



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

# DENİZLİ

## CLIMATE CHANGE ACTION PLAN

2016 - 2030







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**CLIMACTION**  
POWER THE REVOLUTION  
FOR CLIMATE ACTION

# DENİZLİ

## CLIMATE CHANGE ACTION PLAN

2016 - 2030

EXECUTIVE SUMMARY



**Prepared by**

Rifat Ünal Sayman - Team Leader  
Onur Akpulat - Senior Climate Change Expert  
Dursun Baş - Senior Climate Change Expert  
Gözde Odabaş - Data Analysis Expert

**Regional Environmental Center  
(REC) Turkey**

**Denizli Metropolitan Municipality Project Group**

Cem Bağcı - Head of Department  
Berna Yılmaz - Chemist (Project Coordinator)  
Pelın Aslı Özen - Economist (Project Assistant)

**Denizli Metropolitan Municipality  
Department of Survey and  
Projects**

**Denizli Climate Change Action Plan**

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**GRANTEE**

On Behalf of Denizli Metropolitan Municipality  
Mayor of Denizli  
Osman ZOLAN

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Regional Environmental Center (REC) Turkey  
Mustafa Kemal Mahallesi 2142. Sokak No:18/11 Söğütözü Ankara Turkey  
Tel: +90 (312) 491 95 30 • Fax: +90 (312) 491 95 40  
E-mail: info@rec.org.tr • Website: www.rec.org.tr

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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.





## EXECUTIVE SUMMARY

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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<sup>1</sup>.

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.













A fully participatory process has been followed while preparing the CCAP and all relevant stakeholders have been included in the preparation process. A Steering Committee was formed in the first phase of the study to provide general guidance to the action plan, by bringing together key institutions. CCAP Steering Committee, 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 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.**

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<sup>1</sup> 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.

## CCAP ADVISORY BOARD MEMBERS

	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

THE VISION OF THE ACTION PLAN IS DEFINED AS “MAKING DENİZLİ A LOW CARBON, CLIMATE CHANGE RESISTANT MODEL CITY”.

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.

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.

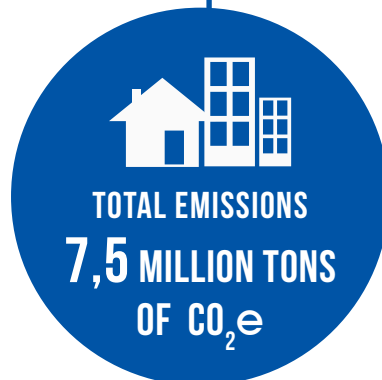
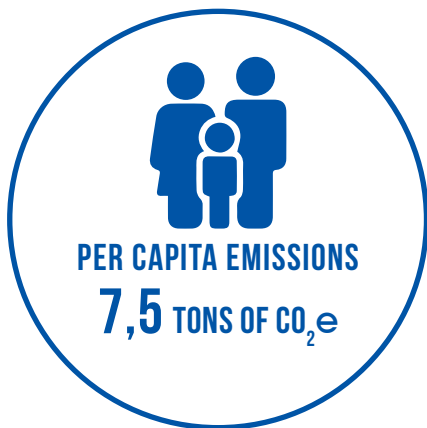
The inventory content is based on the classification of emission sources set by GPC. When preparing inventory in the framework of GPC, the scope of the inventory was determined depending on the detail, accuracy and reliability of the available data. GPC evaluates greenhouse gas emissions in 3 scopes; 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<sub>2</sub>e. This amount refers to 7.5 tons of CO<sub>2</sub>e 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<sub>2</sub>e per capita. Total emissions of Denizli in Turkey's total emissions in 2016 constitute 1.5%.

