

# SIXTH NATIONAL COMMUNICATION OF TURKEY

Under The UNFCCC

## SIXTH NATIONAL COMMUNICATON OF TURKEY

Under The United Nations Framework Convention on Climate Change  
Rebuplic of Turkey Ministry of Environment and Urbanization

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**Rebuplic of Turkey Ministry of Environment and Urbanization**  
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# FOREWORD



One of the most important problems facing humanity today is climate change.

Urgent measures should be adopted on a global, regional and local scale in order to combat negative impacts of climate change.

Strategies to combat environmental problems and climate change dominate economy and politics in the 21st century. Turkey is committed to fulfil its duty in combatting climate change.

Turkey became a party to the United Nations Framework Convention on Climate Change in 2004 and to the Kyoto Protocol in 2009.

National policies and strategies for combatting climate change are determined by the Coordination Board on Climate Change and Air Management. Public and private institutions participate in the Board which is chaired by the Minister of Environment and Urbanization.

The National Climate Change Strategy and the National Climate Change Action Plan and National Climate Change Adaptation Strategy and Action Plan were prepared in 2010 and 2011, respectively.

Moreover, the Paris Agreement was adopted by the consensus of 195 countries, including Turkey, at the Paris Climate Conference in December 2015. The Agreement, entering into force in 2020, aims to keep the increase in global average temperature well below 2 degrees Celsius above pre-industrial levels.

Having completed the Paris Climate Conference negotiations with success, Turkey has set course to combat climate change with a 2030 roadmap.

Turkey, with a fast developing economy, aims to reduce greenhouse gas emissions up to 21 percent reduction from Business-As Usual Scenario by 2030.

This value represents the emissions reduction goals in all economic sectors (energy production, industry, agriculture, waste, buildings, transportation and forestry) through plans and policies.

Turkey defines her position and climate change policy after 2020 as "integrating climate change goals with development policies, and increasing the exploitation of clean and renewable energy sources".

Thus, by improving development criteria and protecting environmental assets, we will leave next generations a clean and developed country.

We aim to create human and environment friendly, aesthetic, participative and prosperous brand cities based on the "Liveable Cities and Sustainable Environment" principle. Accordingly, we will take concrete steps towards establishing low-carbon cities by planning energy use, transportation, housing, landscape planning, waste management and public health within the scope of climate change.

"6th National Communication on Climate Change", submitted to the Secretariat of The United Nations Framework

Convention on Climate Change (UNFCCC), was prepared by the Ministry of Environment and Urbanization, and the TUBITAK Marmara Research Centre with the participation of public and private sector representatives, NGOs and the academy. The National Communication is a comprehensive document, prepared with a holistic and scientific approach. It presents the current and future status of Turkey within the scope of climate change and it is pivotal in integrating international climate change policies with national policies.

I believe that the 6th National Communication on Climate Change is a visionary contribution to the future of our country. I extend my gratitude to all participants from the Ministry of Environment and Urbanization, researchers from TUBITAK Marmara Research Centre, and representatives of institutions.

**Fatma Güldemet SARI**

Minister of Environment and Urbanization



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## LIST of ABBREVIATIONS

<b>LULUCF</b>	Land Use, Land-Use Change and Forestry
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>GHG</b>	Greenhouse Gas
<b>SHW</b>	State Hydraulic Works
<b>GEF</b>	Global Environment Facility
<b>GDP</b>	Gross Domestic Product
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>NCCAP</b>	National Climate Change Action Plan
<b>NCCSD</b>	National Climate Change Strategy Document
<b>CBCCAM</b>	Coordination Board on Climate Change Air Management
<b>ITU</b>	Istanbul Technical University
<b>KOSGEB</b>	Small and Medium Enterprises Development Organization
<b>GDM</b>	General Directorate of Meteorology
<b>MidSEFF</b>	The Turkish Mid-size Sustainable Energy Financing Facility
<b>METU</b>	Middle East Technical University
<b>OECD</b>	The Organization for Economic Co-operation and Development
<b>GDF</b>	General Directorate of Forestry
<b>NGO</b>	Non-Governmental Organization
<b>GDWM</b>	General Directorate of Water Management
<b>TOE</b>	Tons of Oil Equivalent
<b>TIKA</b>	Turkish Cooperation and Coordination Agency
<b>TTGV</b>	Technology Development Foundation of Turkey
<b>TurSEFF</b>	Turkey Private Sector Sustainable Energy Finance Facility
<b>TUBITAK</b>	The Scientific and Technological Research Council of Turkey
<b>TurkStat</b>	Turkish Statistical Institute
<b>UNDP</b>	United Nations Development Programme
<b>UNIDO</b>	United Nations Industrial Development Organization
<b>UNEP</b>	United Nations Environment Programme
<b>GDRE</b>	General Directorate of Renewable Energy



A close-up photograph of a vibrant green leaf, showing a complex network of veins. The central vein runs vertically, with smaller veins branching out horizontally and diagonally, creating a grid-like pattern. The leaf's surface has a fine, textured appearance. The background is a soft, out-of-focus green, suggesting other leaves or a natural setting.

## **EXECUTIVE SUMMARY**

## 1. INTRODUCTION

Turkey has submitted the First National Communication on Climate Change in 2007 and the Fifth National Communication on Climate Change where second, third, fourth and fifth communications were submitted together in 2013 to the United Nations Secretariat of Climate Change. In this communication which was prepared as the Sixth National Communication on Climate Change, the works carried out after the fifth communication and the issues not included in the previous communications are covered. Turkey carries out intensive works in subjects such as providing incentives to increase the use of renewable energy, accelerating the investments in public transport which cause less carbon emissions and increasing the energy efficiency within the scope of the fight against climate change.

## 2. NATIONAL CIRCUMSTANCES

According to the Turkey Statistical Institute's data, Turkey's population which was 56.47 million in 1990 reached 77.70 million as of 2014. The population is estimated to reach about 93.50 million in 2050. In Turkey, the population density for 2014 is 101 people/km<sup>2</sup>. In our country, the urban population increases in direct proportion to the total population and a decline is observed in the rural population. Since Turkey with a 8,592 km long coastal border is located within the middle zone, the country experiences four seasons distinctly within the year. Although Turkey which is located between mid-latitude climate zone and subtropical climate zone has many climate zones due to its different topographical characteristics, it is located within the Mediterranean macro-climatic zones in general.

The Gross Domestic Product (GDP) which showed a continuous increase between 2001 and 2008, showed a decrease in 2009 as a result of the economic crisis that affected our country in 2008 and which had a world-wide effect. With the measures taken, GDP again increased and showed a stable behavior between 2011 and 2014. The annual foreign trade volume that improved by showing a similar behavior with GDP was 403 billion US dollars in 2013.

In Turkey, oil took 28% (7% domestic production), natural gas took 31% (1.1% domestic production) and coal took 29% (44.5% domestic production) share in primary energy consumption which was 120.30 Mtoe in 2013. Indigenous lignite and hydro energy are other energy consumption resources with 11% and 4% shares respectively. The shares of wind, solar and geothermal energy in consumption are around 1% for each. On the other hand, in 2013, building sector (commercial and residential) took 35%, industry sector took 33%, transport sector took 26%, agriculture took 2% and non-energy took 4% share within the total energy consumption.

In 2013, Turkey's electricity consumption increased by 1.20% compared to the previous year and became 245.50 TWh, 4% of which (8,792 GWh) was generated from renewable sources mainly from wind and geothermal and 44%, 26% and 25% was met from natural gas, coal and hydro-electric respectively. A significant capacity on solar energy has just begun to form in 2014. Renewable energy consumption was 14,098 Ktoe with 15% increase. Thus, 12% of the total primary energy supply in 2013 in Turkey was met from renewable energy sources. As of the end of 2013, 32%, 37%, 19%, 5%

and 6% of the renewable energy supply were obtained from biomass sources, hydraulic resources, geothermal resources, wind and solar energy respectively.

During the period of 2000-2013, annual primary energy intensity index and final energy intensity index of Turkey decreased. When it is compared with 2000 figures, in 2013 primary energy intensity index improved by 18.20% and final energy intensity index improved by 18.80%.

The share of the Turkish industry sector in the GDP in 2013 was 15.30% with the current prices. When the product sales amounts are examined, according to the 2013 data, food industry and textile/apparel industry are at the forefront with 14.90% and 13.20% shares respectively. When shares of the sectors in the country's exports are reviewed, textiles/apparel/leather sector takes the first place with 18.10% and followed by the automotive industry with 12.60%. 99.80% of the total number of enterprises in the industry sector consists of Small and Medium Enterprises (SMEs). According to 2013 data; 75.80% of the total employment in the sector, 59.20% of the export and 39.90% of the import are carried out by the SMEs.

According to the data in 2013 Energy Balance tables, 25.47% of the primary energy consumption which is 89.42 Mtoe in total was from the transport sector with 22.77 Mtoe. 91% of primary energy consumption of this sector is road transportation, 5.50% is airway transportation, 1.6% is maritime transportation, 1.10% is pipelines and 0.70% is railway transportation.

Waste generation per capita in Turkey has been decreasing since 1998 as a result of the increase in the portion of the population living in cities, the campaigns to produce less waste and the use of packaging that create less waste in the industry. With the establishment of local waste associations that were introduced with the Waste Management Action Plan and the landfills that have begun to be operated by this means, as of 2008 a rapid increase has been observed in the waste services provided in Turkey. In particular, in accordance with the Wastewater Treatment Action Plan prepared within the same year, the actions in the treatment of domestic and municipal wastewater in metropolis have been accelerated and a progress has been shown in the wastewater treatment in conjunction with the basin management works.

Despite a decline over the years in the total agricultural lands in Turkey, the added value derived from the agricultural sector has been gradually increasing. According to statistics of year

2009, the total area of the agricultural lands in Turkey together with the perennial area is 24.30 million ha. In 2011, a decrease was seen in the total agricultural land; however, it is considered that there was no significant change in the last 3 years.

While there was a steady decrease seen in total number of large and small ruminants between the years 1990-2009 in Turkey, there was a steady increase between 2009 and 2013.

Turkey is quite rich in terms of biodiversity and about 2% of the species defined in the entire world show dispersion in Turkey. Eight thousand of the species defined in Turkey (4 thousand plant and 4 thousand animal species) are endemic. In addition, up to 50 animal and up to 1,284 plant species are endangered. 8 animal species and 11 plant species are estimated to be extinct in Turkey.

In Turkey, forests are managed according to the sustainable forest management principles and the country is one of the few countries in the world that have increased their forest areas. The forest area which was 20.20 million ha in 1973 when the first forest inventory was carried out increased to 21.90 million ha as of 2013. The annual net carbon accumulation which was 7.65 Mton (28.01 Mton CO<sub>2</sub>-eq) in the Turkey forests increased to 13.94 Mton (51.10 Mton CO<sub>2</sub>-eq) in 2013.

According to the World Tourism Organization data, Turkey has become one of the world's most important tourism centers by maintaining its 6th position in the rankings of countries that attract the tourists most in 2013. Tourism sector interacts with 54 different sectors with the purchase of a total of 26 billion US dollars for one year. Several studies are carried out in order to make tourism activities sustainable in Turkey. In order to show that tourism is sustainable, some eco-labels such as Blue Flag and Green Star are used.

Turkey's consumable surface and ground water potential is 112 billion m<sup>3</sup> per year. Utilization rate of the current 112 billion m<sup>3</sup> of available water resources is still around 36%. The amount of water available per capita per year in Turkey is about 1,519 m<sup>3</sup>. 32 billion m<sup>3</sup> of the available water is used for irrigation, 7 billion m<sup>3</sup> is used for drinking and 5 billion m<sup>3</sup> is used in the industry. In this case, about 74% of Turkey's water resources is used for irrigation, 11% is used for industry, 15% is used for urban consumption.

### 3. INVENTORY OF GREENHOUSE GAS EMISSIONS AND SINK

Turkey's total greenhouse gas emissions in 2013 were 459.10 Mton of carbon dioxide equivalent (excluding LULUCF). 67.8% of the total emission is caused by energy, 15.7% is caused by industrial processes and product use, 10.8% is caused by agriculture sector and 5.7% is caused by waste sector. The vast majority of the energy sector emissions is caused by fuel combustion activities and 24.8% of this is due to the combustion of fuels in the energy industry, 15% is due to the combustion of fuels in the transportation, 13.6% is due to the combustion of fuels in the industry sector and 12.8% is due to the combustion of fuels in other sectors (commercial/institutional, residential and agriculture/forestry/fishing sub-sectors).

While GDP in Turkey increased by 139% between 2000 and 2013, 47.7% increase in the total greenhouse gas emissions indicates a positive trend in terms of that the economic development is being based on activities that will create less greenhouse gas emissions. Emissions between the years 1990-2013 show a steady increase except the years 1994, 1999, 2001, 2008 and 2013 when a negative growth rate was observed. While the total greenhouse gas emissions per capita was 3.96 tons of CO<sub>2</sub>-eq in 1990, it increased to 6.04 tons of CO<sub>2</sub>-eq. in 2013. However, this value is below the OECD average which is 12.47 tons of CO<sub>2</sub>-eq. per capita and above the world average which is 4.88 tons of CO<sub>2</sub>-eq. per capita.

Breakdown of the 2013 greenhouse gas total emissions according to the type of gas is as follows: CO<sub>2</sub> emissions 363.40 Mton (79,15%), CH<sub>4</sub> emissions 65.81 Mton CO<sub>2</sub>-eq. (14.33%), N<sub>2</sub>O emissions 23.23 CO<sub>2</sub>-eq. (5.06%) and F-gas emissions 6.67 Mton CO<sub>2</sub>-eq. (1.45%) (excluding LULUCF).

#### Energy

The energy sector is the sector which is Turkey's main source of greenhouse gas emissions with the emissions caused by the combustion of fuels for the power and industrial production rising based on the country's economic growth and population growth trends. According to the 2013 data, total greenhouse gas emissions resulting from the energy sector constitute 67.8% of total emissions with 311.25 Mton CO<sub>2</sub>-eq. (excluding LULUCF).

Compared to the year 1990, in 2013, an increase of 136.6% is observed in greenhouse gas emissions from the energy sector. In the economic crisis periods observed in 2001, 2008 and 2009, respectively 7.75%, 3.99% and 4.64% reductions were observed in greenhouse gas emissions compared to the previous year.

## Industry Sector

Emissions caused by the use of fuel in the manufacturing industry and construction, have a 20.0% share in the energy sector's total emissions. Non-metallic minerals (cement) sub-sector within this sector constitutes 42.7% of the emissions of this sector, chemical production constitutes 7.1%, food processing, beverages and tobacco sector constitute 4.9% and non-ferrous metals, pulp, paper and print and other industries constitute the remaining.

