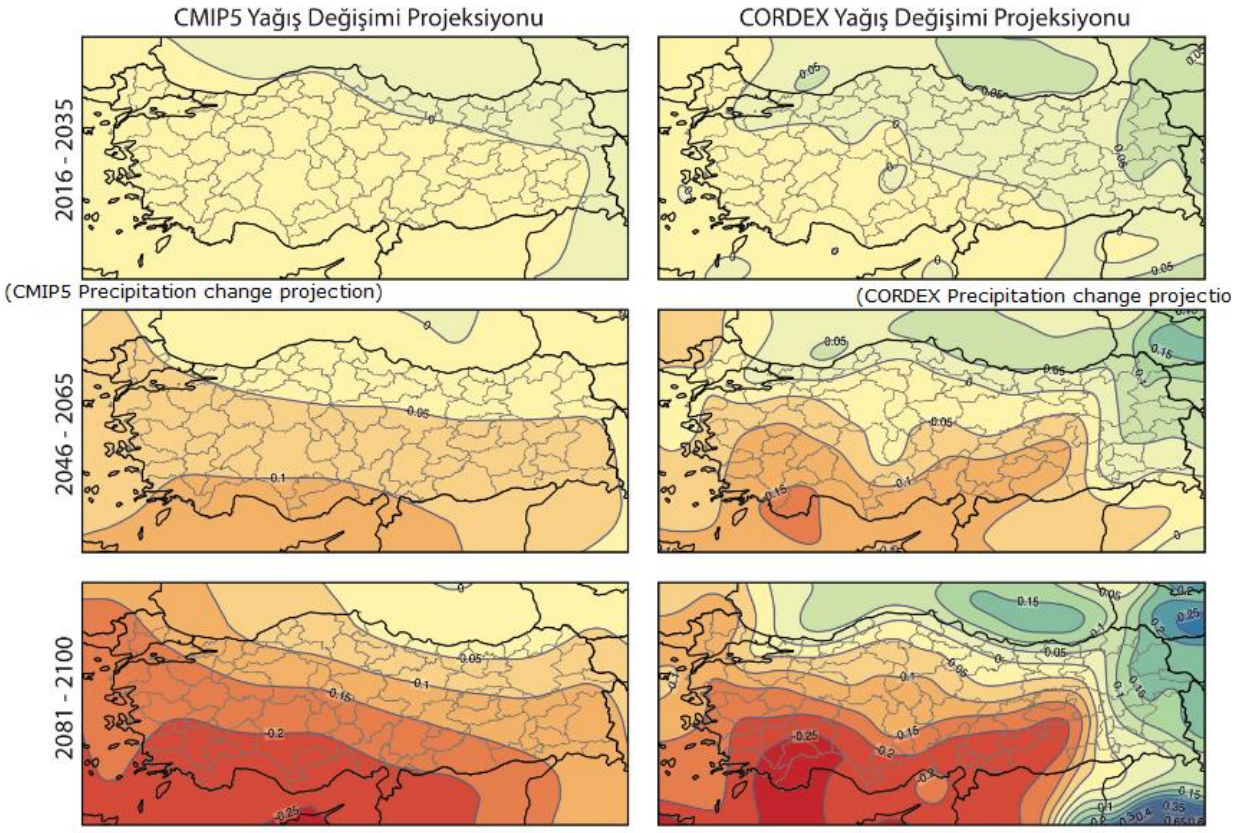


Figure 82 - Precipitation change anticipated for Turkey by the CMIP5 and CORDEX experiments as per RCP8.5 scenario



CMIP5 projection covering the RCP8.5 scenario indicates that the precipitation will not change for Denizli until 2035s. And as from 2045, a decrease is estimated especially in its south areas. In the results of CORDEX experiment, decrease is expected as from 2045. When regional distribution is considered, higher decrease is observed at the south of Denizli.

8.4. Hydrological Assessment

8.4.1. Water Potential / Budget

In the following figures, the information on Change of Water Surplus / Deficit for Büyük Menderes Basin as per RCP4.5 and RCP8.5 Scenarios has been presented.

Figure 83 - Climate Change Projections Change of Water Surplus / Deficit as per RCP8.5 Scenario

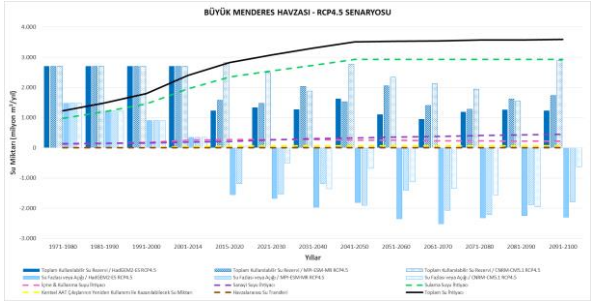
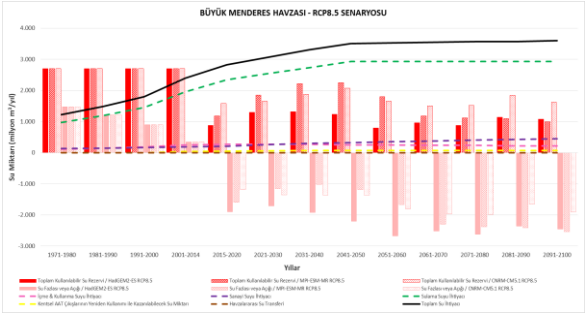


Figure 84 - Climate Change Projections Change of Water Surplus / Deficit as per RCP8.5 Scenario



8.4.2. Basin Based Water Surplus / Deficit on

The following figures indicate the proportional (%) differences of Basin Based Gross Water Potentials as per the Reference Periods according to HadGEM2-ES model, RCP4.5 and RCP8.5 scenarios for the Climate Projections for the whole Turkey.

Figure 85 - Basin Based Gross Water Potential *(*RCP4.5 2015-2040)

Figure 86 - Basin Based Gross Water Potential (RCP 4.5 2041-2070)

Figure 87 - Basin Based Gross Water Potential (RCP 8.5 2015-2040)

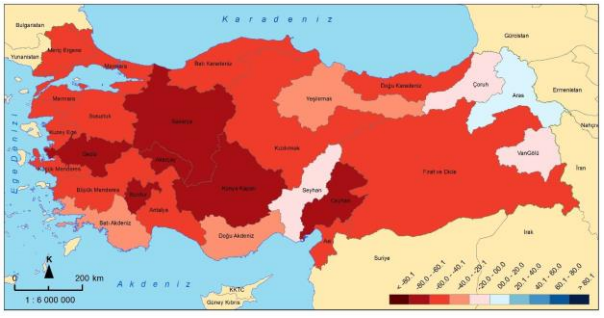


Figure 88 - Basin Based Gross Water Potential (RCP 8.5 2041-2070)

According to the above projections, a distinctive decrease is expected at Burdur Basin, Büyük Menderes Basin, and West Mediterranean Basin in the following period. It is expected for the Büyük Menderes, West Mediterranean, Burdur and Gediz Basins -where the districts of Denizli extend- to encounter a similar decrease in the groundwater reserves. The greatest impact is expected at Burdur Basin. West Mediterranean and Büyük Menderes Basins follow it.