## GHG INVENTORY SUMMARY RESULTS

### DENIZLI

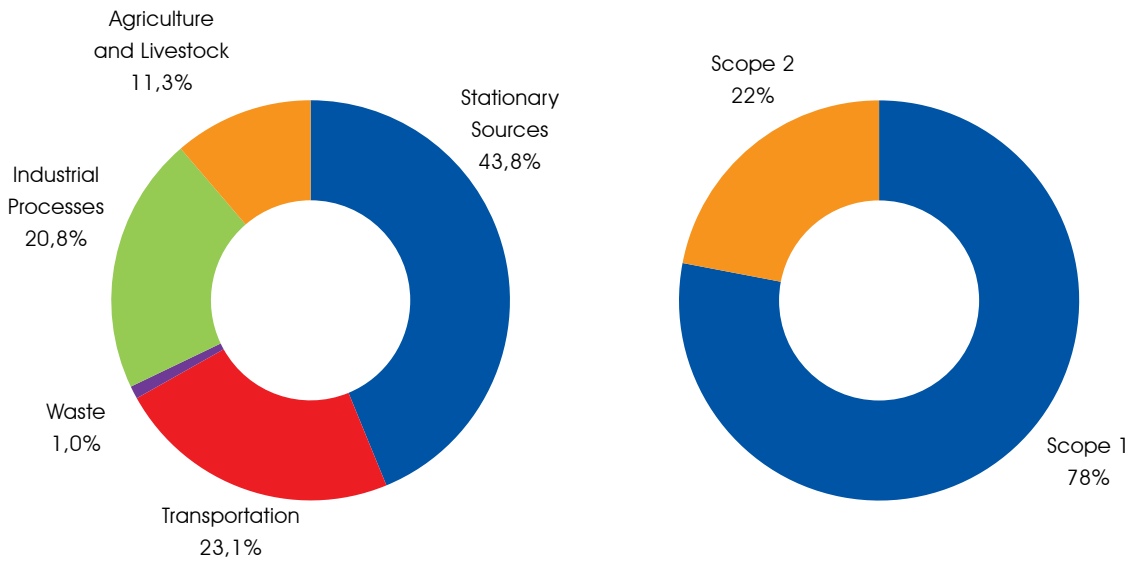
A REDUCTION  
TARGET OF **21%**  
HAS BEEN SET FOR  
2030.



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 / corporate buildings, manufacturing industry and construction, energy industry and agricultural activities have been calculated in the stationary sources. Emissions from roads, railways, waterways and airways 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, fertilizer management and enteric fermentation have been mainly calculated in the scope of agriculture and livestock sector. Details of inventory is presented in the CCAP.

### SECTORAL BREAKDOWN OF GHG INVENTORY



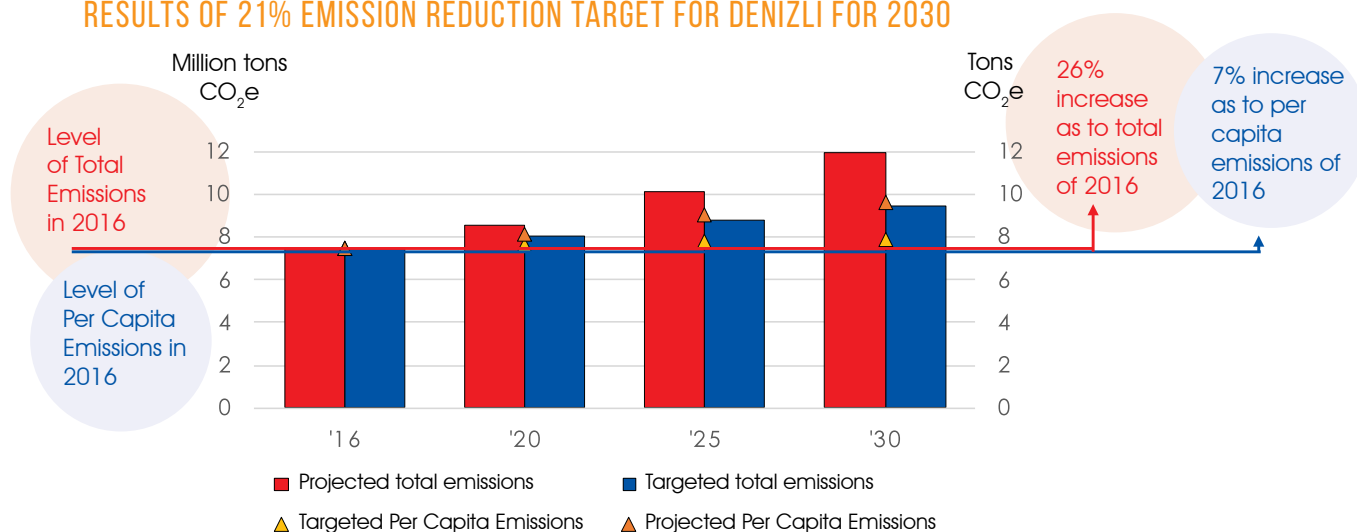
SECTOR (TON CO <sub>2</sub> e)	SCOPE 1	SCOPE 2	SECTORAL TOTAL
Stationary Sources	1.635.897	1.649.444	3.285.341
Transportation	1.729.770	1.333	1.731.104
Waste	78.092		78.092
Industrial Processes	1.560.472		1.560.472
Agriculture and Livestock	847.659		847.659
Scope Total	5.851.890	1.650.777	7.502.667