The mean annual increase observed in the industrial sector greenhouse gas emissions was determined approximately as 1.70 Mton CO<sub>2</sub>-eq. between the years 1990-2013. This value corresponds to an increase of approximately 84% over the same period.

## Transportation

The amount of greenhouse gas emissions caused by the transportation sector is 69.0 Mton CO<sub>2</sub>-eq. and its share in the energy sector is 22.18% and its share in the total national emissions is around 15.04%. The sector is one of the main gas emission sources for the N<sub>2</sub>O, NO<sub>x</sub>, CO and NMVOC gases resulting from the energy sector.

Road transportation is at the status of highest source of greenhouse gas emissions within the Transportation Sector with a 91% share. Between the years 1990-2013, while the amount of CO<sub>2</sub>-eq. emissions originating from roads did not show any change, civil aviation increased from 3.4% to 5.4% and the share of railway decreases from 2.7% to 0.7%. The observed average annual growth trend in the transport sector was 1.40 Mton CO<sub>2</sub>-eq. and was lower than the energy and industry sectors (respectively 3.88 and 1.70 Mton CO<sub>2</sub>-eq.). The main reasons for this low-increase trend are the new car and engine technologies, the slight increase seen in the use of alternative fuels and carrying out incentive works for the removal of old motor road vehicles from the market.

## Industrial Processes and Product Use

For the year 2013, total greenhouse gas emissions resulting from the Industrial processes sector constitute 15.7% of total emissions with 72.03 Mton CO<sub>2</sub>-eq. Compared to 1990, an increase of 131.8% was observed in greenhouse gas emissions from the industrial processes and product use. In 2013, 57% of greenhouse gases from industrial processes originated from the mineral products sector that involves cement and lime production processes.

## Agriculture

According to country's greenhouse gas emissions inventory data for year 2013, agricultural activities constitute approximately 10.8% of the total anthropogenic greenhouse gas emissions. During 1990-2013, while substantial increases were noted in the greenhouse gas emissions caused by all other sectors, a more stable trend was observed in greenhouse gas emissions from agricultural activities. The downward trend observed during the period 1990-2008 reversed after 2008 and switched to an upward trend as a result of livestock development efforts carried out by the Ministry of Food, Agriculture and Livestock. While emissions from agricultural activities were 41.60 Mton CO<sub>2</sub>-eq. in 1990, in 2013, emissions increased approximately by 19.7% and increased to the 49.80 Mton CO<sub>2</sub>-eq. level.

## Land Use, Land Use Change and Forestry

Land Use, Land Use Change and Forestry (LULUCF) sector constitutes a sink that is equivalent to approximately 12.8% of the total anthropogenic greenhouse gas emissions. The net amount of carbon accumulated in the forests annually corresponds to 11.10% of all greenhouse gas emissions. The amount of greenhouse gas held in the harvested wood products corresponds to 1.6% of all emissions. The contribution to the total greenhouse gas emissions due to the conversion of the cultivated areas to the residential areas is 0.12%.

In Turkey, as a result of land use and changes between 1990 and 2013, an increase in carbon retention was observed which was equivalent to approximately 1.13 Mton CO<sub>2</sub>-eq. emission per year. Sink increase is caused by the substantially ascending presence of forests.

## Waste

Waste sector greenhouse gas emissions include emissions originating due to the management and disposal of urban solid waste, hazardous waste and medical waste as well as the emissions originating from formation and disposal of treatment sludge resulting from the wastewater treatment plants.

The share of waste sector in total greenhouse gas emissions in Turkey is 26.02 Mton CO<sub>2</sub>-eq. (5.66%) and it comes after the energy, industrial processes and agriculture sectors (excluding LULUCF). 82.7% of the waste sector greenhouse gas emissions in Turkey originates from regular and irregular (uncontrolled) landfills, while the remaining originates from domestic and industrial wastewater treatment.

## 4. POLICIES AND MEASURES

Since climate change is a multi-disciplinary subject, climate change studies have been studied by various institutions and organizations. Therefore, the "Coordination Board on Climate Change and Air Management" was established where private sector's and civil society organizations' representatives take part and that is coordinated by the Ministry of Environment and Urbanization. Within the framework of the responsibilities arising from the United Nations Framework Convention on Climate Change (UNFCCC), European Economic Commission Convention on Long-Range Transboundary Air Pollution and the protocols and domestic legislations attached to these conventions, this board ensures taking necessary measures for fight against climate change and prevention of air pollution and coordinating studies for determination of appropriate internal and foreign policies by also considering the circumstances of our country on this regard.

National Climate Change Strategy Document was formed to guide the studies to be done on climate change between the years 2010-2020 and to determine the basic policies on this issue. In line with the objectives on this document, by offering actions for the control and adaptation works of the greenhouse gas emissions, "National Action Plan on Climate

Change" defining the responsible parties and timing for the implementation of this action was prepared. Besides; despite not benefit from the flexibility mechanisms which are subject to Kyoto Protocol's emissions trading, projects for Voluntary Carbon Market founded in Turkey around environmental and social responsibility principles and operates independent from these mechanisms have been developed and implemented for a long time.

## Energy

In Turkey, in recent years, various policy documents such as strategic plan, action plans, roadmaps strategy papers mainly about energy policy and which will affect especially the climate change were published.

The main objective of Turkey's general energy policy is to provide the energy required to support economic growth and social development on a timely, reliable and cost-effective manner, at reasonable prices and in an environmentally-conscious manner. In this context, the key strategies and policies based on Turkey's energy supply security are to ensure the diversity of resources by giving priority to local resources, to increase the share of renewable energy sources within the energy supply, to improve energy efficiency, to give full effect to free market conditions and to ensure the improvement of the investment climate, to ensure diversity in sources of oil and natural gas fields and to take measures to reduce the risks resulting from imports, to use the geostrategic position effectively and become an energy corridor and terminal in the framework of regional cooperation processes in the energy field, to ensure that activities in the energy and natural resources areas are carried out in an environmentally friendly manner, to increase the contribution of the natural resources to the country's economy, to increase the production of industrial minerals, metal and non-metal mines and to ensure their utilization within the country, to make the energy accessible to consumers in terms of cost, time and amount.

For the purpose of fulfilling the goals on the policy documents stated above in order to use the renewable energy which will affect the greenhouse gas reduction more positively and to increase the energy efficiency, incentives for generating electricity from renewable energy sources were developed with the "Law on the Use of Renewable Energy Sources for the Purpose of Generating Electrical Energy" which came into force in 2005. Then, with the "Law on Energy Efficiency" which came into force in 2007, a legal platform that covers all final sectors

for energy efficiency was created. The functionality of these laws are enhanced and continuing to be enhanced by publishing many notices and regulations related to these laws and other laws supporting this law in the Energy Market. As a result of this, there have been significant increases in installed capacity of renewable energy and the energy efficiency practices have become widespread throughout the country.

## Industry

The policies and measures for energy consumption in the manufacturing industry which contributes 16% to the GDP are generally towards increasing energy efficiency and share of renewable resources in industry.

With the policies enacted recently, it is foreseen to provide gains in aspect of low carbon economy by focusing on innovation and advanced technology products and sectors in plan period process, to maximize efficiencies in existing sectors and to provide gains especially in renewable technology field through green technologies.

Firstly, it is principal to support fast-growing enterprises or enterprises with growth potential and SMEs that are innovative in aspects of product, service and business model. In this context, policies on matters of improving the R&D, innovation and export capacities of SMEs and supporting SMEs in operating and clustering in a more organized manner in collaboration both among themselves as well as with large enterprises, universities and research centers have been issued; with the primary transformation programs, increasing the efficiency in production and energy is planned.

## Transportation

In Turkey, there has been needs of the switching to corridor approach, supply of integration between transportation modes, and further improvement of transportation connections of less developed regions and the regions should obtain a more efficient, fast and safe transportation and logistics infrastructure particularly for freight transportation and the north-south connections should be strengthened so as to increase the interaction between major regional centers of the country. It is aimed to increase the shares of rail freight and passenger transport by giving emphasis on these transportation areas. In this context, investments towards the improvement, regeneration and development of the rail

infrastructure by constructing new lines were carried out. It is aimed to reduce the share of road transport by supporting the rail, maritime and air transport. Within the 2011-2023 period, especially the infrastructure projects that will be carried out in the road, rail, marine, aviation, logistics and combined transport, urban transportation, pipelines sector and also places, costs and other technical details of the project will be determined by the Transportation Master Plan to be prepared with the active participation of all relevant institutions and organizations in the sector.

## Agriculture

In Turkey, a number of works are carried out in issues of providing coordination between the public institutions involved in irrigation, transportation and land consolidation activities, increasing the irrigation ratio by activating the in-farm development services, accelerating the transition to a closed irrigation systems by renewing the water transmission and distribution facilities and extending the modern methods of irrigation in in-farm irrigation. Issues such as the development of and supporting the agricultural sector and rural areas; protection of and enhancing the soil by preventing its loss and loss of its characteristics; the regulations to be made to determine the research, planning, reclamation projects, grazing time, utilization system, conservation and control measures to ensure maintenance, improvement, protection, control and proper use of the meadows, grasslands and pastures; breeding activities, preservation of genetic resources, economic livestock production, increasing the competitiveness power for increasing all kinds of animal production and activities, productivity of animals; food and feed safety; operation of the irrigation areas and areas with high agricultural potential and use of fertilizers are defined and secured by various laws and regulations.

## Forestry

In Turkey, since the 1960s, protection of the forests and providing their sustainability, improvement of degraded forests, increasing their productivity and afforestation are aimed. In the coming period, improving the fight against forest fires as well as against pests and diseases, accelerating the afforestation and rehabilitation of the degraded forest areas, identification, conservation, sustainable use, development of and monitoring the biodiversity are among the main targets regarding to forests. Among these, protection of forests, development of forests and utilization of forest resources which are indirectly related to climate change are the main targets. In addition,

carbon sequestration in forests is considered as an ecosystem service and under the heading of strategy of utilization of the protecting and environmental functions of forests together with this issue, the works of achieving the targets of improving the forest areas to be allocated to forest functions and the works towards awareness in the community about the importance of forest functions are contained. For the realization of the set targets in Turkey, since the 2000s, action plans have been prepared and implemented.

## Waste

The most common disposal method for the disposal of municipal waste in Turkey is still landfilling, composting and/or other recovery applications are not yet at the desired level. In recent years there has been a reduction in waste generation. Thanks to the control work of biodegradable waste and the waste recycling campaigns launched especially in metropolitan municipalities, more progress is expected in these issues in the coming years. Although burning of waste is supported as a policy in Turkey, any significant increase has been achieved in this regard. For the reduction of greenhouse gas emissions resulting from the waste sector in Turkey, especially during the process of the Environment Stage EU Negotiations opened in 2009, there are many important regulations enacted within the scope of waste sector legislative adaptation.

In Turkey, in the coming period, reduction of waste by enabling the management of solid waste, decomposition in the source, collection, transportation, recycling and disposal stages as a whole with the technical and financial aspects; giving priority to the development of awareness and institutional capacity are planned. Encouraging the use of recycled materials in production is aimed. In accordance with the Sustainable Cities approach, with applications such as waste and emission reduction, energy, water and resource efficiency, recycling, prevention of noise and visual pollution, use of eco-friendly materials in cities, the environmental awareness and the quality of life will be increased. The targets which were set for the reduction of greenhouse gas emissions are the establishment of a regional and national waste plan and ensuring its continuity, encouraging the use of technologies that minimize the generation of waste during production and harmonization of the international trade of the waste with the EU criteria and ensuring the implementation of this.

## 5. PROJECTIONS OF GREENHOUSE GAS EMISSIONS

On September 30th 2015, the Republic of Turkey submitted its Intended Nationally Determined Contribution (INDC) to UNFCCC towards achieving the ultimate objective of the Convention, which is set out in its Article 2 and clarifying information, in accordance with decisions 1/CP.19 and 1/CP.20. Accordingly, the projections of greenhouse gas emissions by 2030 are based on two scenarios: Business-As-Usual Scenario and Mitigation Scenario. In Business-As-Usual Scenario; total emissions are projected to be 672,9 Mton CO<sub>2</sub>-eq. and 1.174,8 Mton CO<sub>2</sub>-eq. in 2020 and 2030 respectively (including LULUCF). In Mitigation Scenario; total emissions are projected to be 599,2 Mton CO<sub>2</sub>-eq. and 929,0 Mton CO<sub>2</sub>-eq. in 2020 and 2030 respectively (including LULUCF). Up to 21% reduction in GHG emissions is anticipated by following the policies and plans which identified under mitigation scenario, from the business as usual level by 2030.

## 6. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION

### Changes in Turkey's Climate

In the analysis using the data for years 1960-2010 across the Turkey, it was observed that the number of summer days, number of hot days and the nights increased and the number of cool days and nights decreased. While an upward trend in the maximum and minimum temperatures was observed, a downward trend in daily maximum and minimum temperature differences was observed. The total annual precipitation trends tend to increase in the north of the country and tend to decrease in Southeast Anatolia, Mediterranean and Aegean Regions. While a strong upward trend was observed in number of days with heavy precipitation in the Eastern Black Sea region, a strong downward trend was observed in the Southeastern Anatolia Region. It is observed that all the stations across

Turkey within the 1950-2013 period have a downward trend in contrast to the upward trend in the temperatures of the time series of annual total precipitation. But the downward trend in total precipitation is not as apparent as the upward trend in temperature.

The average temperature across Turkey between the years 1971-2000 was 13.20°C. Temperature showed increase more particularly since the 1990s. In this period, there was no significant increase or decrease in precipitation in general averages of Turkey.

## Turkey Climate Projections

Of the global models used under the CMIP5 project, regional climate projections were created with the scale minimization method in the RegCM4 model of the HadGEM outputs. 1971-2000 period was taken as reference and a projection for years 2013-2099 was made. To produce high-resolution climate projections which will be used in regional climate change adaptation and impact assessment studies, products of coordinated regional climate model studies (Coordinated Regional Climate Downscaling Experiment, CORDEX) supported by the World Climate Research Programme were used. When it is evaluated together with the results of the outputs for all of the scenarios, while some differences can be seen depending on the scenario, it is generally seen that the temperatures will rise by 2-3°C in average and the precipitation will significantly reduce. It is estimated that across Turkey, there will be a significant increase in the number of consecutive dry days, the number of days with frost will decrease and the average temperature in the basins will show an upward trend until 2099.