Table 42 - Impact of climate change on Turkey's potential groundwater reserves

Basin No.	Basin Name	Max. POTENTIAL RESERVE (km^3)	HadGEM2-ES RCP4.5 SCENARIO - I		HadGEM2-ES RCP8.5 SCENARIO - II		MPI-ESM-MR RCP4.5 SCENARIO - III		MPI-ESM-MR RCP8.5 SCENARIO - IV		CNRM-CM5.1 RCP4.5 SCENARIO - V		CNRM-CM5.1 RCP8.5 SCENARIO - VI	
			2091 - 2100 Period (km^3)	Climate Change Impact Rate (%)	2091 - 2100 Period (km^3)	Climate Change Impact Rate (%)	2091 - 2100 Period (km^3)	Climate Change Impact Rate (%)	2091 - 2100 Period (km^3)	Climate Change Impact Rate (%)	2091 - 2100 Period (km^3)	Climate Change Impact Rate (%)	2091 - 2100 Period (km^3)	Climate Change Impact Rate (%)
1	MERIÇ	125.093	123.094	**1.60**	121.570	**2.82**	123.078	**1.61**	123.072	**1.62**	123.035	**1.65**	122.556	**2.03**
2	MARMARA	28.778	26.560	**7.71**	26.470	**8.02**	25.868	**10.11**	25.998	**9.66**	25.824	**10.26**	25.952	**9.82**
3	SUSURLUK	18.493	16.502	**10.77**	16.475	**10.91**	16.510	**10.72**	16.521	**10.67**	16.471	**10.94**	16.516	**10.69**
4	KUZEY EGE	9.951	8.081	**18.80**	7.958	**20.03**	7.986	**19.75**	8.052	**19.08**	7.824	**21.38**	8.033	**19.28**
5	GEDIZ	21.470	18.503	**13.82**	18.439	**14.12**	17.607	**17.99**	17.928	**16.50**	17.169	**20.03**	17.835	**16.93**
6	KÜÇÜK MENDERES	31.808	30.416	**4.38**	30.237	**4.94**	30.666	**3.59**	30.449	**4.27**	30.482	**4.17**	30.441	**4.30**
7	BÜYÜK MENDERES	137.938	128.479	**6.86**	123.652	**10.36**	128.369	**6.94**	127.314	**7.70**	125.575	**8.96**	127.678	**7.44**
8	BATI AKDENIZ	42.875	38.394	**10.45**	38.251	**10.79**	33.728	**21.33**	34.759	**18.93**	33.572	**21.70**	34.273	**20.06**
9	ANTALYA	167.650	159.287	**4.99**	157.041	**6.33**	150.888	**10.00**	153.078	**8.69**	147.096	**12.26**	152.987	**8.75**
10	BURDUR GÖLLER	26.115	21.544	**17.51**	21.540	**17.52**	19.334	**25.97**	20.599	**21.12**	19.272	**26.20**	19.440	**25.56**

Figure 89 - Change in Potential Groundwater Reserve (RCP4.5)

Figure 90 - Change in Potential Groundwater Reserve (RCP4.5)

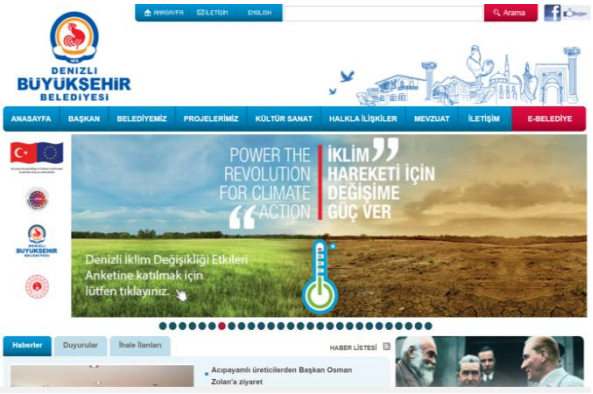
ANNEX 9 - QUESTIONNAIRE ON IMPACTS OF CLIMATE CHANGE

Within the scope of the project, **Questionnaire on the Impacts of Climate Change for Denizli** has been prepared in order to compile the general opinions and experiences regarding the subject of the people living in Denizli. The questionnaire consists of 2 sections. While personal information is obtained in the first section, there are 8 questions mostly consisting of multiple choice questions in the second section.

By the questionnaire, it has been tried to compile the impacts of climate change and the areas which may be affected from the viewpoint of the people living in Denizli. These results have been considered in the determination of adaptation actions.

High representation have been tried to be ensured through the dissemination of the questionnaire by both the metropolitan municipality and the relevant stakeholders. But no special inclusion practice has been applied for more vulnerable groups (farmers, the elderly, women etc.). Assessments have been made considering the formation of majority of the participants of the questionnaire from central districts, lack of individuals from some districts who have completed the questionnaire, and geographical position of Denizli that is extending to different climatic areas.

Figure 91 - Dissemination of the Questionnaire via the Internet Pages of DMM and DESKI



"The time of seasons has changed, and even two out of four seasons have been a thing of the past. Now there are summer and winter seasons. Untimely precipitation became harmful instead of being beneficial. Such as the precipitation for agricultural products during harvest season. In the past, the precipitation would start at the end of September in Denizli, they would pause for a couple of days towards the end of October, rained from November until December 20, and it snowed for a few times in winter months, and it was raining in March, April and until May 15. Denizli's famous Kırkikindi Rains were in that period, now they are a thing of the past. In the past, the mountains were covered by snow of 3-4 meters, now it does not snow. The rains of the summer generate flood, and they only bring harm"

(Participant of Questionnaire)

The questionnaire has been completed by 1.225 individuals in Denizli. The results of the questionnaire have been presented in brief in the following section.

Figure 92 - Some Remarkable Opinions from the Questionnaire

I am 40 years old and I was born in Denizli. In my childhood, the climate was harsher (colder) in Denizli. Sometimes I tell my students that when we heard news saying over 40oC temperatures in Aydın, we asked ourselves "how can people bear with such climate" . However, seeing over 40oC degrees during recent years in Denizli became a "normal" which is very scary when you think future.

We are facing with difficulties during physical education courses at school.

Our institution has been working intensely supply a clean water to public via aquifers. However, groundwater levels is decreasing continuously. It is becoming very challenging and costly to supply healthy water services to public.

I have been planting thymus for a long time; however I have been encountering rain irregularities which affect planting time and use of pharma.

There was no grape in this year in our vineyard.

The information we learned in primary school which is 4 seasons in a year is no longer true. We are now experiencing 2 seasons only summer and winter.