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 modeling performed in the study,

the emissions of Denizli for the year 2030 has been anticipated as 11.9 million tons of CO<sub>2</sub>e. In the same year, the emissions per person are being expected to be 10.1 tons of CO<sub>2</sub>e. 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<sub>2</sub>e, and to have the total emissions remain as 9.5 million tons of CO<sub>2</sub>e.

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 <sub>2</sub> e)	AMOUNT OF REDUCTION (MILLION TONS OF CO <sub>2</sub> e)	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**			
<b>TOTAL</b>	<b>11.95</b>	<b>2.51</b>	<b>%21</b>

\* 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 and waste management" 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 effects 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 chapters of the CCAP in detail.

- Climate Change Models and Scenarios
- Past and Present Climatic Effects
- Denizli's Climate Projections
- Climate Change Impact Survey
- Risk Assessment Framework
- 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 projection regarding the average temperatures of Denizli;

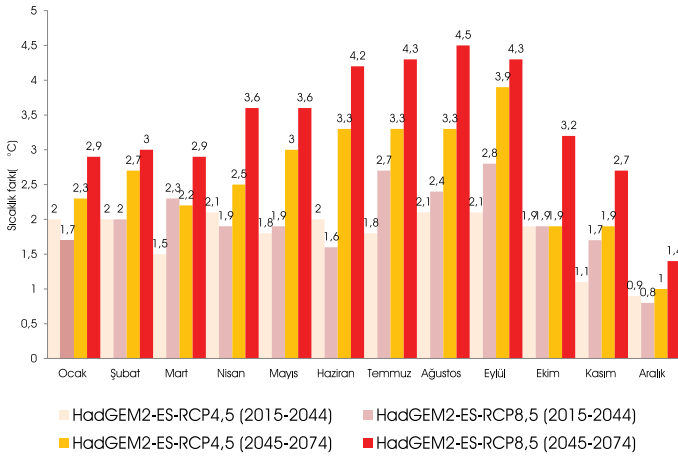
IT IS EXPECTED FOR THE SEMI-ARID AND SEMI-HUMID CLIMATE OF DENIZLI TO SHOW A CHANGE TOWARDS ARID CLIMATE.

- 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.

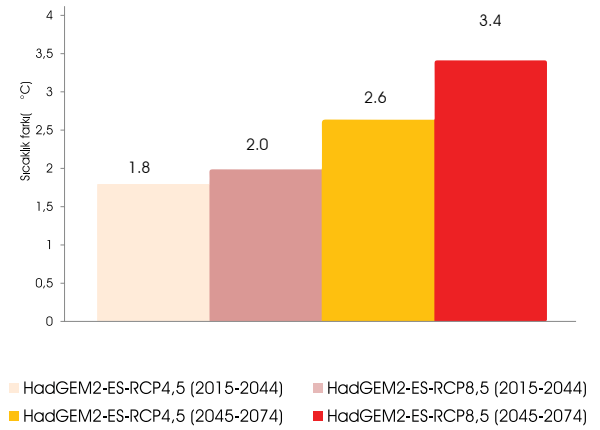
It is expected for the semi-arid and semi-humid climate of Denizli to show a change towards arid climate.