## Expected Impacts, Vulnerability and Adaptation Measures

### Water resources

The present sustainable and usable water potential of Turkey is 112 billion m<sup>3</sup> and 98 billion m<sup>3</sup> of this is surface water and 14 billion m<sup>3</sup> of this is underground water. It is expected that the total water consumption will increase three times from 2004 until 2030. The total amount of water to be used in 2023 is close to the amount of the existing water resources that can be used as sustainable (annually) and when negative effects such as climate change, decrease of raining,

increase in the watered fields, the filling of the bottoms of the present storage areas with sediment, and the non-homogeneous distribution of water resources are taken into account, it is likely to experience significant water stress. The water stress levels in Turkey and in EU countries in 2000 and 2030 have been estimated by the European Environment Agency. Accordingly, as of 2030, it is expected to experience water stress at a rate exceeding 40% in Turkey's middle and western region. In southeast and eastern regions this ratio will be between 20-40%.

For the reduction of water stress, within the framework of sustainable development principle in the industrial investments, works towards saving water and reusing wastewater (clean production applications in the industry), applications made on the city supplies for losses or leaks (measures to reduce the water leakage in the supply, works on irrigation water saving) are carried out. To ensure efficiency in water management, basin-based approaches are developed, basin protection action plans are prepared where integrated protection and controlled used principles are determined and the follow-up of the implementation is provided.

## Agriculture and Food Security

The importance of the agricultural sector is revealed when the predictions such as the added value derived from the agricultural sector to increase gradually, about a quarter of the employment to be in this sector, the sector to be one of those which will be affected by climate change are analyzed together. As well as the food supply, the sector provides raw material to the agro-industry and agricultural sectors are affected by the economic crisis less than other sectors.

Several concrete steps were taken regarding the impact of climate change on agriculture, projects were developed, training programs were made and a number of support programs were carried out and continue to be carried out for farmers. However, studies based on the in-situ measurements for the establishment of national factors are insufficient.

In a study on the economic impact assessment of the climate change on agriculture in Turkey, it is estimated that there will be a decline in the yield of products in seven geographical regions in Turkey and across the country, the amount of production will reduce due to a decrease in yield, there will be changes in the production patterns in regional terms, the exports of wheat and sunflower will decrease and imports of corn and

cotton will increase, the product prices will increase and while the prosperity of the producers will increase against the increase in the product prices, the consumer's and total welfare will decrease.

The studies towards the evaluation of satellite images and data from terrestrial measurement networks and converting these data into current agricultural information in terms of product and location and to transmit these information to the stakeholders instantaneously continue. Strategies in terms of fight against agricultural drought were determined and an action plan was published. An action plan for the activation of use of water in agriculture was prepared and taking measures such as the reduction of groundwater utilization, extending the modern irrigation systems were planned.

## Extreme Weather Events and Disasters

According to climate change scenarios 1-2°C increase which could be seen in the mean air temperature means extreme temperatures and a few times increase in heavy precipitation. Thus, many regions of the world witness a large number of hydro-meteorological disasters which are unique in terms of severity, impact, duration and the place of occurrence. Indeed, a significant increase in the number of natural disasters such as tornado, flood, lightning, extreme temperatures and hail has been observed in our country. In Turkey, flood management plans are being prepared and observation and early warning systems are being developed. Reforestation and erosion control studies are continued and sectorial compliance planning in basins is conducted.

## Ecosystem Services

The expected effects of climate change on inland water ecosystems are the impacts such as area and volume losses of the inland water masses, reduction in fresh water supply, decreases in flow and flow rate and it is an expected probability that these impacts will cause problems such as desertification, shortages and lack of water, decline in agricultural yield and food shortages.

When the studies where the relationships between climate change and level changes in the lakes and changes in water resources were examined are evaluated, it has been stated that there is increase in the level of the lakes located in the northern half of our country, decrease in the lakes in the

Central Anatolia and the Mediterranean Region and that there is no trend in the lakes in the Marmara Region.

## Coastal Areas

There are 28 coastal cities in Turkey. According to 2014 census data, 54.70% of Turkey's population live in these cities. Land use changes, coastal erosion and flooding, saltwater intrusion, rise in the sea level, agriculture, tourism and ecosystem interactions, sensitive areas and hot spots are among the most significant impacts of the climate change on the coastal areas, water potential and water temperatures in coastal areas in Turkey. The overall risk situation of coastal regions against a rise in the sea level and disasters are identified and it was seen that the places to be most affected by climate change in Turkey coasts are coastal deltas with high agricultural production, wetlands and low-altitude tourism regions.

In Turkey, integrated coastal zone plans are prepared that include guiding strategy and objectives for the provision of integrated policy and decision-making processes by taking into account all sectors and for the applications regarding the coastal constructions to be made in the coastal areas. However, projects outputs such as the determination of water quality, impacts on the ecosystem and measures to be taken on a sectoral basis are carried out.

## Health

Among the effects of climate change which are estimated to cause problems by affecting the human health directly or indirectly are death and injury due to extreme climate events, an increase in diseases transmitted by water and food, an increase in the respiratory diseases due to air quality degradation, increase in allergic diseases related to the shift in seasons and the disruption of the air quality, increase in diseases transmitted by vectors and rodents, increase in the skin cancer depending on the thinning of the ozone layer.

## Settlement Areas and Tourism

Uneven distribution of the population between cities in relation to the rapid growth of urban centers is one of the primary problems of urbanization related to climate change. Existing spatial expansion ways and consuming habits in Turkey continue to be growing urban population greenhouse gas emission sources. The main topics discussed in the context of climate change in urban planning are transportation, residential, green spaces,

energy, and waste management. Especially the metropolitan municipalities have determined strategic development objectives and have prepared projects for increasing the efficiency in urban water and energy use, increasing the green cover and open, permeable areas with afforestation in urban areas and for the degradation in air quality and decreasing amount of the greenhouse gas emissions.

The tourism sector, unlike many other sectors, is a sector both affecting the natural environment and being affected by the environment that it uses as the source. The temperature rise, rise in the sea level and extreme weather events will directly affect the mass tourism. Effect on the tourism activities by drought and desertification, forest fires, water scarcity, biodiversity loss, coastal erosion, diseases observed due to extreme weather events and observing the vectors-borne infectious diseases are the indirect effects of climate change on tourism. The tourism activities in Turkey with more sea-sand-sun axis are concentrated in the Mediterranean and the Aegean Sea coasts. In all the studies in the literature, it is stated that the Mediterranean basin will be adversely affected by the climate change. Apart from sea-sand-sun-axis mass tourism, winter tourism depending on snowfall also suffers from the adverse effects of the climate change. Within the context of sustainable tourism in Turkey, Environmentally Responsible Accommodation Certificate and Green Star certificate applications have been implemented in order to protect the environment, develop the environmental awareness, encourage and incentivize a positive contribution to the environment by the tourist facilities.

## 7. FINANCIAL RESOURCES AND TECHNOLOGY TRANSFER

As referred in its 1th and 5th National Communication, Turkey, as a non-Annex II country, is not responsible for providing support to developing countries according to Articles 4.3, 4.4, 4.5 of the UNFCCC, and Article 11 of the Kyoto Protocol. Turkey, although listed in Annex I to the UNFCCC, it was accepted as a developing country according to both the World Bank and International Monetary Foundation classifications. As a developing country Turkey could have accessed

resources from bilateral and multilateral development banks and international funds to combat climate change. For Turkey as an Annex I Party with special circumstances, the need of accessing financial resources to combat climate change is recognized by the COP. In order to implement its nationally determined contribution and to achieve ambitious national targets such as increasing share of renewable energy in national mix and mobilize its huge mitigation potential, it is important that Turkey could have accessed financial resources in addition to existing funds that Turkey can access.

## 8. RESEARCH AND SYSTEMATIC OBSERVATION

Across Turkey, many studies on climate processes and climate system including paleoclimate studies, modeling and prediction including general circulation models, research on the effects of climate change, socio-economic analysis including climate change impacts and response options, research and development on mitigation and adaptation technologies are conducted at research institutions and universities. Under Europe 7th Framework Programme, five projects are available involving the organizations and institutions in Turkey with regard to climate change. In the aforementioned issues, Turkey has implemented over 60 projects and nearly 170 thesis so far. Apart from these, various studies on climate change are also conducted in public institutions. Within the scope of R&D activities, while Turkey's R&D expenditures in GDP ratio in 2003 were 0.48%, this ratio has increased to 0.95% in 2013. This shows that the funding allocated for R&D has increased. While R&D expenditures in 2003 were 4.01 billion TL, this amount reached 15.70 billion in 2013.

Turkey is actively involved in all programs of the World Meteorological Organization. Some of these programs can be sorted as the Global Observation System-GOS, the Global Climate Observation System-GCOS, the Surface Radiation Network-SRN and the Global Atmospheric Watch-GAW. Under the Global Observation System, surface observations, marine observations, high level observations and the observations made with aircrafts as well as satellite and radar are performed. In Turkey, measurement under surface observations is made at

1,280 points in total. 69 maritime automatic meteorological observation systems were put into operation for sea surveillance purposes. One mobile high-level measurement station, 11 weather radars are available. Apart from these, the installation of seven more radars still continues. In addition, in some municipalities and within the scope of their projects, ozone measurements for special researches are made at many points. Besides, air quality data is provided to the European Monitoring and Evaluation Programme-EMEP which is the scientific part of the long-range transboundary air pollution agreement with the United Nations.

In Turkey, within the Turkish National Sea Level Monitoring System (TUDES), 20 automatic tide gauge stations are available. Besides the measurement of sea level at tide gauge stations, meteorological parameters such as temperature, humidity, pressure, wind speed and direction are measured and the data is collected and stored in a data processing center in Ankara. Within the scope of terrestrial climate observations and within the framework of the Forest Ecosystem Monitoring Program, Turkey is conducting monitoring studies at 602x Level 1 observation areas since 2012. In the hydro-meteorological observation network, 3,713 flow monitoring stations (FMS) are available. In the measurement of Air Quality, across Turkey, there are 198 air quality measurement stations running as integrated to the National Air Quality monitoring network.

## 9. EDUCATION, TRAINING AND PUBLIC AWARENESS

In Turkey, starting from pre-primary education, at primary, secondary and higher education, lessons on climate change are contained in the education syllabus. The number of educational and awareness activities carried out for different audiences such as students, farmers, parents, teachers, employees of organizations on issues concerning climate change has been increasing in the recent years. Various publications and public spots are prepared with the aim of raising awareness on climate change issues and numerous educational films are broadcasted with television applications. In addition, via various websites, awareness-raising activities are carried on up to date information and news. Under the

Coordination Board on Climate Change and Air Management restructured in 2013, an Education, Raising Awareness, and Capacity Building Working Group has been established.

Participation of local governments, private sector and especially non-governmental organizations (NGOs) to the activities carried out on the climate change issues have been gradually increasing. Many NGOs operating in the current situation are conducting awareness-raising activities on energy and water saving, energy efficiency, recycling and renewable energy sources.

International cooperations on adaptation to climate change and reducing the impact of climate change on a global scale also gain importance. In this context, various international educational programs and projects are carried out. In addition, education and awareness-raising activities for climate change, its impact and reducing the impact of climate change are specified by the strategy documents and action plans.



# 1. INTRODUCTION



## 1. INTRODUCTION

Intensive use of fossil fuels that has started with the industrial revolution and begun to be used rapidly, led to the accumulation of greenhouse gases in the atmosphere with increasing density. Intense accumulation of greenhouse gases has brought the most severe, complex and largest-scale threat that the mankind has faced throughout the history, in other words the global climate change. Turkey believes that the problems on the global scale can be solved with the participation on global dimension. In this context, in the 7th Conference of the Parties to the United Nations Framework Convention on Climate Change that held in 2001, Turkey has become a party to the convention upon the recognition of its special status and being removed from the Appendix II list. It has become a party to the Kyoto Protocol in 2009.

Turkey has no emission reduction commitments under the Kyoto Protocol. However, Turkey carries out intensive works on subjects such as incentives to increase the use of new and renewable energy, accelerating the investments in public transport that cause less carbon emissions and increasing the energy efficiency to contribute to the works to fight against climate change and to reduce the greenhouse gas emissions. On the other hand, the country makes efforts for the development of the voluntary carbon market and its integration to the compulsory markets.





## 2. NATIONAL CIRCUMSTANCES

## 2. NATIONAL CIRCUMSTANCES

### 2.1. State Structure

The State of Turkey is a Republic that legislative power belongs to The Grand National Assembly of Turkey on behalf of Turkish nation. The Grand National Assembly of Turkey consists of 550 deputies elected by universal suffrage. The Grand National Assembly of Turkey elections are held every four years. Turkey is divided into provinces in terms of central administrative structure, according to geographical conditions, economic conditions and requirements of the public services and the provinces are divided into further sections gradually. There are 81 provinces in Turkey. Representatives of the central government in the provinces are the Governorates which are attached to the Ministry of Interior. Governors who are in charge of the provincial government are appointed by the central government.

The political decisions that directly affect climate change such as the climate change strategy and the decisions on indirect issues such as policies on energy, transportation and waste are taken by the central government and applied by making the relevant legislative regulations.

Local governments are public entities that of the principles of foundation is specified by law and that of the decision-making bodies are again indicated in the law, to meet the local collective needs of provincial, municipal or village communities,

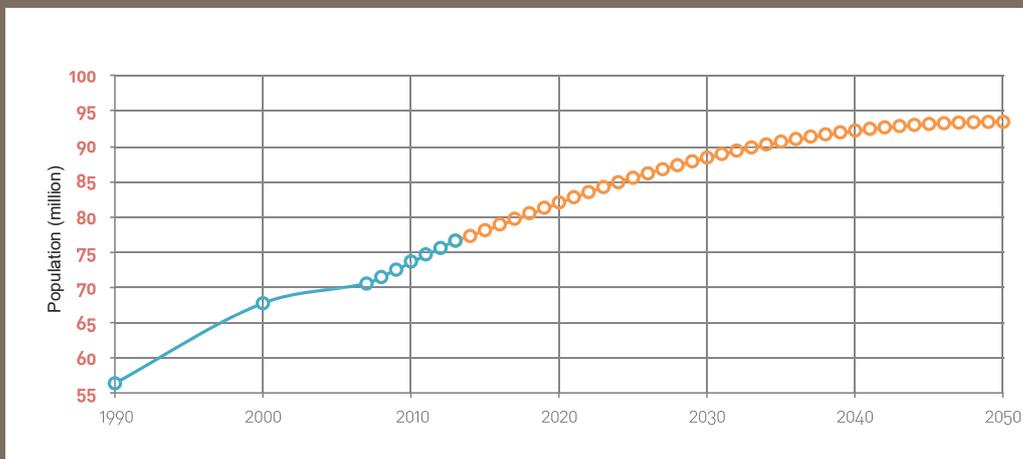
and that is formed by being elected by the voters. In the provinces, representatives of the local administration is determined by election. Elections for local administrations are held every five years.