Figure 93 - Educational Level of the Participants

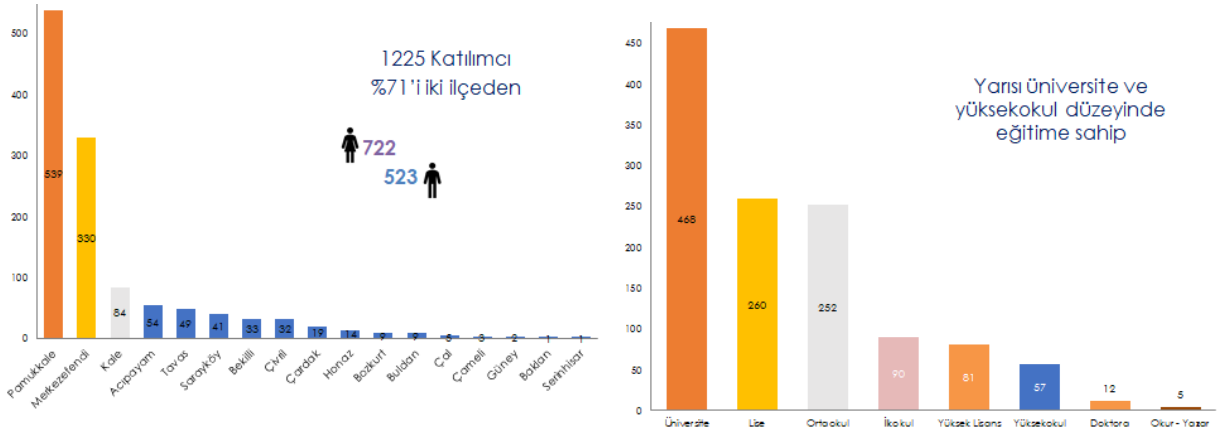
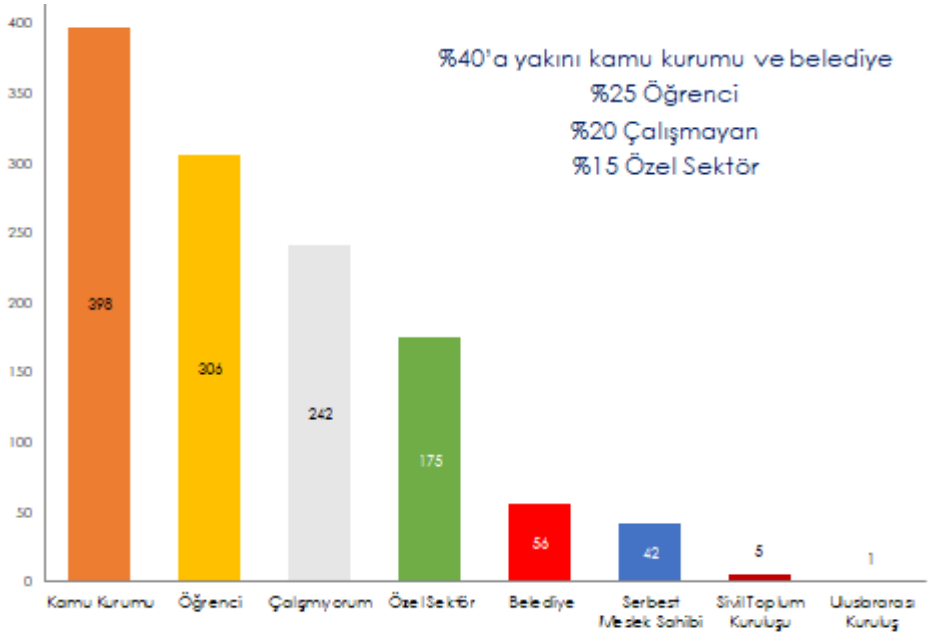


Figure 94 - Institutional Background of the Participants



88% of 1.225 participants of the questionnaire have specified that the impacts of climate change are observed in Denizli.

Figure 95 - Answers provided for the question of "Can the impacts of climate change be seen?"

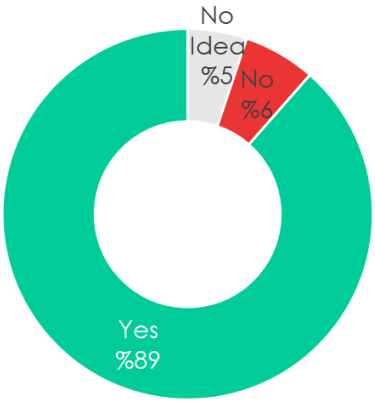
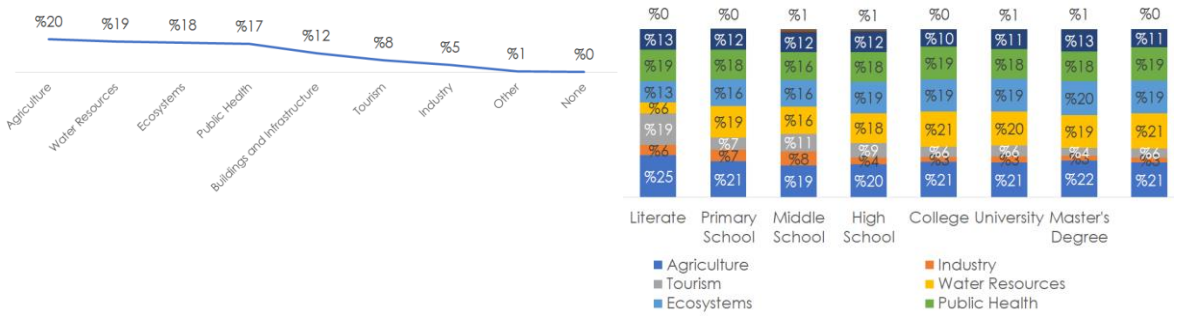


Figure 96 - Breakdown of Sectors which will be Affected from Climate Change



The institutions that the participants of the questionnaire deem as the most important for struggle with the impacts of climate change are as follows: Ministry of Agriculture and Forestry, Ministry of Environment and Urbanization, Denizli Metropolitan Municipality, and Denizli Regional Directorate of Forestry. The importance degree of private sector and non-governmental organizations remains in the lower ranks. 61% of the participants of the questionnaire think that the capacity of the institutions in Denizli for struggling the impacts is insufficient. It has been observed that the ones answering this question as "capacity is insufficient" consist of individuals with higher educational level. It is possible for the confidence factor with regards to the reflection on public of the humane and technical capacity that the municipality and other institutions have and of the implementations, to affect the responses provided for this question.

Figure 97 - Important Institutions in Struggle with Impacts

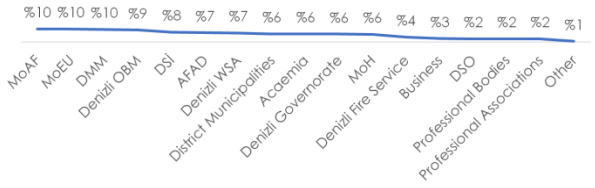
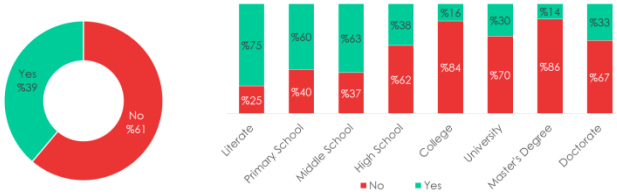