## DENIZLI'S TEMPERATURE PROJECTIONS FOR THE RCP 4.5 AND RCP8.5 SCENARIOS

CHANGE OF MONTHLY AVERAGE TEMPERATURES, PERIODS OF 2015-2044 AND 2045-2074 (FOR RCP4.5 AND RCP8.5 SCENARIOS)



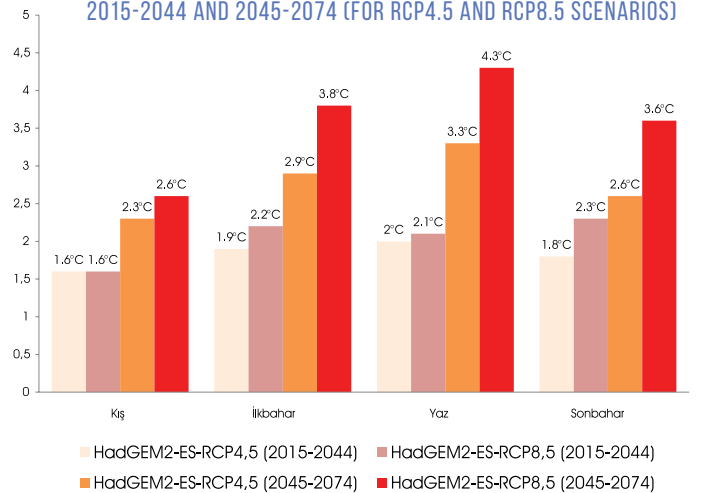
CHANGE OF ANNUAL AVERAGE TEMPERATURES, PERIODS OF 2015-2044 AND 2045-2074 (FOR RCP4.5 AND RCP8.5 SCENARIOS)



CHANGE OF SEASONAL AVERAGE TEMPERATURES, PERIODS OF 2015-2044 AND 2045-2074 (FOR RCP4.5 AND RCP8.5 SCENARIOS)

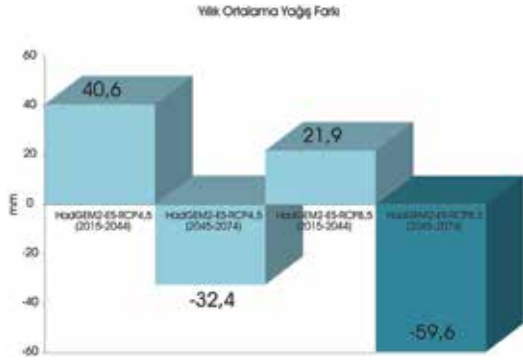


CHANGE OF SEASONAL MAXIMUM AVERAGE TEMPERATURES, PERIODS OF 2015-2044 AND 2045-2074 (FOR RCP4.5 AND RCP8.5 SCENARIOS)

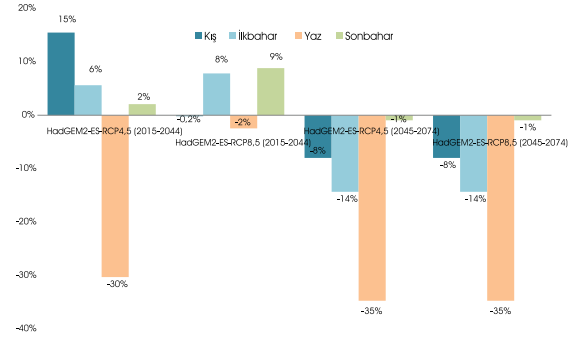


## DENIZLI'S PRECIPITATION PROJECTIONS FOR THE RCP4.5 AND RCP8.5 SCENARIOS

ANNUAL AVERAGE PRECIPITATION DIFFERENCE, PERIODS OF 2015-2044 AND 2045-2074 (FOR RCP4.5 AND RCP8.5 SCENARIOS)



ANNUAL AVERAGE SEASONAL PRECIPITATION DIFFERENCE RATE, PERIODS OF 2015-2044 AND 2045-2074 (FOR RCP4.5 AND RCP8.5 SCENARIOS)



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 effects 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.