There are 30 Metropolitan Municipalities in Turkey. Municipalities are responsible for services such as transportation, infrastructure services such as drinking water and sewerage as well as the energy efficiency, waste disposal and environmental planning. In this regard, municipalities play an active role in the development and implementation of local climate change policies. In Turkey, Ministry of Environment and Urbanization which is also the focal point of United Nations Framework Convention on Climate Change (UNFCCC) is responsible for the establishment and implementation of the environmental policies. In this context, policies related to climate change are determined by the participation of relevant ministries and organizations under the coordination of Ministry of Environment and Urbanization. Practices relating to national climate change in Turkey are carried out by the Coordination Board on Climate Change and Air Management (CBCCAM) that is under the administrative and legal umbrella of the Ministry of Environment and Urbanization and established with the participation of senior representatives of relevant institutions and organizations. CBCCAM is also responsible for the fulfillment of obligations such as the preparation of national communication reports and relevant studies of the Republic of Turkey to UNFCCC.



## 2.2. Population

Turkey's population which was 56.47 million in 1990 reached 77.7 million as of 2014. It is estimated that the population will show a decreasing rapid growth trend and reach about 93.50 million in 2050. Population profile for the years 1990-2050 is seen in Figure 2.1. In 2014, the proportion of the male population is 50.18% and the proportion of the female population is 49.82%. In 2012, while the proportion of people residing in provincial and district centers are 77.30%, in 2014 this proportion was 91.75%. The establishment of metropolitan municipalities in 14 provinces and participation of the towns and villages as a quarter to the district municipalities in a total of 30 provinces with metropolitan status influenced the increase of this ratio significantly (TurkStat\_a, 2014).



Source: TurkStat\_a, 2014

Figure 2.1 Turkey population profile in years 1990-2050

While the annual population growth rate was 1.20% in 2012; it was 1.37% in 2013 and 1.33% in 2014. In Turkey, the population density for 2014 is 101 people/km<sup>2</sup>. Istanbul is the province with the highest population density with 2,725 people per kilometer square. Changing population growth rate and population density by years are provided in Table 2.1 (TurkStat\_a, 2014).

Year	1990	2000	2007	2008	2009	2010	2011	2012	2013	2014
Annual population growth rate (%)	2.17	1.83	-	1.31	1.45	1.59	1.14	1.20	1.37	1.33
Population density (people/km <sup>2</sup> )	73	88	92	93	94	96	97	98	100	101

Source: TurkStat\_a, 2014

Table 2.1 Turkey population growth rates and population densities

## 2.3. Geography

### Geographical Position and Boundaries

Turkey is located between 36°-42° north latitude and 26°-45° east longitude in the Northern Hemisphere. Accordingly, there is a 76-minute local time difference between the west and east. Due to being located in the mid zone, four seasons are experienced distinctively during the year. Bulgaria and Greece in the west, Georgia, Armenia, Azerbaijan/Nakhichevan and Iran in the east and Iraq and Syria in the south constitute the neighbors of Turkey the lands of which are located between Europe and Asia. Turkey's land borders are 2,949 km long in total (SHW, 2014). The coastal border of the peninsula which is surrounded by three sides with the Black Sea in the north, the Aegean Sea in the west and Mediterranean in the south is 8,592 km in total except the islands.

### Surface area

Turkey's total surface area is 785,347 km<sup>2</sup> and when natural lakes and reservoirs are removed the remaining area is 769,604 km<sup>2</sup> (TurkStat\_a, 2013). When the distribution of land-use classes to the surface area for year 2012 in Turkey is examined, agricultural lands come in the first place with 31.10%. While 27.60% of the country's land is forest areas, 18.60% is grasslands, 1.40% is water areas and 21.30% is used for other purposes (GDF\_a, 2012). Turkey is composed of seven geographic regions. These regions from small to the large based on their surface area are the Eastern Anatolia Region, Central Anatolia, Black Sea region, Mediterranean Region, Aegean Region, Marmara Region and South-eastern Anatolia Region.

## 2.4. Climate

Although Turkey which is located between mid-latitude climate zone and subtropical climate zone has many climate

zones due to the different topographical characteristics, it is within the Mediterranean macro-climatic zones in general (Iyigun et al., 2013). The climate zones observed in Turkey are the Mediterranean Climate where summers are hot and dry and the winters are mild and rainy; the Black Sea Climate where summers are cool and winters are warm in the coastal area and snowy and cold at the higher parts; the Terrestrial Climate where temperature differences between summer and winter and day and night is very big and the Marmara Climate showing the characteristics of a climate transition between the Terrestrial, Black Sea and Mediterranean climates.

Turkey's climate is under the influence of Azores High Pressure Center (HPC) usually from the southwest and causing an increase in temperature in the summer and the Basra Low Pressure Center (LPC) from the southeast and with a hot and without precipitation season in summer. In the winter, while a rainy climate is observed with the effect of Iceland LPC and Mediterranean LPC systems, a cold and dry season is experienced when under the effect of Siberia HPC.

When the temperature change between the years of 1970-2014 in Turkey was examined, it was seen the average temperature which was 12.70°C between 1970 to 1978 increased to 13.80°C between 2006-2012. The average temperature distribution covering the period of years 1970-2014 is provided in Figure 2.2. When the temperature distribution is analyzed, the highest average temperature is observed in the Eastern Mediterranean and the lowest average temperature is observed in the Northeast (SMS\_a, 2014).

The total annual average precipitation was 635.50 mm between 2006 and 2014 in Turkey. The average precipitation distribution covering the period of years 1970-2014 is provided in Figure 2.3. According to the precipitation distribution, while the northeast of the Black Sea is the region with the most precipitation with 2100-2200 mm, the Central Anatolia Region as well as Igdir and Sanliurfa are the regions with the least precipitation with 260-480 mm. (SMS\_a, 2014)



Source: SMS\_a, 2014

Figure 2.2 The average temperature distributions of Turkey (1970-2014)



Source: SMS\_a, 2014

Figure 2.3 The average precipitation distributions of Turkey (1970-2014)

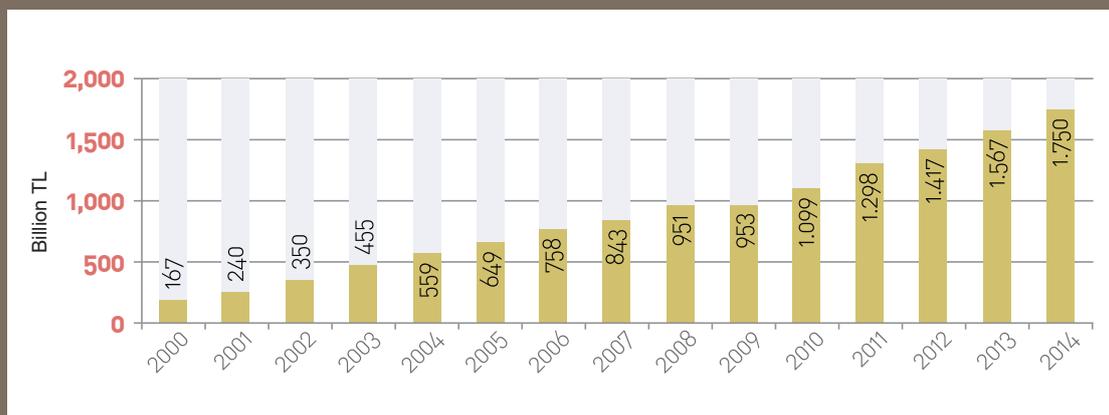
## 2.5. Economy

### Gross Domestic Product (GDP)

According to annual gross domestic product (GDP) per capita for years 2000-2014, the GDP per capita which was 4,129 US dollars in 2000, reached 3,019 US dollars with a 26.88% decline in 2001 due to the economic crisis experienced by Turkey in 2001. Owing to the economic policies implemented since 2002, GDP per capita had continuous growth until the economic crisis in 2008. The GDP per capita which reached 10,444 US dollars in 2008 declined to 8,561 US dollars as a result of our country being affected by the world economic

crisis in 2009. But, the crisis was overcome in a short time with the measures taken and the GDP per capita had a growth again and reached 10,822 US dollars at the end of 2013. The GDP per capita for 2014 was announced to be 10,404 US dollars (TurkStat, 2015).

The annual GDP for the years 2000-2014, which are estimated by Turkish Statistical Institute (TurkStat) with the method of production and with current prices are provided in Figure 2.4. It can be seen in this table that annual GDP was in continuous growth by 2014 and the lowest increase was between the years 2008-2009 due to the economic crisis that took place in 2008. The percentage distribution of the annual GDP for 2014 is composed of agriculture with 9.54%, industry with 27.51% and services with 62.95% (TurkStat, 2015).



Source: TurkStat, 2015

Figure 2.4 Annual GDP for the years 2000-2014

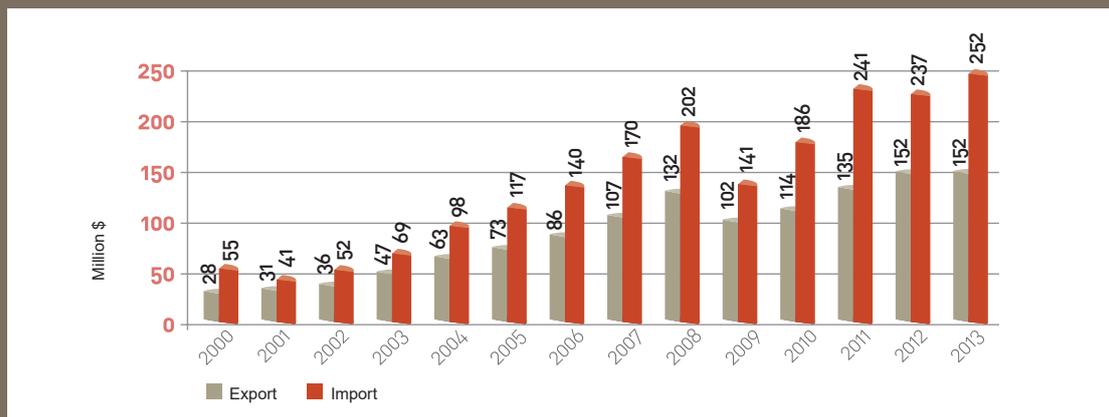
## Import - Export

Information on foreign trade of our country involving import and export data between 2011 and 2013 is provided in Table 2.2. Accordingly, in 2013 annual foreign trade volume was about 403 billion US dollars. Between 2011 and 2012 export showed an increase of 13% and experienced a decrease of 0.40% in 2013. In addition to Table 2.2, Turkey's export-import situation in the years 2000-2013 is shown in Figure 2.5. Negative impact of the economic crisis in 2008 on the import-export can be seen in Figure 2.5 (TurkStat\_b, 2014).

Year	Export Value (Thousand US Dollars)	Change (%)	Import Value (Thousand US Dollars)	Change (%)	Balance of foreign trade (Thousand US Dollars)	Volume of foreign trade (Thousand US Dollars)	Proportion of imports covered by exports (Export/Import)
2011	134,906,869	18.50	240,841,676	29.80	-105,934,807	375,748,545	56.00
2012	152,461,737	13.00	236,545,141	-1.80	-84,083,404	389,006,877	64.50
2013	151,802,637	-0.40	251,661,250	6.40	-99,858,613	403,463,887	60.30

Source: TurkStat\_b, 2014

**Table 2.2** Foreign trade data for years 2011-2013



Source: TurkStat\_b, 2014

**Figure 2.5** Import and export status for years 2000-2013

## 2.6. Energy

### Primary Energy

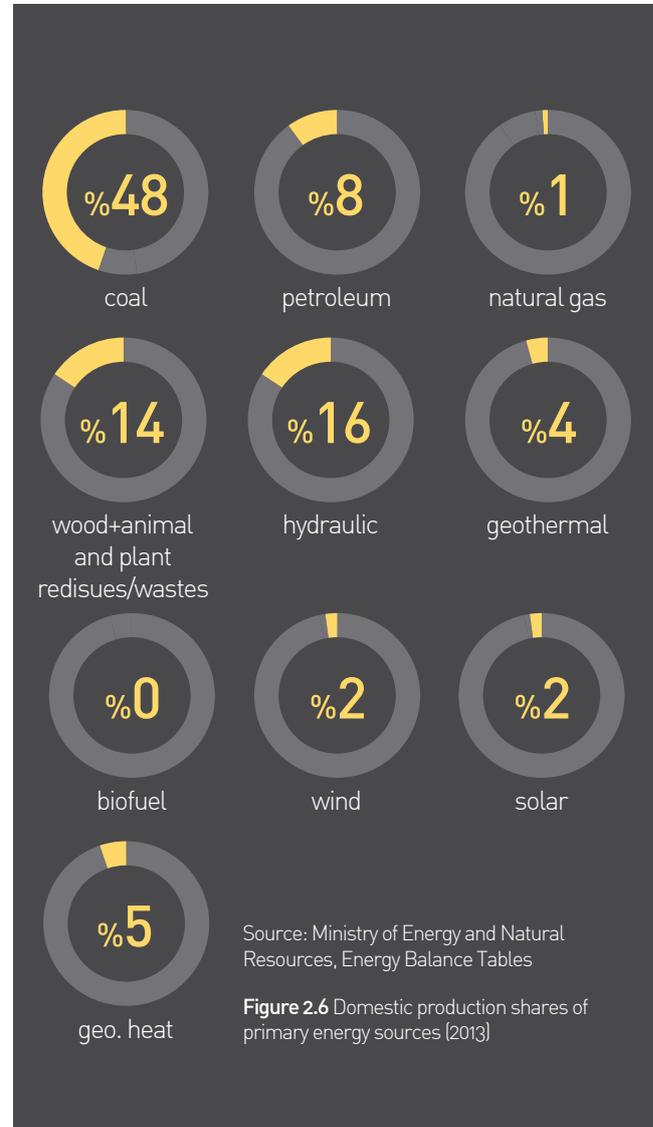
Turkey's primary energy demand doubled as a result of rapid economic growth for the past twenty years. The country is in the position of one of the world's fastest growing energy markets where the increase of energy demand is the most among the Organization for Economic Development and Cooperation (OECD) countries in the past decade. On the other hand, with the demand for fossil fuel energy which is growing and important due to the development and population growth, the position of being the leading country in the increase of greenhouse gases in the energy consumption compared to the other countries and with the position of high dependence to the imported energy, it is also one of the vulnerable countries that will be affected by the new conjuncture in the world.

Primary energy consumption per year in the years 1990-2010 increased steadily at an average rate of around 4%. The economic crisis during the last quarter of 2008 and throughout 2009 led to a decrease in current demand. The year 2013 was one of the years when the energy consumption did not increase. Primary energy consumption in 2013 was 120.3 Mtoe (120.98 Mtoe in 2012). When primary energy consumption is considered, Turkey ranks the 21st in the world with a share of 1%.