Figure 98 - Capacity of Interference to / Struggle with Impacts



ANNEX 10 - RISK ASSESSMENT FRAMEWORK

10.1. Scope and Method

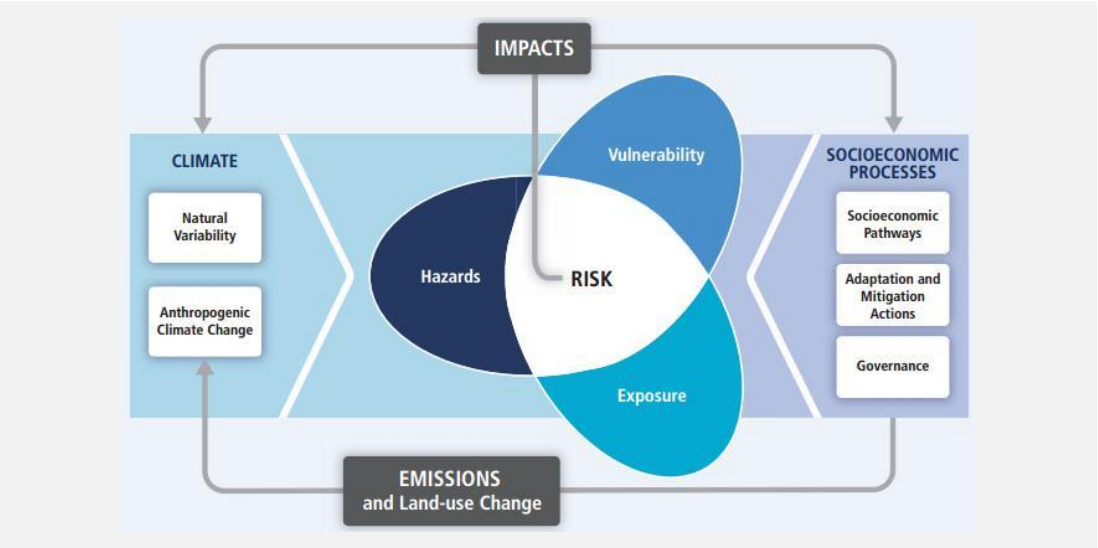
Although the main purpose in the operations carried out in the context of operations of adaptation to Climate Change is the same, different approaches and terminology may be used in the assessment of possible hazards arising from climate change. The concept of "**Risk**" followed in this study has been expressed as the sum of possibility of occurrence of the relevant hazardous incidence, and the negative results that it will cause in case of its occurrence.

Framework of Risk Analysis and Adaptation

The unprecedented increase of accumulation of greenhouse gases in the atmosphere depending on human related activities compared to natural processes triggers a series of successive bio-physical and humane incidences. It causes primarily the increase in global temperature averages, and irregularities in precipitation regimes and various changes on the global climate system (atmosphere, oceans and glacial areas), and these changes affect the presence and distribution of natural resources, and this irregularity is again reflected on socio-economic structures.[71] In the identification of the components of risk, the risk assessment framework suggested in IPCC 5th Assessment Report (AR%) has been used. This framework addresses the risk within the framework of the components of "climatic hazards", "exposure", and "vulnerability".

[71] Climate Change Guide from A to Z, REC Turkey

Figure 99 - Components of the Risk of Climate Change



Even if all the emissions arising from human activities are stopped in the struggle with climate change, the changes in climate system (increases in the frequency and severity of extreme weather events) will continue to be observed for tens of years by the cumulative impact of greenhouse gases that have been emitted in the past and that are emitted today to the atmosphere.

Within this framework, the societies are required to pursue in parallel the operations of both mitigation of the greenhouse gas emissions and adaptation to possible impacts in order to minimize the possible negative impacts.

In order to support the adaptation operation in struggle with these impacts, the approach of "Climate Change Risk Assessment" took its place in policy formation processes as a significant means considering the current and future risks and uncertainties of climate change. In the context of adaptation to climate change, risk assessment not only observes the negative impacts, but also ensures the "opportunities" to be considered.

UNFCCC describes adaptation as "mitigating the damage of natural or human systems to arise from current or expected climatic impacts (hazards), or their re-adaptation for benefiting from the opportunities arising from these impacts".

The geographical scope of the performed climate change risk analysis is the Denizli Province, and in some cases the risks which form outside of the province and which may have impacts on the humane activities and natural environment of Denizli has also been included in the analysis. The Risk Analysis study has followed the following stages:

1. Obtaining projections of different scenarios for Denizli (changes of temperature and precipitation, indices, etc.)
2. Determination of possibility of occurrence of climatic hazards for the projections of these different scenarios;
3. Determination of negative results of possible hazards that may arise in different scenarios;

4. Risk assessment for the relevant group, sector or service.

The projections for Denizli has been divided into 2 periods as to be until the end of this century. These periods are 2015-2044 (near-future period) and 2045-2074 (far-future period).Climate projections of different scenarios for Denizli have been obtained from the database formed by the data generated on the basis of basins within the scope of Impact of Climate Change on Water Resources Project of Ministry of Agriculture and Forestry General Directorate of Water Management (GDWM). HadGEM2-ES model, RCP4.5 and RCP8.5 scenarios have been run.21,8% of Denizli Province is located in West Mediterranean Basin (Acıpayam)[73], 4,3% of it is located in Burdur Basin (Çardak), 3% of it is located in Gediz Basin (Buldan, Güney)[74], and the remaining 70,1% of it is located at Menderes Basin.[75] In the risk analysis study, the results for Büyük Menderes Basin have been used. Following the obtainment of projections, the possibility of occurrence of climatic hazards which may arise for different scenarios, and the negative results of these hazards have been presented by the approach of risk assessment matrix. The participation of relevant specialists and the opinions of all the stakeholder groups in Denizli have been taken into consideration in the formation of this matrix.

10.2. Determination of Priority Spheres of Influence During the preparation of the report, the available sectoral risk analyses have been reviewed, and a literature survey has been performed. Following that survey, priority sectors have been determined for the determination of risks for the risk analysis by the participation of relevant specialists. In the workshop, it was tried to reach the findings regarding how the risks are perceived by the units and affiliates of DMM, relevant stakeholders and public. Thus, the findings previously determined by desk works and literature survey could be compared with the perceptual results.

Within the scope of climate change risk analysis study, prioritization was made in the light of available data, opinions of specialists and meetings with stakeholders, and it was decided to assess the following main headings:

- Water and Waste Water;
- Transportation;
- Agriculture and Ecosystems;
- Industry;
- Energy.

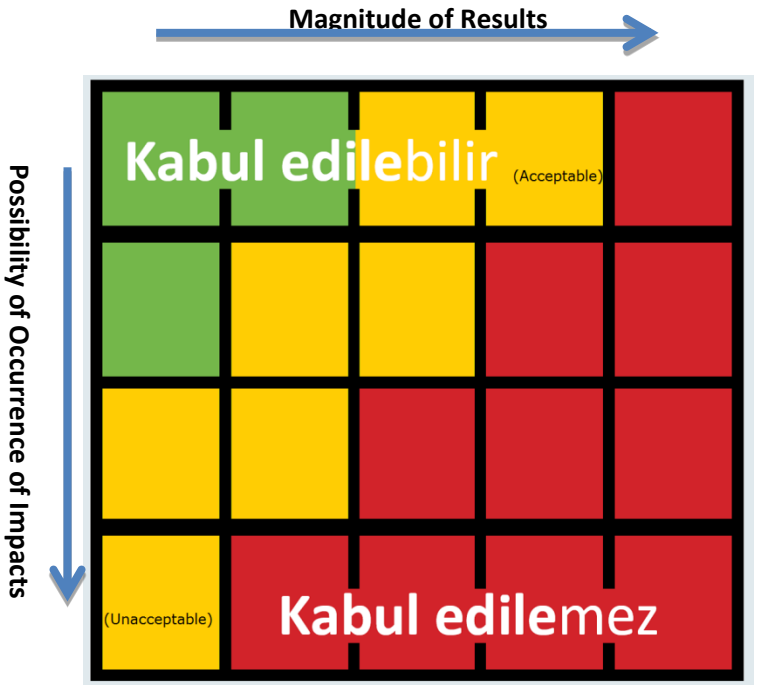
The risk assessment framework suggested in IPCC 5th Assessment Report (AR5) was used in identification of the components of risk. The report assesses the socio-economic and environmental risks. , The risk matrix structure was suggested to be followed in the prioritization of risks.