TABLE • AGRICULTURE AND ECOSYSTEMS SECTOR RISK ASSESSMENT TABLE

Negative Effect	Risk Level	Period of Effect	Size of Results	Effect'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

TABLE • AGRICULTURE AND ECOSYSTEMS SECTOR RISK ASSESSMENT TABLE (CONTINUE)









	Negative Effect	Risk Level	Period of Effect	Size of Results	Effect's Possibility to Arise	Capacity to Struggle	Groups / Institutions to be Affected
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
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 species of 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 effectiveness 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

TABLE • WATER AND WASTE WATER SERVICE SECTOR ASSESSMENT TABLE

Negative Effect	Risk Level	Period of Effect	Size of Results	Effect'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 (lodgings, 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

TABLE • TRANSPORTATION SECTOR RISK ASSESSMENT TABLE





Negative Effect	Risk Level	Period of Effect	Size of Results	Effect'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 airway transportation by extreme precipitation and storms	Low	2015-2044	Low	Medium	Low	Airways, passengers
5. Accident risk and negative effect on vehicles' traffic by extreme cold weather and icing	High 	2015-2044	High Effect	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 Effect	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 Effect	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 effect	Low	Medium	Highways, Metr. Mun.-District, Local public, Logistic companies, Infrastructure institutions

TABLE • INDUSTRY SECTOR RISK ASSESSMENT TABLE

Negative Effect	Risk Level	Period of Effect	Size of Results	Effect'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

TABLE • ENERGY SECTOR RISK ASSESSMENT TABLE

Negative Effect	Risk Level	Period of Effect	Size of Results	Effect'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 Effect	Medium	Low	All groups having energy requirement
2. Deterioration and damages on transmission lines caused by high temperatures	Medium	2045-2074	High Effect	Low	High	All groups having energy requirement
3. Heavy load imposed on electric grid with the purpose of cooling by the effect of urban weather island to arise due to higher severity of hot weather	Low	2045-2074	Low Effect	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 Effect	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 Effect	Low	Medium	Everyone using technology and information communication

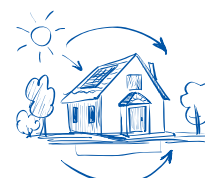
Implementation period for the following mitigation and adaptation actions determined in line with the vision and objective of the action plan, the emission reduction potential, the estimated costs, the responsible stakeholders, and the risks that may occur in the implementation are presented in detail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

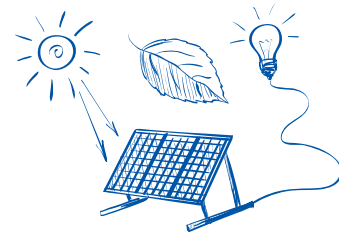
In the scope of CCAP, a total of 12 objectives and 36 actions have been created under 6 action areas in terms of greenhouse gas reduction. Objectives and actions are presented in the table below.



ACTION AREA	OBJECTIVES	ACTIONS
<b>BUILDINGS</b>	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 effects 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
<b>AGRICULTURE AND LIVESTOCK</b>	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





ACTION AREA	OBJECTIVES	ACTIONS
<b>ENERGY</b>	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
<b>TRANSPORTATION</b>	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
<b>WASTE/ WASTEWATER</b>	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
	Objective W2: Reducing the amount of landfilled organic waste and recyclable waste	Action W1.2: Providing sewage and waste water treatment plant services to the entire population of the province
	Objective W3: Increasing renewable energy and energy efficiency practices in solid waste and waste water disposal	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 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
<b>INDUSTRY</b>	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		

## 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.



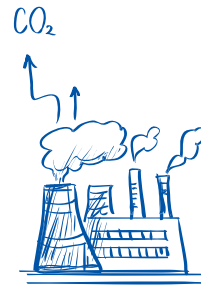
ACTION AREA	OBJECTIVES	ACTIONS
<b>AGRICULTURE AND ECOSYSTEMS</b>	Objective A1: Sustaining agricultural productivity	Action A1.1: Plant selection according to water requirement and rotation of crops Action A1.2: Training and support of farmers to promote the use of healthy seedlings, seeds and widespread 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