### Production of Primary Energy Sources

From past to present, despite Turkey's energy demand has constantly increased except the years of crisis, the production of primary energy relatively remained stable and the production which was 25.50 Mtoe in 1990 only increased by 25% (6.50 Mtoe) and became 31.9 Mtoe in 2013. The increase in demand at the end of this period was 67.6 Mtoe. In this way, consumption increased by more than 8 times compared to the production and energy import dependency of the Country is significantly increased.

In Turkey, of which dependence on imports for primary energy was 73% in 2013 and which was a net importer in terms of energy resources, about 56 billion dollars were spent for the energy imports (60 billion dollars in 2012). This value is more than half of the foreign trade deficit which was approximately 100 billion dollars in 2013 and which challenged the country's economy. When the domestic production share of primary energy sources are reviewed, coal (48%) and renewable energy (43%) (hydraulic and others) are seen as the main sources (Figure 2.6)



### Primary Energy Resource Consumption

When compared to 1990, it is observed that three fossil energy sources (coal, oil and natural gas) among the total primary energy supply increased from 81% to 88% in 2013 despite the continuous increase in renewable energy. In 1990, wood, animal and plant residues which were used by burning as fossil fuels had a 14% share in the primary energy supply. Today, these resources which take place with a 4% share in the energy balance tables have begun to be consumed as energy source gradually by using modern methods (gasification, pyrolysis, etc.)

Sources	Unit	1990	2000	2013
Coal	Ktoe	16,379	24,096	34,668
	%	31	30	29
Oil	Ktoe	23,901	32,297	33,896
	%	45	40	28
Natural gas	Ktoe	2,804	12,378	37,628
	%	5	16	31
Hydraulics	Ktoe	1,991	2,656	5,110
	%	4	3	4
Wood, waste etc.	Mtoe	7,208	6,457	4,374
	%	14	8	4
Geothermal, Solar, Wind	Ktoe	461	978	4,081
	%	1	1	3
Other	Ktoe	-63	288	584
	%	-0.12	0.004	0
Total Primary Energy	Ktoe	52,681	79,150	120,341
	%	100	100	100

Source: Ministry of Energy and Natural Resources, Energy Balance Tables

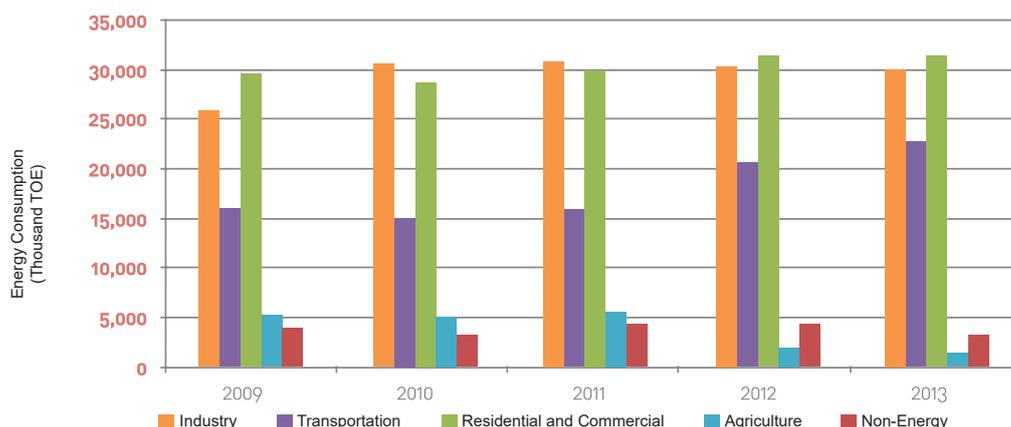
**Table 2.3** The amount and share of the resources in the total primary energy supply

In Turkey, oil took 28% (7% domestic production), natural gas took 31% (1.1% domestic production), coal took 29% (44.5% domestic production) share in primary energy consumption which was 120.30 Mtoe in 2013. Indigenous lignite and hydraulic energy are other consumption energy resources with 11% and 4% shares respectively. The shares of wind, solar and geothermal energy in consumption are around 1%.

The most critical issue here is that the energy consumption is dependent on fossil fuel with a 88% ratio and that the import dependency in natural gas which takes the largest share is more than 98%. The most important source of substitution in reducing this dependence on natural gas is considered as coal (imports and domestic production).

### Sectoral Energy Consumption

During the years when the energy consumption increases, industrial sector has the largest share within the final sector. Due to the continuity of the economic contraction in 2012, in 2013 the building sector (residential and services) was the most energy consuming sector (Figure 2.7). This sector had a 35% share of the total energy consumption in 2013. The share of industry in total energy consumption was 33% following the building industry.



Source: Ministry of Energy and Natural Resources, Energy Balance Tables

**Figure 2.7** Change of the end use energy consumption sectors between 2009 and 2013

While the share of the transportation sector in energy consumption was between 19-20% in the previous years, sector increased its share as a result of the increasing mobility in the sector and urbanization and increased to 26% in 2013 (Figure 2.8).

### Renewable Energy Resources

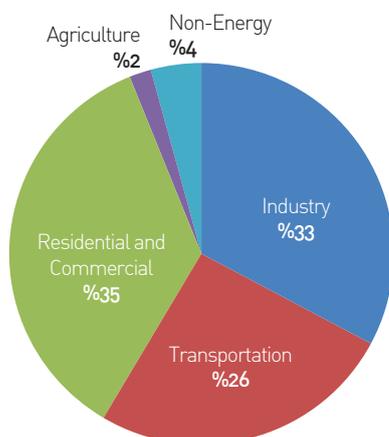
Besides increasing the energy efficiency, one of the main alternatives to get rid of the negative aspects of dependence on energy imports and climate change is the use of renewable energy sources and Turkey has significant potential in this area.

Utilizing the renewable energy sources such as hydraulic, wind, solar, geothermal, biomass, waves and of the country and bringing in to the economy has a strategic importance in terms of providing the resource diversity. Therefore, within the context of the Strategic Plan of Ministry of Energy and Natural Resources, increasing the share of renewable energy in electricity generation and also using it as a source of heat energy are also aimed.

While the renewable energy (production and) consumption which was 12 Mtoe in 2012 took a 10% share in primary energy consumption, in 2013, renewable energy (production and) consumption increased by 13% to 13.60 Mtoe. Thus, 11% of the total primary energy supply in 2013 in Turkey was met from renewable energy sources.

By the end of 2013:

- 32% of renewable energy supply was obtained from biomass sources (as wood, animal and plant residues, waste - heat and electricity),



Source: Ministry of Energy and Natural Resources, Energy Balance Tables  
**Figure 2.8** Share of end use energy consumption by sectors (2013)

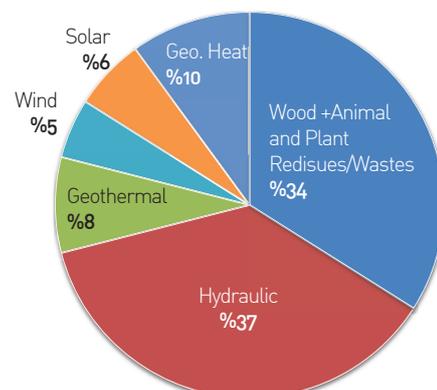
- 37% was obtained from hydraulic resources,
- 19% was obtained from geothermal resources (as heat and electricity),
- 5% was obtained from wind (as electricity generation),
- 6% was obtained from sun (as heat energy) (Production of electricity is negligible).

The distribution of renewable energy production by sources is seen in Figure 2.9.

In terms of power generation, renewable energy installed capacity increased by 3,300 MW compared to the previous year in 2013 and by 2,454 MW in 2014. As of the end of 2014, Turkey's total installed capacity reached 69,520 MW. 28,006 MW (40.20%) portion of this value consists of renewable resources.

More than 80% of the renewable energy was generated from the hydraulic sources and while the wind energy takes a 16% share, the share of the solar energy for which we have a significant potential due to our geographical location in the generation is yet very close to zero. Turkey has an important renewable energy sources potential due to the geographical region it is located (Table 2.4). However, an important part of this potential is not yet utilized.

Following the Regulation on the Unlicensed Electricity Generation in the Electricity Market dated October 2, 2013, an important expansion potential emerged in the climate-friendly electricity generation capacity. As of January 2015, the acceptance of a total of 124 power generation facilities with 58 MW installed capacity have been made. Under unlicensed generation, with 116 solar facilities, on site generation and consumption have begun.



Source: Ministry of Energy and Natural Resources, Energy Balance Tables  
**Figure 2.9** Distribution of energy profile by sources (2013)

In summary; by TEDAS; as a result of the project approval processes of the unlicensed cogeneration-trigeneration plants, the total power of the projects applied for was reported to be: 79.50 MW, the total of approved projects: 46.70 MW, power of the projects commissioned: 8.30 MW, power of the projects in the process of being commissioned: 20 MW.

### Wind Power

In Turkey, wind power plant (WPP) projects gained momentum with the enactment of the Renewable Energy Act. According to TEIAS data; the WPP installed capacity which was around 18.90 MW in 2002 reached 2,760 MW as of the end of 2013 and 3,630 MW installed capacity as of the end of 2014 with a total of 90 plants.

By utilizing the Geographic Information Systems Techniques and satellite images, the wind energy potential has been identified and Turkey Wind Potential Atlas (WEPA) has been published. According to the Turkey Wind Energy Potential Atlas (WEPA), in the wind class, there is a 48,000 MW potential between good and exceptional. In the Electricity Market and the Security of Supply Strategy Paper, wind power installed capacity is expected to reach 20,000 MW in 2023.

A total of 270 wind projects in a total of 9508 MW power were given licenses by the end of 2013 by the Energy Market Regulatory Authority (EMRA). By 2014, total capacity of all WPPs licensed and in the license process exceeded 13,000 MW.

In order to benefit from the potential of wind energy in our country at the maximum level, the condition of connection all the WPPs to the Wind Power Monitoring and Forecast Center (RITM) was introduced with a regulation made in the year 2013 in order to integrate more wind power plants to the electricity system and predict the electrical power to be generated from the wind. As of 2014, power generations of 20 WPPs can be monitored simultaneously in the center facility and estimates for 48-hours power are carried out. The total installed capacity of the WPPs connected to the center is over 1,000 MW as of today (RITM, 2014).

Many investors wishing to establish manufacturing facilities based on wind energy in our country may receive the wind information of the areas they are interested in by applying to the Ministry of Energy and Natural Resources, General Directorate of Renewable Energy (GDRE).

Renewable Energy Resource	Potential (GWh) (2013)
Hydroelectric	59,420.5
Wind	7,557.5
Geothermal	1,363.5
Sun	1,527 kWh/m <sup>2</sup> -year
Biomass	1,171.2

Source: Ministry of Energy and Natural Resources, Blue Book, 2014

**Table 2.4** Turkey's renewable energy sources potential (electricity generation)

### Geothermal Energy

Geothermal energy is an important indigenous and renewable energy source in Turkey because of the intense tectonic movements. Turkey has the world's 7th largest geothermal energy potential. The use of geothermal fields in Turkey has a distribution of;

- Direct use (heating, etc.) - 35%
- Thermal use (spa) - 56%
- Electricity Generation - 9%

Turkey's geothermal thermic energy potential is assumed to be 31,500 MWt. The proven actual available technical capacity is 4,078 MWt and 34% (1306 MWt) of this potential already in use. While the technical potential for electricity generation is considered to be 600 MWe, the geothermal installed capacity which was 17.50 MW by the end of 2002 increased to 311 MW (1364 GWh) by the end of 2013 and 15 plants reached a 404.90 MW installed capacity by the end of 2014. In the last 2-year period, Turkey's electricity generation from geothermal sources doubled. On the other hand, geothermal applications reached 2,832 decar from 2002 to 2013 (3,130 decar in September 2014) with a 466% increase in greenhouse heating and 89,443 dwelling in residential heating with 198% increase (89,563 dwelling in September 2014).

### Solar Energy

Turkey is located in one of the regions called sunbelt as of the location in the world and that can best benefit from solar energy. In the Turkey's Solar Energy Potential Atlas (GEPA) prepared by GDRE, it has been determined that the total annual insolation duration is 2,737 hours (7.50 hours per day in total) and the annual solar radiation is 1,527 kWh/m<sup>2</sup> (daily 4.20 kWh/m<sup>2</sup> in total).

Renewable Energy Sources Act No. 5346 which is necessary for the widespread use of photovoltaic system was revised in 29/12/2010 and the legislative work was completed in 2013. Wide usage is expected in recent years with falling costs of photovoltaic systems and increase of productivity.

In Turkey, most extensive use of solar energy is hot water production; greenhouse heating and agricultural products drying. 18-20% of existing dwellings mostly in Mediterranean, Aegean and Southeast Anatolia (3-3.50 million) have been used solar collectors. The distribution of Turkey's solar energy potential by regions is provided in Table 2.5.

The studies of potential identification for effective and efficient use of the solar and biomass resources and to utilize these resources in energy production were made by GDRE and General Directorate of Meteorology (GDM) and the information produced in this context was published in the Turkey's Solar Energy Potential Atlas (GEPA) album (GEPA, 2014).

Solar energy based power generation capacity reached a total value of 40.20 MW installed capacity value with 112 solar power plants by the end of 2014 (0.10%). In February 2015, while the installed capacity only accepted as unlicensed was 44 MW, this installed capacity is expected to increase rapidly upon the licenses become operational.

### Hydraulic Energy

In Turkey, the gross theoretical hydropower potential is 433 billion kWh and the hydropower potential which can be considered technically is 216 billion kWh, while the economic potential is 150 billion kWh/year and it is estimated to increase further and reach about 170 billion kWh/year in the coming years with the new projects.

In Turkey, total installed capacity of 503 hydroelectric power plants which are operational as of the end of the year 2014 is 23.694 MW and the average annual generation is 83,046 billion kWh and this value corresponds to 50.70% of the total technical potential. 12,369 MW (26.40%) of the 23,694 MW installed capacity performed in the process of converting the hydroelectric potential to the power was performed by the hydroelectric power plants developed and constructed by the SHW.

Additionally, 4 power plants which are included in the SHW investment program and that of the construction is ongoing as of the beginning of 2015 and with an installed capacity of 2,000 MW and average annual energy generation of 6,188 billion kWh are expected to be commissioned by 2017. When these hydroelectric power plants are completed, the hydroelectric potential built and commissioned by SHW will reach 14,295 MW and annually 49,500 GWh generation is expected with these plants.