[73] http://iklim.ormansu.gov.tr/ckfinder/userfiles/files/Iklim Nihai Rapor Bat%C4%B1 Akdeniz Ek 10 REV nihai.pdf
[74] http://gediz.ormansu.gov.tr/gediz/Files/Gediz%20Havzas%C4%B1%20Nihai%20Raporu.pdf
[75] http://suyonetimi.ormansu.gov.tr/Files/Havzakormaeylemplanraporlari/Burdur_Havzas%C4%B1.pdf

Risk assessment is basically performed in the light of anticipated climate change. Accordingly, the inventory of economic and physical assets which may get harmed is obtained, the actualization possibilities of possible impacts are defined, and the results which will arise in case of actualization of impacts are determined. No matter which method is followed, the risk and vulnerability analysis should have the following content as minimum:

- Change of various climatic parameters, and their tendencies in different climatic scenarios (for instance, average precipitation, average seasonal temperature, extremely hot and cold days, extreme precipitation etc.),
- Risks and opportunity that are expected directly and indirectly (for instance, types of climatic damages, distribution of population and economic activities in the city, the parts of the society which will be affected the most, economic activities under threat etc.),
- Dimension of time (distinction of risks in the short, medium and long term),
- Uncertainty in forecasts (the possibility of occurrence of these impacts).

The concept of risk in this study is expressed as the combination of the probability of occurrence of the related hazardous event and the negative results the occurrence of that event will create, if occurs. For instance, if the impacts that are more possible to arise have more significant results, they are included in the high risk class, and if they cause problems of low significance, they are included in the class of impacts with low risk. And the insignificant risks are the ones whose possibility to arise is low, and which have less significant negative impacts in terms of their results. The risk matrix facilitates determining the high risks which are required to be addressed primarily.



10.3. Scoring the Risks

The risks to arise for the relevant sectors as a result of the impacts of the climate change in Denizli have been assessed in the classes of very low, low, high possibility as per the possibility of occurrence of the impact, and in the classes of low, medium, high and very high negative impact as per the size / significance of the (negative) results of the impact (loss of lives and assets, narrowing in ecosystems, economic costs, loss of labour etc.).

Table 43 - Risk Scoring Table

Period of Impact	Size / Significance of the Results of the Impact	Possibility to Arise	Capacity to Struggle
Near-future period: 2015-2044 or* Far-future period: *2045-2074	**There is no impact, or very low impact:** No loss of lives, assets, products and service occur, the ecosystems are not affected.	High, or Medium, or Low	High, or Medium, or Low
	Medium level impact: • Injury of 1-10 individuals, no occurrence of death, 1-10 households and/or small workplaces are affected • Daily impacts at local areas on agricultural products, and low economic losses, non-permanent impacts on ecosystems, no stop of services		
	High impact: • Death of 1-3 individuals and/or injury of 10-20 individuals • 10-20 households and/or workplaces affected • Daily interruption of services, decrease in the quality of service • Loss of more than 50% at local areas on agricultural products, economic loss in agricultural products at the level of 1 or 2 districts, 1-10% decrease in agricultural employment • Decrease in production at the facilities at local areas, loss of productivity and labour • Decrease in areas covered by different ecosystems (forests, wet areas etc.) (1-10% decrease)		
	Very high impact: • Death of 3 and more individuals and/or injury of 20 and more individuals • More than 20 households and/or workplaces affected • Interruption of services for a week or more • Decrease in general industrial production, loss of productivity and labour, economic shrinkage in the whole province or district, and decrease in employment • Loss in agricultural products at the level of 3 and more districts, decrease of more than 10% in agricultural employment • Decrease of more than 10% at areas covered by different ecosystems (forests, wet lands etc.) and/or irrevocable environmental impacts		

The following scale has been used for the assessment of risks as per the possibility of occurrence of the impact, and as per the size of its results.

Table 44 - Risk Matrix Scale

Size of Results	Possibility to Arise	Risk
Very High	High, or Medium, or Low	Very high risk
High	High, or Medium	High Risk
High	Low	Medium level risk
Medium	High, or Medium, or Low	Medium level risk
Low	High, or Medium, or Low	Low risk

ANNEX 11 - RESULTS OF CLIMATE CHANGE RISK ANALYSIS

The temperature increase and changes in precipitation regime that occurred in the recent century in Denizli have started to be felt more in the recent past. In the scenario, in which extensive measures and policies cannot be implemented in Denizli that is located within the Mediterranean Basin which will be affected the most from the climate change, it is possible for the significance of negative impacts on social and bio-physical systems to increase.

Denizli Climate Change Risk Analysis verifies also for Denizli the most basic finding determined for the cities in international and national reports:

- Climate change further increases the socio-economic (irregular urbanization, land requirement, food safety, potable water need, water demand management etc.) and environmental (loss of habitat, decrease in biological diversity, forest fires etc.) pressures encountered in the current state.

The risks, in the light of climate projections of two different scenarios for Denizli, have been assessed for the periods of 2015-2044 and 2045-2074. Within the scope of climate change risk analysis, prioritization has been made in the light of available data, opinions of specialists and meetings with stakeholders, and it has been decided to assess the following main headings:

- Agriculture and Ecosystems;
- Water and Waste Water (Infrastructure);
- Transportation;
- Industry;
- Energy

It should be expected that exposure to risks to arise in the above sectors will be in different manners at different areas within the city. In addition to this, the level of exposure to the risks which may arise in the same area will depend on the socio-economic level, and the vulnerability of the groups affected.

Agriculture and Ecosystems Sector Risk Assessment Table						
Negative Impact	Risk Level	Period of Impact	Size of Results	Impact's Possibility to Arise	Capacity to Struggle	Groups / Institutions to be Affected
21. Decrease in agricultural productivity and production due to extremely hot weather	Very high ☹	2015-2044	Very High	High	Low	Employees of agriculture sector, Factories, Consumers
22. Increase in forest fires affecting large areas along with drought and increasing temperatures	-	-	Lack of detailed data	Lack of detailed data	Lack of detailed data	Lack of detailed data
23. Submerging of fertile agricultural lands as a result of floods	Very high ☹	2015-2044	Very High	High	Low	Agriculture sector, Public, Factories
24. Soil erosion caused by extreme precipitation	Very high ☹	2015-2044	Very High	High	Low	Agriculture sector, Factory, Consumer (Public)
25. Inability to meet the increasing water demand for agricultural irrigation along with increase of drier soils	Very high ☹	2015-2044	Very high	High	Low	Consumer, Factory, Producer
26. Decrease in the efficiency of livestock raising due to temperature stress (decrease in the reproduction efficiency, increasing deaths)	Very high ☹	2015-2044	Very high	High	Low	Consumer, Factory, Producer
27. Decrease in the production of milk and milk products of farm animal due to temperature stress	Very high ☹	2015-2044	Very high	High	Low	Consumer, Factory, Producer
28. Loss of products / decrease of yield as a result of increase of agricultural pests	Very high ☹	2015-2044	Very high	High	Low	Consumer, Factory, Producer
29. Loss of products as a result of increase in agricultural diseases	Very high ☹	2015-2044	Very high	High	Low	Consumer, Factory, Producer
30. Losses at areas where greenhouse cultivation is performed intensely due to sudden and extreme precipitation and hail etc.		No data	No data	No data	No data	No data
31. Migration to city centre from other counties of the province, and from rural areas	Very high ☹	2015-2044	Very high	High	Medium	Consumer, Factory, Producer