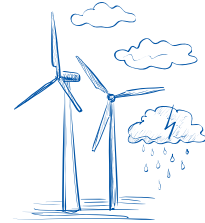
ACTION AREA	OBJECTIVES	ACTIONS
<b>WATER AND WASTEWATER</b>	Objective W1: To increase the resistance of existing water and sewerage infrastructure	Action W1.1: Regular maintenance of infrastructure and sewerage systems
		Action W1.2: Increasing the effectiveness of Infrastructure Coordination Centre (AYKOME)
		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
<b>TRANSPORTATION</b>	Objective T1: Preventing excessive rainfall from damaging the railway and road transport network infrastructure	Action T.1: Increasing inspections and maintenance according to meteorological data
		Action T.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
		Action T3.1: Reducing the impact on public transport drivers and public transport users
	Objective T3: Personnel and vehicles in public transport system on roads are resistant to climate change	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 effects 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

## FINDINGS OF ADAPTATION QUESTIONNAIRE



Within the scope of the project, **Questionnaire on the Effects 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 effects 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.

### 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 Kirkikindi 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 below in brief.

### 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 Aydin, 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. ”

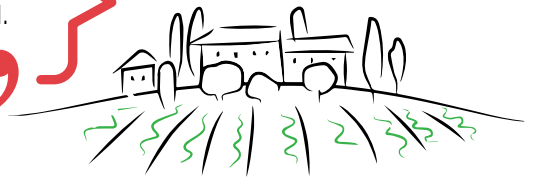
“ We are facing with difficulties during physical education courses at school. ”

“ 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. ”

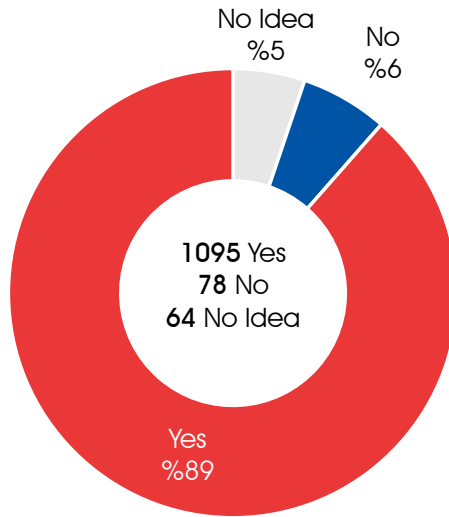
“ There was no grape in this year in our vineyard. ”

“ 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. ”

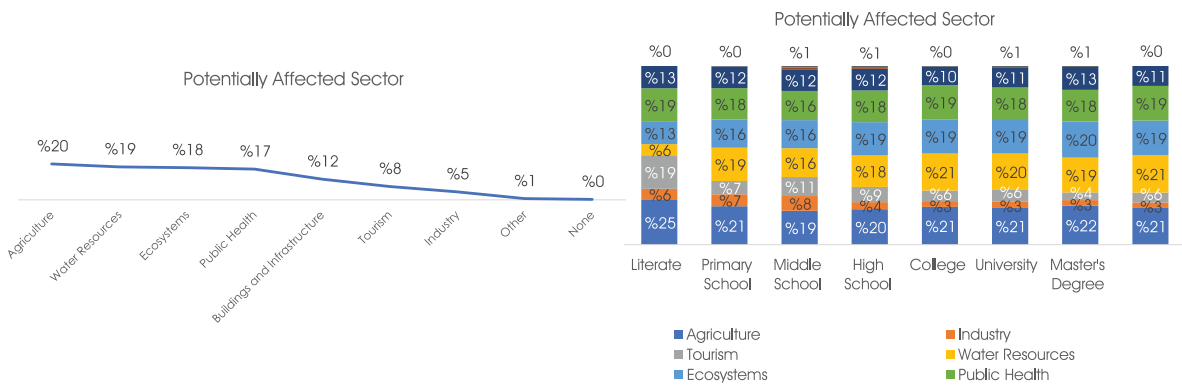


88% of respondents stated that the impacts of climate change were seen in Denizli.