Region	Total Solar Radiation (kWh/m <sup>2</sup> -year)	Insolation Duration (hours/year)
Southeastern Anatolia	1,460	2,993
Mediterranean	1,390	2,956
East Anatolia	1,365	2,664
Central Anatolia	1,314	2,628
Aegean	1,304	2,738
Marmara	1,168	2,409
Black Sea	1,120	1,971

Source: GDRE, 2014

Table 2.5 Distribution of Turkey's total annual solar energy potential by region

The hydroelectric potential and the number of HEPP installed capacity which was started with Seyhan I HEPP in 1956 reached 65 with the commissioning of the Alpaslan I, Akköprü, Kılavuzlu ve Ermenek HEPPs in 2012, Deriner Dam and HEPP in 2013, Çine Dam and HEPP and Manyas Dam and HEPP in 2014 as well as with 6 minor HEPPs (Anamur, Ercis, Kernek, Silifke-I, Uludere, Durucasu) with an installed capacity of less than 2 MW built by SHW. The total installed capacity of these 65 hydroelectric power plants commissioned and that of the constructions are completed is 12,369 MW and the average annual generation is 43,357 billion kWh.

### Biomass Energy and Biofuels

Until 2011, the number of plants generating power from biomass, which are very few except some biogas plants obtained from wastewater and municipal waste increased with the Law on Amendment on the Law on the Use of Renewable Energy Resources for the Purpose of Electrical Energy Generation, No. 6094 enacted in 2011. From Turkey's biomass sources, 1,171 GWh of electricity generation capacity occurred in the biogas sector with an installed capacity of 200 MW by the end of 2013. The bioethanol installed capacity in Turkey is 149.50 million liters and there are 3 plants.

In Turkey, biodiesel production was 21,876 tons according to Energy Market Regulatory Authority in 2013. In the same

year, 31,557 tons of bioethanol was blended in the gasoline (EMRA 2013; TAMRA, 2013).

From the Biomass Energy Potential Atlas (BEPA) prepared by GDRE in order to identify Turkey's biomass potential, the total biomass potential is defined as 20.30 Mtoe.

### Electricity Sector

Turkey's electricity consumption increased by 317% since 1990 and was 245.5 TWh in 2013. While the increase in the electricity demand was 9.40% in 2011 and 5.20% in 2012, it was 1.20% in 2013. In parallel to the high economic growth rates achieved in recent years, annual electricity consumption growth rate was 5.80% in average in the last 11 years.

239.30 TWh of the consumed 245.50 TWh electricity power was produced in the country in 2013 and 7.40 TWh was imported. And 1.20 TWh energy was exported. As of the end of 2014, demand for electricity power was 255.50 TWh, with an increase of approximately 3.70% compared to the previous year. While 250.40 TWh generated, 7.80 Billion kWh was imported and 2.70 billion kWh was exported from the total supply of electricity power (TEIAS\_a, 2014).

With 2009, increases are seen in renewable energy-based electricity generation. Since 2003, geothermal and wind-based generation from renewable energy sources have increased by

Year	Thermic	Hydraulics	Geothermal + Wind	Total	Increase (%)
2003	105,101	35,330	150	140,581	8.60
2004	104,464	46,084	151	150,698	7.20
2005	122,242	39,561	153	161,956	7.50
2006	131,835	44,244	221	176,300	8.90
2007	155,196	35,851	511	191,558	8.70
2008	164,139	33,270	1,009	198,418	3.60
2009	156,923	35,958	1,931	194,813	-1.80
2010	155,828	51,796	3,585	211,208	8.40
2011	171,638	52,339	5,418	229,395	8.60
2012	174,872	57,865	6,760	239,497	4.40
2013	171,256	59,246	8,792	239,293	-0.08
Shares (2013)	71.60%	24.70%	3.70%	100%	-

Source: MENR\_a,2014

**Table 2.6** Development of Turkey's electricity power generation by resource (2003-2013)

about 59 times and reached the level of 8792 GWh from 150 GWh level (MENR\_a, 2014) (Table 2.6). As a remarkable capacity for solar power have begun to form as of 2014, it is not included in the tables and graphs.

In Turkey, in 2013, 44% of electricity generation was met from natural gas, 26% was met from coal, 25% was met from hydroelectric and 3% was met from wind (MENR\_a, 2014) (Table 2.7). As can be seen from these figures, Turkey's electricity sector is largely dependent on the natural gas imported from Russia. Since natural gas dependent electricity generation structure bears an important risk, the Government aims to increase the share of domestic and imported coal and renewable energy of the electricity generation capacity to reduce dependence. At the same time, commissioning two nuclear power plants in stages, including the first unit of the first nuclear power plant in 2019 (Akkuyu) and

the first unit of the second nuclear power plant in 2023 (Sinop) is planned (MENR\_b, 2014).

An increase in the existing share of electricity generation from the renewable sources and a significant portion of this increase to be met by the new wind power installed capacity are expected.

### Turkey's Electric Power Installed Capacity

Turkey's electric power installed capacity which was 35,587 MW in 2003 reached 64,007 MW in 2013 and 69,519.80 MW by the end of 2014. As of the end of 2013, 34% of the current installed power consisted of hydraulic, 32% of natural gas, 19% of coal, 4% of wind and 10% consisted of other sources. According to the provisional results of the year 2014, 60% of the installed capacity was thermal power, 34% was hydraulic, 1% was geothermal and 5% wind and less than 1% was solar.

Despite the installed capacity share of the wind energy is 4% in 2013, which has grown significantly in recent years, its contribution to generation is only 3% due to meteorological constraints. Turkey's wind power generation which was 5.849 GWh in 2012 increased by 28.50% in 2013 and reached to 7,518 GWh. On the other hand, the contribution of wind power to electricity installed capacity in 2012 was 2,261 MW and 2,760 MW in 2013.

In Turkey, between 2003 and 2013, the installed capacity of electricity in the last 11 years increased by 6.60% annually in average. With the power plants commissioned in 2013, a 6,935 MW capacity was added to the electric power installed capacity (Table 2.8). 64% of the power plants commissioned in 2013 are renewable, while 36% is based on thermal sources.

Primary Energy Resource		Power Generation (GWh)	Share in the Total Generation (%)
COAL	Hard Coal + Imported Coal + Asphaltite	31,458	13.20
	Lignite	30,018	12.50
	Total	61,476	25.70
LIQUID FUEL	Fuel-Oil	3,195	1.30
	Diesel	528	0.20
	LPG	91	0.04
	Naphtha	76	0.03
	Total	3,890	1.60
Natural gas+LNG		104,835	43.80
Renewable+Waste		1,055	0.40
Thermic Total		171,256	71.50
Hydraulics Total		59,246	24.70
Wind Total		7,518	3.10
Geothermal Total		1,274	0.50
GENERAL TOTAL		239,293	100

Table 2.7 Electricity generation by resource (2013)

Year	Thermal			Hydraulics	Wind	Geothermal	Sun	Total	Increase (%)
	Coal	Natural gas	Other						
2003	8,239	10,053	4,683						11.70
2004	8,296	11,349	4,500	12,645	18.90	15	-	36,824	3.50
2005	9,117	12,275	4,487	12,906	20.10	15	-	38,820	5.40
2006	10,197	12,641	4,520	13,063	59	23	-	40,502	4.30
2007	10,097	12,853	4,322	13,395	146.30	23	-	40,836	0.80
2008	10,095	13,428	4,072	13,829	363.65	29.80	-	41,817	2.40
2009	10,501	14,555	4,284	14,553	791.60	77.20	-	44,761	7
2010	11,891	16,112	4,276	15,831	1,320	94.20	-	49,524	10.60
2011	12,491	16,003	5,438	17,137	1,729	114.20	-	52,911	6.80
2012	12,530	17,162	5,337	19,620	2,261	162.20	-	57,072	7.90
2013	12,428	20,254	5,965	22,289	2,760	311	-	64,007	12.20
Ratio (%)	19.2	31.6	9.3	34.3	4.3	0.5	0.0	100	-

Source: MENR\_a, 2014

**Table 2.8** Change of electric installed capacity by resources and years

### Electricity Demand Projections

The increase in Turkey's electricity demand is expected to continue in the coming years. Ministry of Energy and Natural Resources foresees that the electricity demand will almost be doubled between 2013 and 2023. One of the most important aspects of this increase is the change that occurs in the distribution of electric power generation based on sources. Almost half of the electricity generation of Turkey in 2013 is based on imported natural gas (44%).

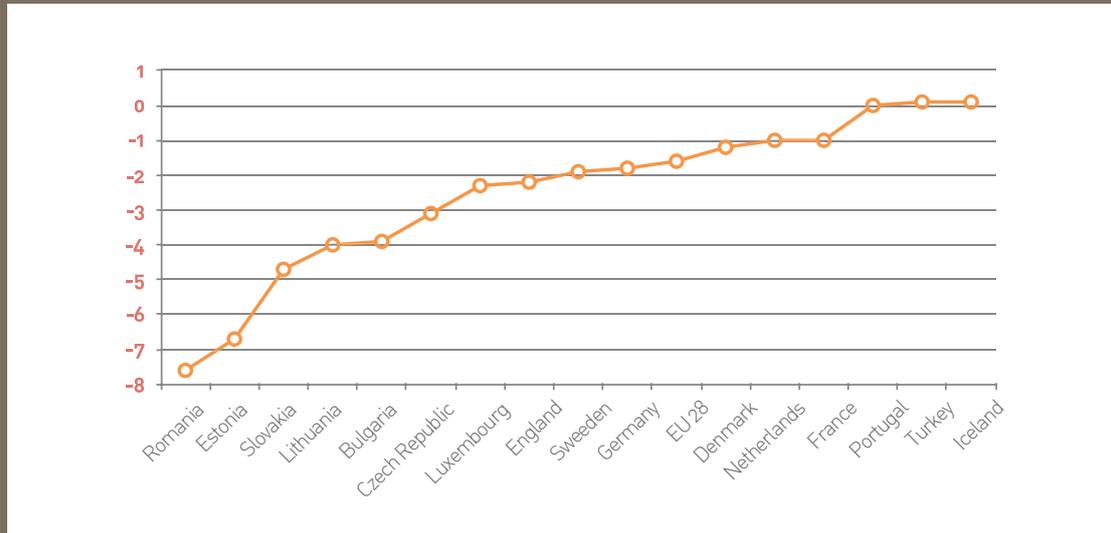
According to the scenario based on the official objectives and plans announced, it is predicted that in the next 15 years, the annual electricity demand will increase by 5.25% annually. It is estimated that the contribution of the coal, nuclear, hydroelectric and other renewable energy sources in electricity generation will increase and the share of natural gas will decrease to 18% in 2030. In the framework of the official plans (existing strategy papers, development plans, etc.), it is shown that the electricity demand (according to the final electricity demand series determined by the Ministry of Energy and Natural Resources) will be 463 Twh in the High Demand Scenario and 381 Twh in the Low Demand Scenario in 2023 and will reach 660 and 506 Twh in 2030 level according to the same scenario (TEIAS\_b, 2014, MENR\_b, 2014).

### Nuclear Energy

Law on the Establishment and Operation of Nuclear Power Plants in Turkey and Sale of Energy has been published in the Official Gazette No. 26707 dated December 21, 2007. With the regulations issued in the years following 2007, legal background preparations were made and an agreement has been signed with Russia for the construction of the Akkuyu Nuclear Power Plant with 4,800 MW power and an agreement has been signed with Japan for the construction of a second nuclear power plant to be built in Sinop with 4,480 MW power. The assessments for the third nuclear power plant continue. According to the planning of the Ministry of Energy and Natural Resources, the first unit of the Akkuyu nuclear power plant is expected to be commissioned in 2020 and the first unit of the Sinop nuclear power plant is expected to be commissioned in 2022.

### Energy Efficiency

Turkey can be considered as one of the "energy intensive" economies in comparison with the developed countries, in terms of primary energy intensity. When compared with the 0.13 TOE/\$ 1000 (2005) "Gross Domestic Product" which is the 2012 OECD average, more energy is spent to generate \$ 1,000 GDP in Turkey with the 0.19 value (with fixed value of US dollar in 2005). Turkey is one of the countries which reduce their energy intensity in average annually among European countries between the years 1990-2012 (EEA, 2014).



Source: EEA, 2014

Figure 2.10 Energy intensity change comparison

On the other hand, to be able to compare the final use energy efficiency, the comparison should be made between GDP Purchasing Power Parity (PPP) and the final energy consumption figures. In comparisons with the purchasing power in Turkey's energy intensity assessments, Turkey is among the countries with a good position (Turkey: 0.12 TOE/\$ 1000(2005), OECD average: 0.13 TOE/\$ 1000(2005); IEA, 2014). According to the studies of GDRE, annual primary energy intensity index of our country in the period 2000-

2013 decreased by 1.50%, while final energy intensity index decreased by 1.40%, being again the same rate. Compared to the previous year, in 2013, there is 2.30% decrease in primary energy intensity index and 3.40% decrease in final energy intensity index observed. When a comparison is made with respect to year 2000, primary energy intensity index improved by 18.20% and final energy intensity index improved by 18.80% (GDRE\_a, 2014). While calculating these intensities, 2000 based new GDP series was used.

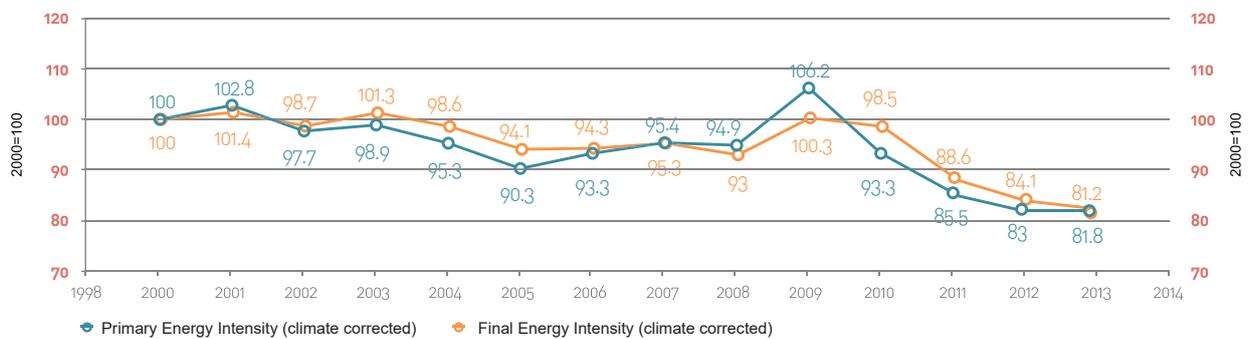
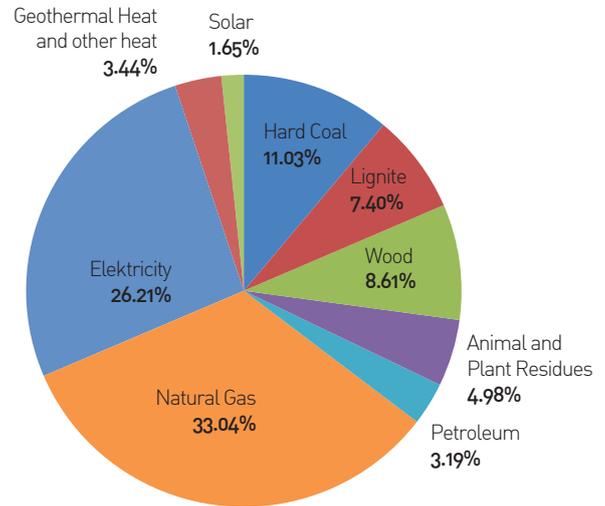


Figure 2.11 Development of primary and final energy intensity index

## 2.7. Buildings and Urbanization

When the statistics regarding the building licensed premises are examined; it can be seen that in 2013, the number of buildings to which a building permit is issued by municipalities increased by 14.70%, the surface area increased by 9.30% and the value increased by 13.80% and the number of apartments increased by 11% compared to the previous year (Table 2.9). In the same table, it is demonstrated that in the first nine months of 2014, the number of buildings to which a building permit is issued by municipalities increased by 25.60%, the surface area increased by 39.20%, the value increased by 54.40% and the number of apartments increased by 33.30% compared to 2013 (TurkStat\_c, 2014).