Agriculture and Ecosystems Sector Risk Assessment Table						
Negative Impact	Risk Level	Period of Impact	Size of Results	Impact's Possibility to Arise	Capacity to Struggle	Groups / Institutions to be Affected
32. Decrease in the employment of agriculture	Very high ☹	2015-2044	Very high	High	Low	Consumer, Factory, Producer
33. Decrease in the production of agricultural products at processing factories along with the decrease of productivity in agriculture	Very high ☹	2015-2044	Very high	High	Medium (Import)	Consumer, Factory, Producer
34. Decrease in the production of agricultural products at processing factories as a result of decrease in agricultural production due to extreme precipitation, storm and flood incidences	Very high ☹	2015-2044	Very high	High	Low	Consumer, Factory, Producer
35. Increase in food prices	Very high ☹	2015-2044	Very high	High	Low (Medium with Import)	Consumer, Factory, Producer
36. Decrease in the quantity of living things in the forest ecosystems	Very high ☹	2015-2044	Very high	High	No data	Exposure of ecosystem, thus exposure of ecological processes Inability to ensure the sustainability of the natural ecosystem
37. Increase in the pest and invader speciesof forest	-	No data	No data	No data	No data	No data
38. Decrease in the quantity of the living things in water ecosystems, and increase in the invader species	-	No data	No data	No data	No data	No data
39. Decrease in surface and groundwaters due to increasing temperature and drought	Very high ☹	2015-2044	Very high	High	?	Agricultural areas, Public, Production
40. Higher impactiveness of agricultural and industrial contamination along with decreasing amount of water in water resources	Very high ☹	2015-2044	Very high	High	?	Agricultural areas, Forest areas, Public, Production

Water and Waste Water Service Sector Assessment Table						
Negative Impact	Risk Level	Period of Impact	Size of Results	Impact's Possibility to Arise	Capacity to Struggle	Groups / Institutions to be Affected
9. Physical damage on water and sewerage system by the extreme precipitation	Very high ☹	2015-2044	Very high	High	Medium	Citizens, and Public institutions
10. Decrease of the amount of water at dams	Very high ☹	2015-2044	Very high	High	Low	All ecosystems and living beings
11. Damage at urban spaces as a result of floods at urban areas due to sudden and extreme precipitation	High ☹	2015-2044	High	High	Low	All ecosystems
12. Loss property and damages on private property (households, workplaces, and vehicles) at urban areas as a result of extreme wind and twister events	Medium	2045-2074	High	Low	Low	All ecosystems
13. Disruption of clean water service due to drought in some districts	Very high ☹	2015-2044	Very high	Very high	Low	All ecosystems
14. Disruption of clean water service due to drought in the whole province	Very high ☹	2015-2044	Very high	Very high	Low	All ecosystems
15. Damage at historical artworks at antique areas by the extreme temperature	Medium	2045-2074	Medium	Low	Low	Tourism sector's stakeholders
16. Damage at historical artworks at antique areas due to increasing floods	High ☹	2045-2074	High	Medium	Low	Tourism sector's stakeholders

Transportation Sector Risk Assessment Table						
Negative Impact	Risk Level	Period of Impact	Size of Results	Impact's Possibility to Arise	Capacity to Struggle	Groups / Institutions to be Affected
9. Damaged railway transportation infrastructure by the extreme precipitation	Very high ☹	2044-2075	Very high	Low	Medium	Railway, Passengers
10. Damaged road transportation infrastructure by the extreme precipitation	Medium	2015-2044	Medium	Medium	Low	Metr. Mun.-District, Highways, Local public
11. Damaged road lines by the extreme temperatures	Medium	2015-2044	Medium	High	Medium	Metr. Mun.-District, Highways, Local public
12. Disruption of aviation by extreme precipitation and storms	Low	2015-2044	Low	Medium	Low	Airways, passengers
13. Accident risk and negative impact on vehicles' traffic by extreme cold weather and icing	High ☹	2015-2044	High Impact	Medium	High	Metropolitan and district municipalities, Local public, Highways
14. Exposure of smart transportation systems to elements such as lightning under extreme precipitation	Medium	2015-2044	Medium Impact	Medium	High	Metropolitan municipalities, Local public, Contractor company (Positive)
15. Disruption of transportation due to extreme precipitation and snow storm, damage at infrastructure by the same	Medium	2015-2044	Medium Impact	Medium	High	Metr. Mun.-District, Highways, Local public, Infrastructure institutions
16. Disruption of transportation as a result of closing of roads under extreme snow, presence of villages that cannot be reached	High ☹	2015-2044	High impact	Low	Medium	Highways, Metr. Mun.-District, Local public, Logistic companies, Infrastructure institutions

Industry Sector Risk Assessment Table						
Negative Impact	Risk Level	Period of Impact	Size of Results	Impact's Possibility to Arise	Capacity to Struggle	Groups / Institutions to be Affected
12. Interruption in production due to scarcity of water in water intense industrial activities	High ☹	2015-2044	High	High	Low	Textile, Marble
13. Decrease in the production of textile industry due to scarcity of raw materials from agriculture	High ☹	2015-2044	High	High	Medium	Agriculture, Textile
14. Loss of productivity in labour due to higher severity of hot weather	Low	2015-2044	Low	High	High	Industrial organizations, Glass, Cement, Textile, Industrial employees
15. Increase of energy consumption cost in value chain	Medium	2015-2044	Medium	High	Medium	Industrial organizations
16. Difficulties in accessing the raw material as a result of negative weather events	Medium	2015-2044	Medium	Medium	High	Industry
17. Decrease in production as a result of disruption of water usage with the purpose of industry due to drought	High ☹	2015-2044	High	High	Low	Textile, Marble
18. Emmigration from the province as a result of decrease in industrial production	Low	2045-2074	Low	Low	Medium	Society
19. Decrease in economic production in the whole province	High ☹	2045-2074	High	Medium	Medium	Industry
20. Damages on factories, and on other fixed assets due to floods	Medium	2015-2044	Medium	High	Low	Industry, Local administration
21. Decrease in the production of food industry due to scarcity of raw materials from agriculture	High ☹	2015-2044	High	High	NA	Society, Agriculture, Food
22. Damages arising from storm, hail, and other similar severe weather conditions	Medium	2015-2044	Medium	High	Low	Industry