ANSWERS PROVIDED FOR THE QUESTION OF "CAN THE IMPACTS OF CLIMATE CHANGE BE SEEN?"

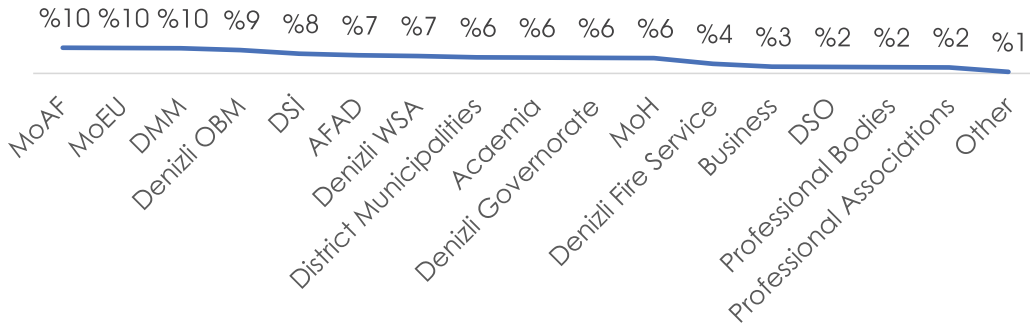


BREAKDOWN OF SECTORS WHICH WILL BE AFFECTED FROM CLIMATE CHANGE

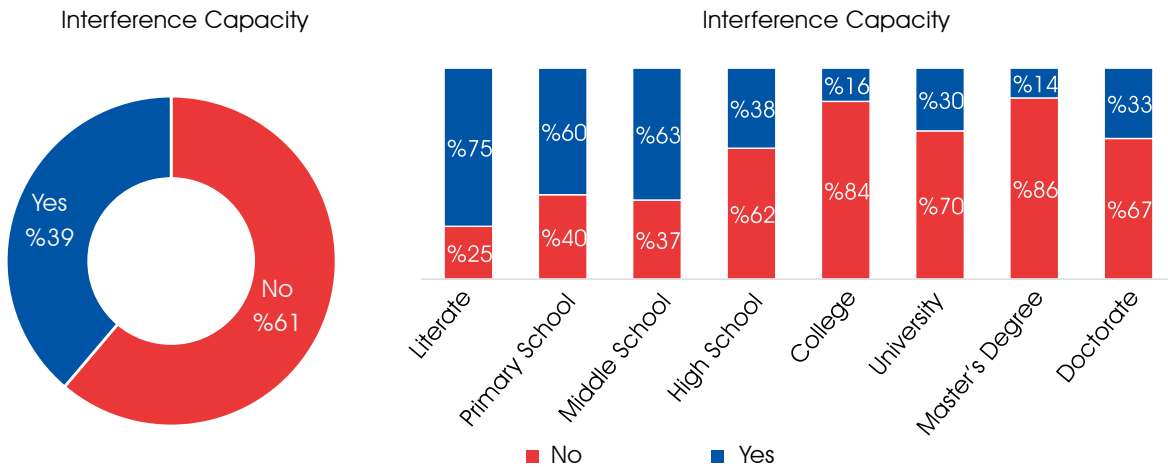


The institutions that the participants of the questionnaire deem as the most important for struggle with the effects of climate change are as follows: Ministry of Agriculture and Forestry, Ministry of Environment and Urbanization, Denizli Metropolitan Municipality, and Denizli Regional Directorate of 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 effects 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.