In Turkey, 35% (31.4 Mtoe) of final energy consumption was caused by the commercial and residential sectors in 2013. In Turkey, 33% of the energy consumption in buildings was met



Source: Ministry of Energy and Natural Resources, Energy Balance Tables  
**Figure 2.12** Shares of primary energy consumption in buildings (commercial and residential) [2013]

Indicators	Year			The number of buildings (%) <sup>1</sup>	
	2012	2013	2014	2013	2014
Number of buildings	75,997	87,163	109,841	14.70	25.60
Surface area (m <sup>2</sup> )	113,722,627	124,342,080	173,126,100	9.30	39.20
Value (TL)	78,130,909,650	88,936,725,104	137,328,440,125	13.80	54.40
Number of apartments	547,335	607,277	809,597	11.00	33.30

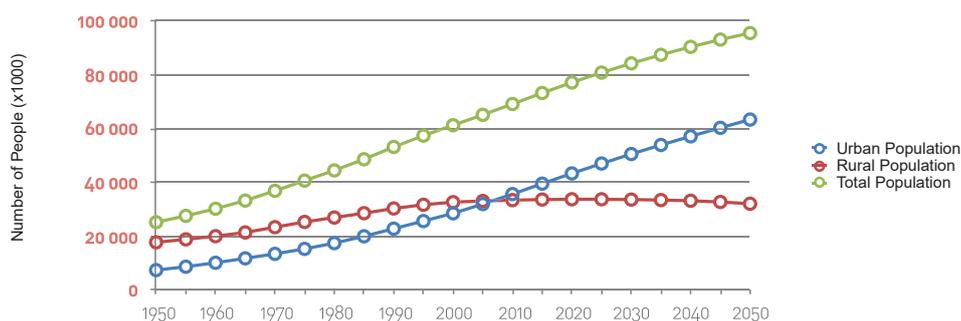
Source: TurkStat\_c, 2014

**Table 2.9** Building licensed building statistics

<sup>1</sup>The number of buildings to which a building license was issued by the municipalities compared to the previous year

from natural gas, 26% was met from electricity, 11% was met from stone coal, 19% was met from renewable energy sources consisting of solar, geothermal, wood, plant and animal waste in 2013.

As stated in Section 2.2, it is foreseen that the downward trend in the annual population growth will continue and Turkey's population is expected to reach 84 million in 2023 (MD\_b, 2013). Urban and rural population change across Turkey by years is provided in Figure 2.13.



Source: EEA, 2014

**Figure 2.13** Urban and rural population change across Turkey by years

## 2.8. Industry

The share of the Turkish industrial sector in GDP in 2013 was 15.30% with the current prices. Exports of the manufacturing industry consisting of several sub-sectors in 2013 and 2014 were 141.4 billion US dollars and 147.10 billion US dollars respectively. In this regard, it effects the growth rates largely. When the sales amounts of the products produced by the enterprises are examined, according to the 2013 data, food industry and textile/apparel industry are at the forefront with 14.90% and 13.20% shares respectively. This sector is followed by primary metal industry with 12.40%, manufacture of motor vehicles industry with 7.80%, manufacture of non-metallic mineral product industry with 5.70%, chemical industry with 5.40% and manufacture of electrical equipment industry with 5.00% (TurkStat\_c, 2013). When shares of the sectors in the country exports are reviewed, in 2013, textiles/apparel/leather sector takes the first place with 18.10% and followed by the automotive industry with 12.60%, primary metal industry with 11.50% and chemical industry with 9.70%. In 2014, these percentages were 19.30%, 13.70%, 10.60% and 9.80%. 99.80% of the total number of enterprises in the industrial sector consists of Small and Medium Enterprises (SMEs). According to 2013 data; 75.80% of the total employment in the sector, 59.20%

	2006	2012	2013	2018
Manufacturing Industry / GDP (Current, %)	17.20	15.60	15.50	16.50
Manufacturing Industry Export (Billion Dollar) <sup>1</sup>	79.60	129.90	144.10	257.10
Index Share of High Technology Sectors within the Manufacturing Industry Exports (%) <sup>1</sup>	5.60	3.70	3.70	5.50
Share of Over the Middle Technology Sectors Manufacturing Industry Exports (%) <sup>1</sup>	30.80	31.40	31.40	32.10
Number of Turkey Triadic Patent Applications <sup>2</sup>	14	35 <sup>3</sup>	63	167
TFP Growth in Industry (%)	1.20	-0.90	-0.80	1.90

Source: 2006 and 2012 data belong to TurkStat. 2013 and 2018 data are estimates of Tenth Development Plan

**Table 2.10** Developments and targets in the manufacturing industry

<sup>1</sup> Values do not contain gold.

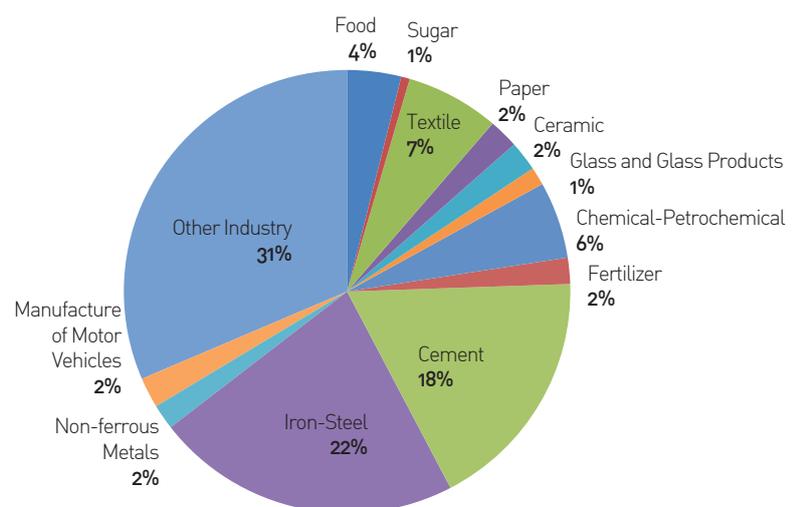
<sup>2</sup> OECD Factbook, 2013

<sup>3</sup> Value of 2010.

of the export and 39.90% of the import are carried out by the SMEs. In addition, the proportion of SMEs with innovative operations in the industrial sector in the period of 2010-2012 was 49% (TurkStat\_d, 2014; MD\_a, 2013).

The industry sector led to an increase in exports of medium technology sectors. But, despite the numerical increase in the exports of high-tech industry, a decrease is seen in its share in the manufacturing industry exports which grow faster. When the productivity gap between the share of the high intermediate good import and the large and small enterprises are considered, it is evaluated that the large-scale enterprises which have gained international competitive power and the SMEs should work together with different scenarios and techniques. With the aim of increasing the share of high-tech products, enabling the collaboration of main and sub-industries in R&D and innovation is important. Developments and objectives in manufacturing are provided in Table 2.10.

Industrial primary energy consumption in 2013 was 89.42 Mtoe and 34% of this value (30.14 Mtoe) was caused by the industrial consumption. When the energy consumption of industrial sectors are reviewed, it is seen that the largest share belongs to other industry sectors with a rate of 31% and that this is followed-by iron and steel with 22% (6.68 Mtoe) and cement sector with 18% share (5.39 Mtoe) (Figure 2.14).



Source: Ministry of Energy and Natural Resources, Energy Balance Tables  
**Figure 2.14** The sectoral breakdown of final energy consumption in the industrial sector (2013)

## 2.9. Transportation

According to the data in 2013 Energy Balance tables, 25.47% of the primary energy consumption which is 89.42 Mtoe in total was from the transport sector with 22.77 Mtoe. 91% of primary energy consumption of this sector is road transportation, 5.50% is airway transportation, 1.60% is maritime transportation, 1.10% is pipelines and 0.70% is railway transportation.

The change over the years of the number of motor vehicles in road transport which constitutes a large portion of primary energy consumption is provided in Figure 2.15. The

total number of vehicles which was 3,750,678 in 1990 reached to 17,939,447 and the road length which was 367,956 kilometers in 1990 reached to 388,666 kilometers in 2013 (TurkStat\_e, 2014).

Changes in the cruise of passenger and cargo transportation on state roads, provincial roads and highways in Turkey are given in Figure 2.16. 2013 vehicle-km value was 99,431, ton-km value was 224,048 million and passenger-km value was 268,178 million. All three parameters have steadily increased since 2009.

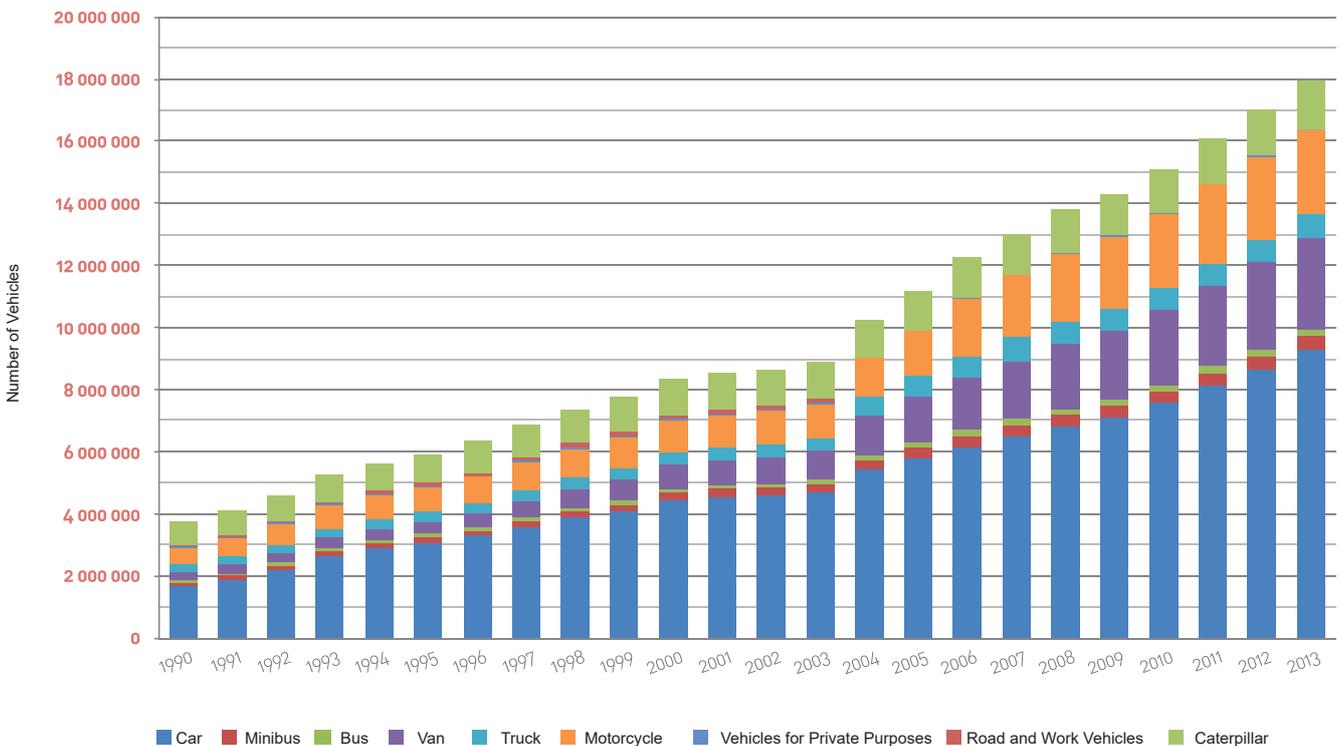
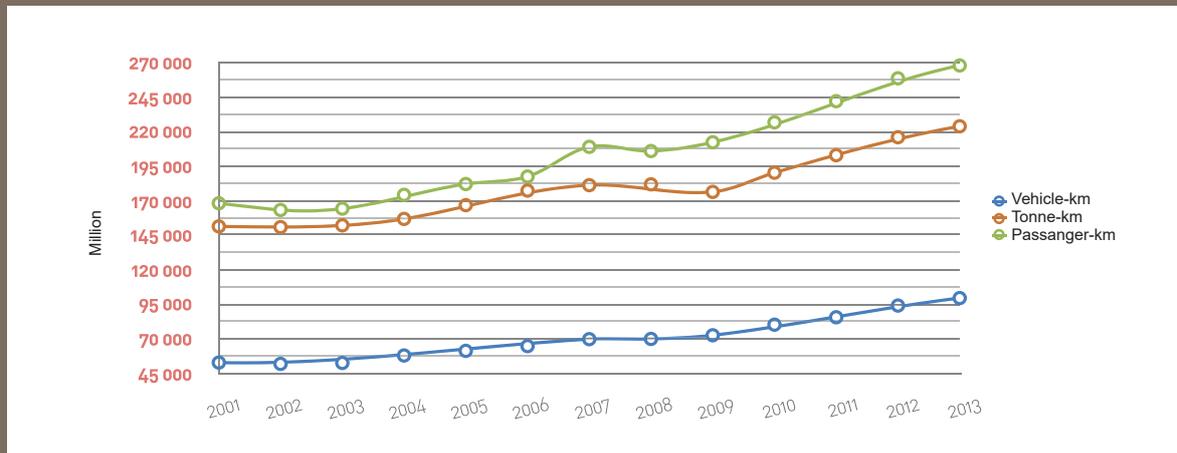


Figure 2.15 Changes in the number of motor vehicles (1990-2013)



Source: TurkStat\_e, 2014

Figure 2.16 Cruise and cargo and passenger transportation on the state roads, provincial roads and highways (2001-2013)

The length of railway lines which was 8,429 km in 1990 reached to 9,718 km in 2013. Despite the increase in the length of the railway lines, since 1999, there has been a decrease in the demand for rail transportation. According to the data of TurkStat, the number of passengers which was 139 million in 1990 was approximately 46.5 million in 2013. Also, in 2013, in Izmir Suburbs (IZBAN) approximately 61 million passengers were transported.