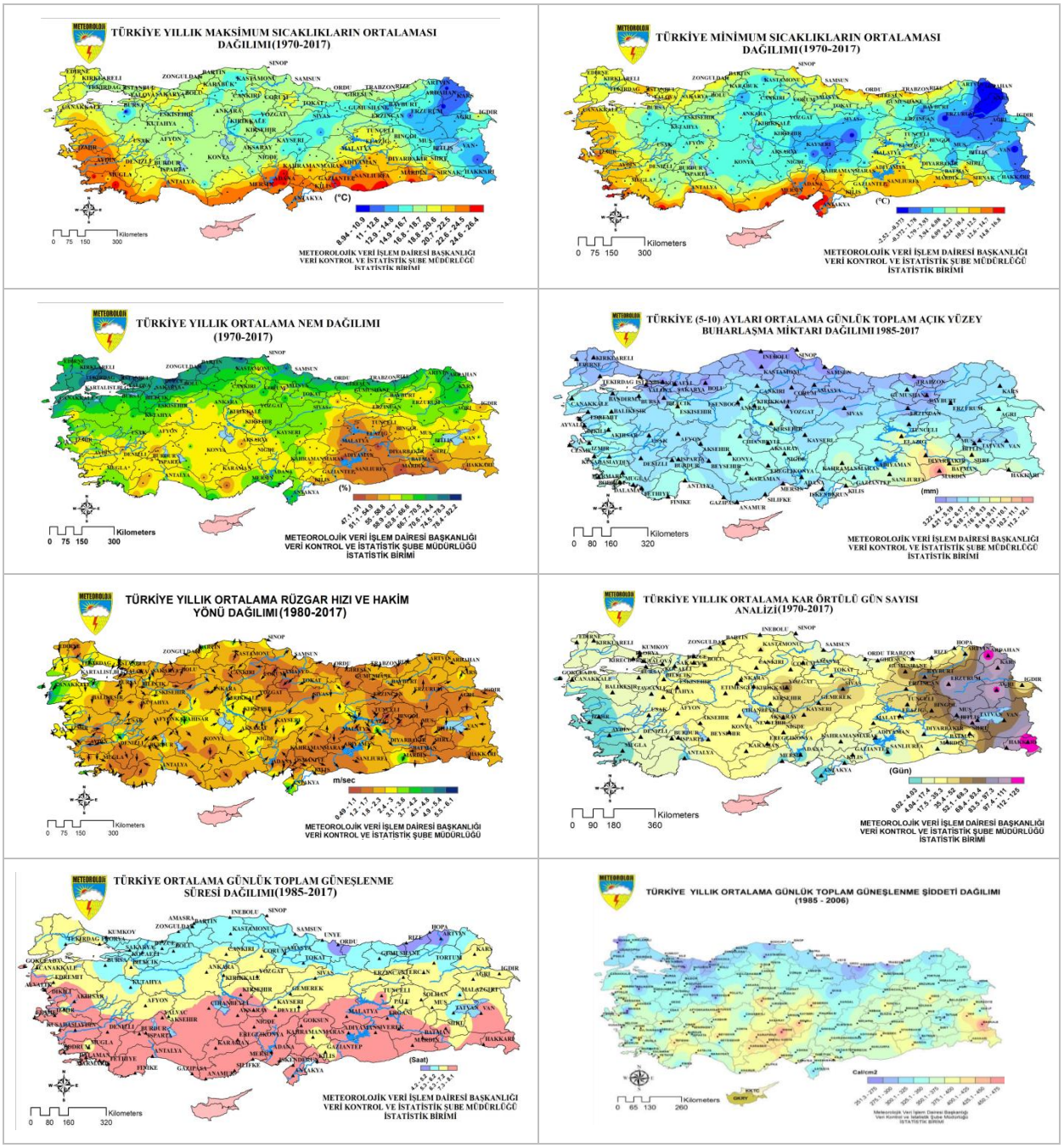
Energy Sector Risk Assessment Table						
Negative Impact	Risk Level	Period of Impact	Size of Results	Impact's Possibility to Arise	Capacity to Struggle	Groups / Institutions to be Affected
7. Decrease in the energy production of hydroelectric power plants	Medium	2045-2074	Medium Level Impact	Medium	Low	All groups having energy requirement
8. Deterioration and damages on transmission lines caused by high temperatures	Medium	2045-2074	High Impact	Low	High	All groups having energy requirement
9. Heavy load imposed on electric grid with the purpose of cooling by the impact of urban weather island to arise due to higher severity of hot weather	Low	2045-2074	Low Impact	Low	High	All groups having energy requirement
10. Occurrence of electricity interruptions as a result of damage on energy infrastructure due to floods	Very high ☹	2015-2044	Very high	Medium	High	All groups having energy requirement
11. Occurrence of damage at energy power plants due to floods, and interruption of energy production	Low	2015-2044	Very Low Impact	Medium	High	All groups having energy requirement
12. Loss of productivity due to permanent damages in information and communication technologies depending on climate change	Very high ☹	2015-2044	Very High Impact	Low	Medium	Everyone using technology and information communication

ANNEX 12 - CLIMATE DATA OF DENİZLİ

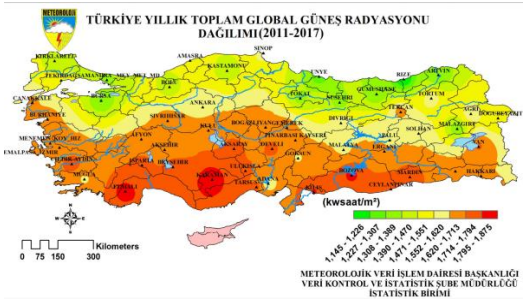
Table 45 - Meteorological Data of Denizli (Periods of 1981-2010 and 1956-2017)

Parameter	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Annual
Measurement Period (1981 - 2010)													
Average Temperature (°C)	6.1	6.9	10.2	14.9	20.2	25.2	27.9	27.5	22.8	17.2	11.3	7.7	16.5
Average Highest Temperature (°C)	10.8	11.9	15.9	20.9	26.6	31.7	34.7	34.7	30.3	23.9	16.9	12.1	22.5
Average Lowest Temperature (°C)	2.5	2.8	5.3	9.5	13.7	18.1	20.9	20.6	16.4	11.9	7	4.2	11.1
Average Sunshine Duration (hour)	3.5	4.1	5.4	6.4	8.6	10.5	11	10.2	8.6	6.3	4.4	3.1	82.1
Average Number of Rainy Days	11	10.9	10.8	10.4	7.7	4.3	2.3	2	2.9	5.7	8.2	11.8	88
Average of Monthly Total Precipitation Amount (mm)	74	74.1	65	56.2	37.4	25.9	17.7	8.9	11.8	31.6	65.5	84.5	553
Measurement Period (1956 - 2017)	**Jan.**	**Feb.**	**March**	**April**	**May**	**June**	**July**	**August**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Annual**
Average Temperature (°C)	5.9	7.1	10.2	14.7	19.8	24.7	27.6	27	22.5	16.8	11.4	7.6	16.3
Average Highest Temperature (°C)	10.4	12.2	15.9	20.7	26.2	31.2	34.4	34.3	29.9	23.7	17.3	12.1	22.4
Average Lowest Temperature (°C)	2.2	2.9	5.2	9	13.1	17.3	20.1	19.7	15.7	11.3	6.9	4	10.6
Average Sunshine Duration (hour)	3.7	4.4	5.6	6.9	9	11	11.8	10.9	9.2	6.8	5	3.4	87.7
Average Number of Rainy Days	11.9	10.7	11.2	10.2	8.9	4.9	2	1.9	3	5.8	7.6	12.2	90.3
Average Monthly Total Precipitation Amount (mm)	91.6	72.3	63.6	53.5	43	25	13	8.3	14.3	35.1	55.6	88.4	564
	Measurement Period (1956 - 2017)												
Highest Temperature (°C)	22.6	25.9	30.8	35.8	37	42.4	43.9	44.4	41.6	34.4	29.9	26.6	44.4
Lowest Temperature (°C)	-10.5	-11.4	-7	-2	2.7	7.9	12.6	11.6	6.6	-0.8	-4.5	-10.4	-11.4