## IMPORTANT INSTITUTIONS IN TACKLING WITH IMPACTS



## CAPACITY OF INTERFERENCE TO / TACKLING WITH IMPACTS



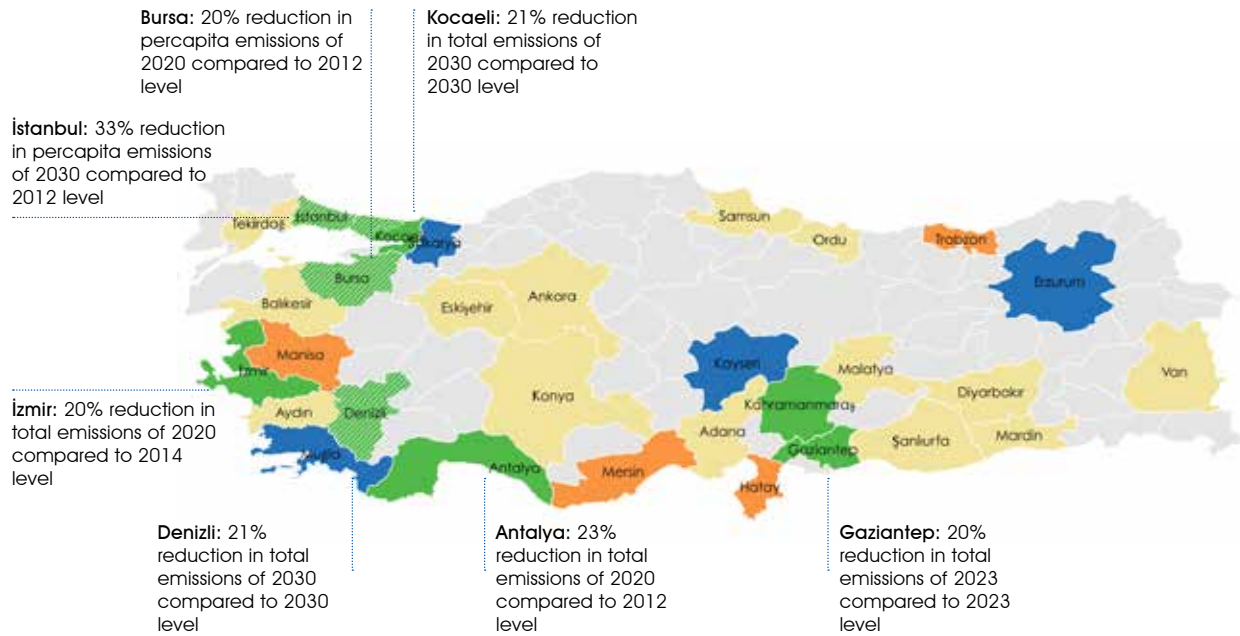
## LOCAL CCAP OF METROPOLITAN CITIES

In order to achieve the national targets in the context of combating global climate change, the local initiative and Local Climate Change Action Plans (LCCAP) play a key role. As of 2019, 12 of 30 Metropolitan Municipalities in Turkey, namely, Antalya, Bursa, Denizli, Erzurum, Gaziantep, İstanbul, İzmir, Kahramanmaraş, Kayseri, Kocaeli, Muğla and Sakarya have completed their GHG inventories. 4 of them, Hatay, Manisa, Mersin and Trabzon, continue to prepare it<sup>2</sup>.

<sup>2</sup> Gaziantep has prepared a total of 3 inventories for 2011, 2013, and 2015 and İstanbul has prepared a total of 2 inventories for 2013 and 2016.



## GREENHOUSE GAS INVENTORY STATUS OF METROPOLITAN CITIES 2019 (REC TURKEY, 2019)



By June 2019, of 30 Metropolitan Municipalities in Turkey;

- 12 metropolitan municipalities have GHG inventories (Some inventories are out of date).
- 8 metropolitan municipalities GHG reduction targets and action plans.
- 4 metropolitan municipalities continue to work on preparing GHG inventory.
- Only 3 metropolitan municipalities have an adaptation action plan: Bursa, Denizli and İstanbul.

## Inventories and Plans of Metropolitan Municipalities (June 2019)

- City does not have an inventory
- City is preparing an inventory
- City has an inventory
- City has an inventory and a reduction target
- City has an adaptation action plan

Of 12 metropolitan municipalities that have prepared GHG inventory, Antalya, Bursa, Denizli, Gaziantep, İstanbul, İzmir, Kahramanmaraş and Kocaeli, have emission reduction target and CCAP. Among these municipalities, only Bursa, Denizli and İstanbul Metropolitan Municipalities have both mitigation and adaptation action plans. With this study, Denizli has taken its place among the leading metropolitan cities.

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