Figure 100 - Turkey Analysis of Meteorological Parameters[76]



[76] https://mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?k=parametrelerinTurkiyeAnalizi


TÜRKİYE YILLIK TOPLAM GLOBAL GÜNEŞ RADYASYONU
DAĞILIMI(2011-2017)
(kwsaat/m²)
1.145 - 1.226
1.227 - 1.307
1.308 - 1.389
1.390 - 1.470
1.471 - 1.551
1.552 - 1.632
1.633 - 1.713
1.714 - 1.794
1.795 - 1.875
Kilometers
0 75 150 300
METEOROLOJİK VERİ İŞLEM DAİRESİ BAŞKANLIĞI
VERİ KONTROL VE İSTATİSTİK ŞUBE MÜDÜRLÜĞÜ
İSTATİSTİK BİRİMİ


TÜRKİYE 100 cm ORTALAMA TOPRAK SICAKLIĞI
(1970-2017)
(°C)
Kilometre
0 85 170 340
METEOROLOJİK VERİ İŞLEM DAİRESİ BAŞKANLIĞI
VERİ KONTROL VE İSTATİSTİK ŞUBE MÜDÜRLÜĞÜ
İSTATİSTİK BİRİMİ


TÜRKİYE 5 cm ORTALAMA TOPRAK SICAKLIĞI DAĞILIMI
(1970-2017)
(°C)
Kilometre
0 87,5 175 350
METEOROLOJİK VERİ İŞLEM DAİRESİ BAŞKANLIĞI
VERİ KONTROL VE İSTATİSTİK ŞUBE MÜDÜRLÜĞÜ
İSTATİSTİK BİRİMİ


TÜRKİYE 50 cm ORTALAMA TOPRAK SICAKLIĞI
(1970-2017)
(°C)
Kilometre
0 95 190 380
METEOROLOJİK VERİ İŞLEM DAİRESİ BAŞKANLIĞI
VERİ KONTROL VE İSTATİSTİK ŞUBE MÜDÜRLÜĞÜ
İSTATİSTİK BİRİMİ

ABBREVIATIONS

AFAD - Directorate of Disaster and Emergency Management
AFOLU - Agriculture Forestry and Other Land Use
AR5 - 5th Assessment Report
AVM - Shopping Centre
C - Confidential
ÇATIDER - Association of Roofing Industrialists and Businessmen
CCAP - Climate Change Action Plan
CDD - Cooling Degree Day
ÇEDBİK - Environmentally Friendly Green Buildings Association
CH_4 - Methane
CIRIS - City Inventory Reporting and Information System
CLUF - Change of Land Use, and Forestry
CNG - Compressed Natural Gas
CO_2 - Carbon dioxide
CO_2e - Carbon dioxide equivalent
CoM - Covenant of Mayors
COP - Conference of Parties
DCI - Denizli Chamber of Industry
DESKI - Denizli Metropolitan Municipality Water and Sewerage Administration
DMM - Denizli Metropolitan Municipality
DSI - General Directorate of State Hydraulic Works
ELT - End-of-life Tire
ENVERDER - Energy Efficiency Association
EPC - Energy Performance Certificate
EPDK - Energy Market Regulatory Authority
EU - European Union
FAO - Food and Agriculture Organization of the United Nations
GDP - Gross Domestic Product
GDRE - General Directorate of Renewable Energy
GHG - Greenhouse Gas
GNAT - Grand National Assembly of Turkey
GPC - Global Protocol for Community-Scale Greenhouse Gas Emission Inventories
HDD - Heating Degree Day
ICLEI - Local Governments for Sustainability
IE - Included Elsewhere
İLBANK A.Ş. - İller Bankası A.Ş.

INDC - Intended Nationally Determined Contributions
IPA - Instrument for Pre-Accession Assistance
IPCC - Intergovernmental Panel on Climate Change
IPPU - Industrial Process and Product Use
IYSD - Thermal Insulation Industrialists' Association
İZODER - Association of Thermal Insulation, Waterproofing, Sound Insulation and Fireproofing Material Producers, Suppliers and Applicators
KGM - General Directorate of Highways
KİSAD - Association of Lime Industrialists
LPG - Liquefied Petroleum Gas
MGM - Turkish State Meteorological Service
MMO - Chamber of Mechanical Engineers
MoAF - Ministry of Agriculture and Forestry
MoENR - Ministry of Energy and Natural Resources
MoEU - Ministry of Environment and Urbanization
MoIT - Ministry of Industry and Technology
MoNE - Ministry of National Education
MoTI - Ministry of Transport and Infrastructure
MRV - Monitoring, Reporting, Verification
MTA - General Directorate of Mineral Research and Exploration
MTEP - Million Ton Equivalent of Petroleum
N_2O - Nitrous oxide
NE - Not Estimated
NGO - Non-governmental Organization
NO - Not Occurring
OECD - Organisation for Economic Co-operation and Development
OIZ - Organized Industrial Zone
PAU - Pamukkale University
PDoAF - Provincial Directorate of Agriculture and Forestry
PDoCT - Provincial Directorate of Culture and Tourism
PDoEU - Provincial Directorate of Environment and Urbanization
PDoIT - Provincial Directorate of Industry and Technology
PDoNE - Provincial Directorate of National Education
PFC - Perfluorocarbon
QA - Quality Assurance
QC - Quality Control
RDoM - Regional Directorate of Meteorology
REC - Regional Environment Center
RW - Railway

SCD - Smart City Denizli
SECAP - Sustainable Energy and Climate Action Plan
SF_6 - Sulfur hexafluoride
SME - Small and Medium-Sized Enterprises
SPP - Solar Power Plant
TCDD - Turkish State Railways
TÇMB - Turkish Cement Manufacturers' Association
TÇÜD - Turkish Steel Producers Association
TEİAŞ - Turkish Electricity Transmission Corporation
TOBB - The Union of Chambers and Commodity Exchanges of Turkey
TÜBİTAK - The Scientific and Technological Research Council of Turkey
TÜBİTAK MRC - The Scientific and Technological Research Council of Turkey Marmara Research Center
TÜREB - Turkish Wind Energy Association
TurkStat - Turkish Statistical Institute
UNFCCC - United Nations Framework Convention on Climate Change
UNFCCC - United Nations Framework Convention on Climate Change
USA - United States of America
USEPA - US Environmental Protection Agency
WEEE - Waste Electrical and Electronic Equipment
WPP - Wind Power Plant
WRI - World Resources Institute
WTP - Wastewater Treatment Plant

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