Freight and passenger transportation by air has increased steadily since 1990. In 2013, the total number of airline passengers including domestic and international flights was 149,430,421 and the amount of freight was 2,595,316 tons (TurkStat\_e, 2014).

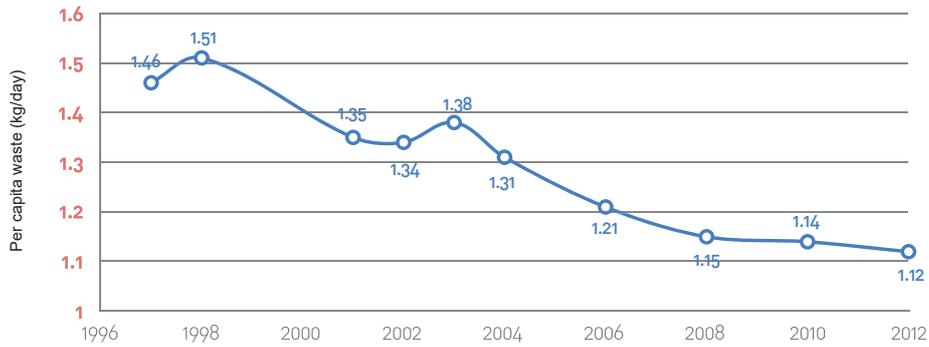
## 2.10. Waste

According to the results of Municipal Waste Survey conducted by TurkStat in 2012, the amount of municipal solid waste collected in Turkey was 25,845,000 tons/year and 83% of the country population and 99% of the municipal population benefit from waste collection services. As of 2012, about 59% of the waste collected from the municipalities are disposed of with methods complying with the waste management legislation and hierarchy such as regular storage and composting (As of the year 2012, about 60.5% of waste collected from municipalities is disposed of in ways appropriate to the waste management legislation and hierarchy such as landfilling and composting).

Per capita waste generation in Turkey was estimated to be 1.38 kg in 2003, 1.21 kg in 2006, 1.15 kg in 2008 and 1.12 kg in 2012 (Figure 2.17). As a result of the increase in the portion of the population living in cities, the campaigns to create less waste and the use of the packaging to generate less waste in the industry, this situation represents a decrease that is expected.

Change of the waste services in Turkey over the years is provided in Figure 2.18. In 1994, while the population of municipalities that served by waste disposal and recycling facilities against the total population was 4% in 1994, it increased to 54% in 2012. In particular, the most important reason for the rapid increase since 2008 is the establishment of local waste associations which were introduced with the Waste Management Action Plan and thus the sanitary landfills which began to be operated. With 80 landfill sites, 1078 municipalities and 70% of the total population are served.

The most common disposal method for the disposal of urban waste in Turkey is still landfilling and the composting and/or other recovery applications are not yet at the desired level. Thanks to reducing the waste production, control works of biodegradable waste and the waste recycling campaigns launched especially in metropolitan municipalities, these issues are expected to show progress in the coming years as well. Although burning of waste is supported as a policy in Turkey, no significant increase has been achieved. (Figure 2.19)

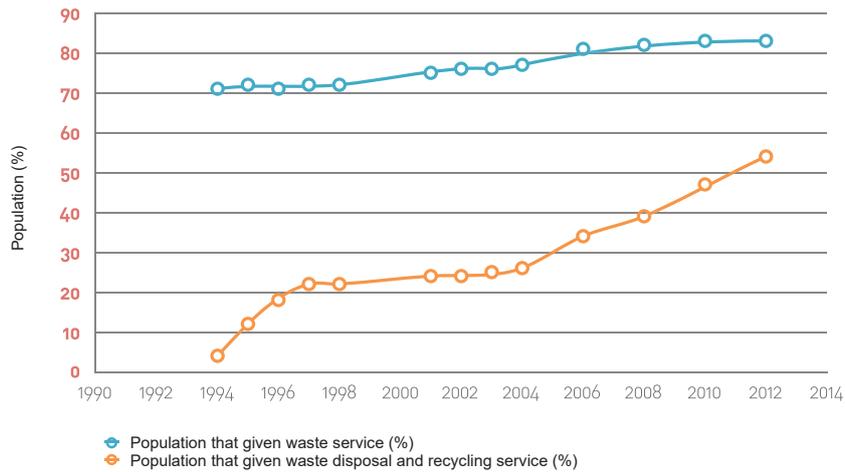


Source: TurkStat\_I, 2014

Figure 2.17 Per capita waste production over the years in Turkey (kg/day) (1997-2012)

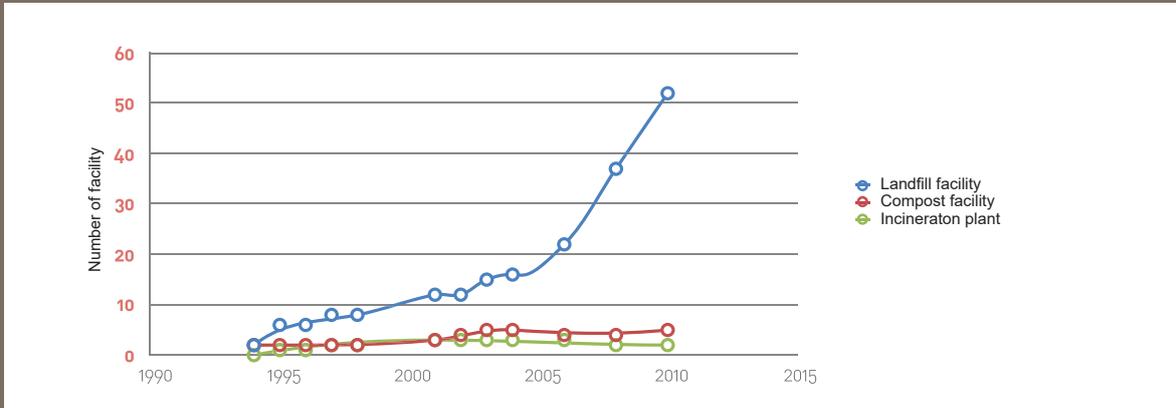
In Turkey, a significant increase has occurred for the treatment of wastewater which is another process that create greenhouse gas emissions, particularly in the recent years. In particular, in accordance with the Wastewater Treatment Action Plan prepared in 2008, the works in the treatment of

household and urban wastewater has been accelerated and a progress has shown in the wastewater treatment in conjunction with the basin management works. Increases in the number of wastewater treatment and treatment plants are provided in Figure 2.20 and Figure 2.21.



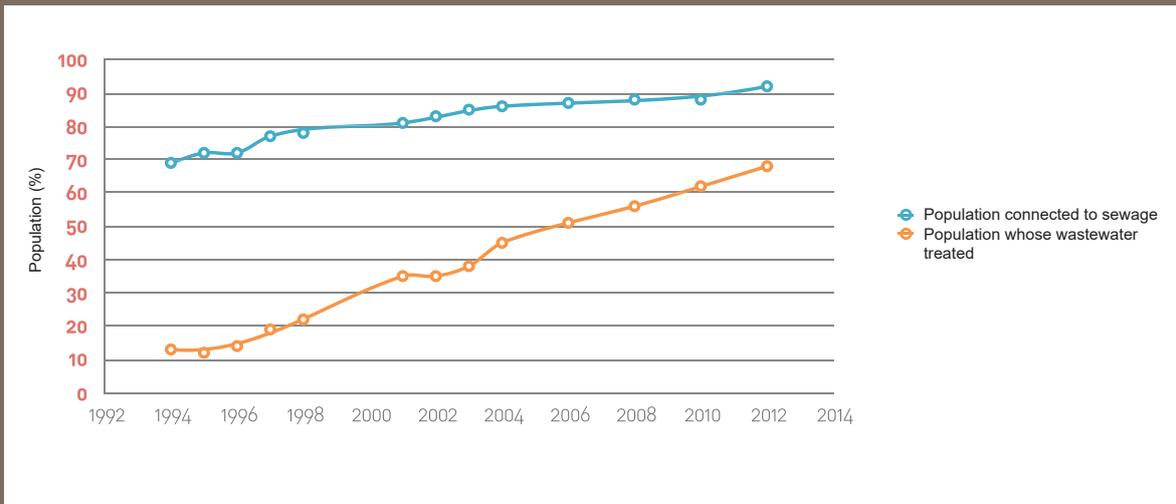
Source: TurkStat\_I, 2014

Figure 2.18 The development of solid waste services in Turkey



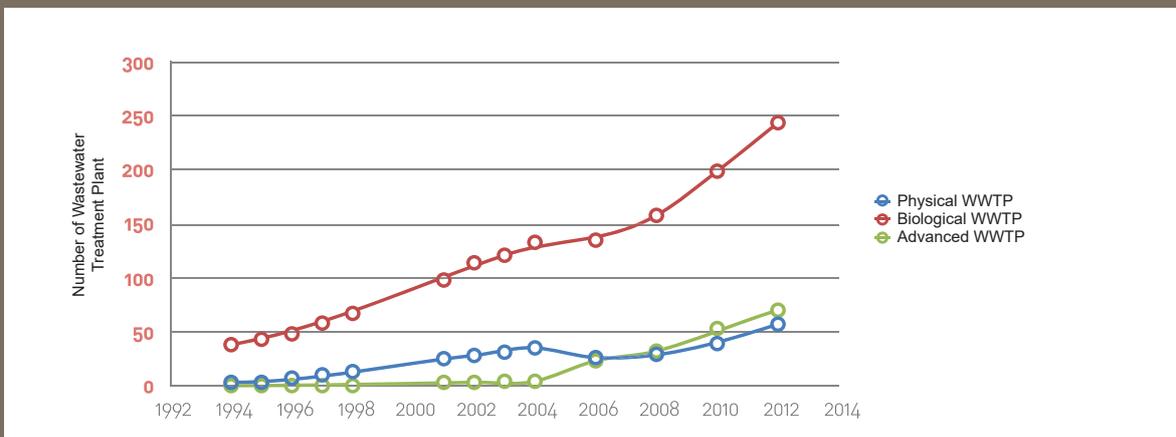
Source: TurkStat\_I, 2014

Figure 2.19 The development of waste disposal in Turkey



Source: TurkStat\_I, 2014

Figure 2.20 The development of wastewater treatment in Turkey



Source: TurkStat\_I, 2014

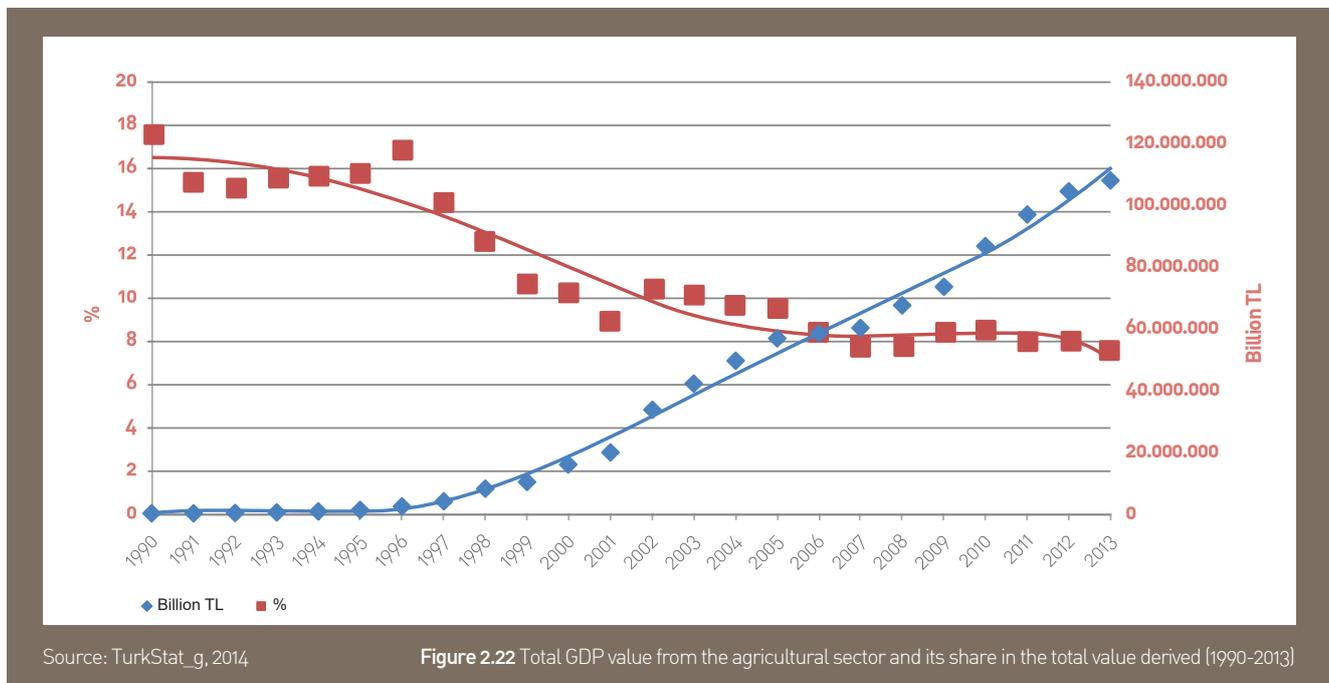
Figure 2.21 The development of wastewater treatment plant in Turkey (WWTP)

## 2.11. Agriculture

### Added Value

Despite a decline over the years in the total agricultural lands in Turkey, the added value derived from the agricultural sector has been gradually increasing. The share of agriculture sector in GDP in 1968 was 40% in Turkey and Turkey was considered to be an agricultural country in these years. With the transformation experienced in 1980s, while the contribution of the agricultural sector to the economy gradually increased as an absolute value, it declined proportionally and

the share of GDP of the agricultural sector decreased below 30% by the end of 1970, below 20% in the mid-1980s and below 10% in 2000s. By the year 2013 the share of industry in GDP has dropped to 7.40% (TurkStat\_g, 2014) and the course of the ratio is expected to continue declining in the coming years. In 1991, due to the start of the Gulf War and then the rapid exchange rate increase being effective in Turkey and the following political instability, an economic crisis emerged and non-agricultural sectors were adversely affected by the crisis and in this period a slight increase occurred in the share of the agricultural sector in GDP. With this aspect, the agricultural sector was less affected by the crisis than the other sectors (Figure 2.22).

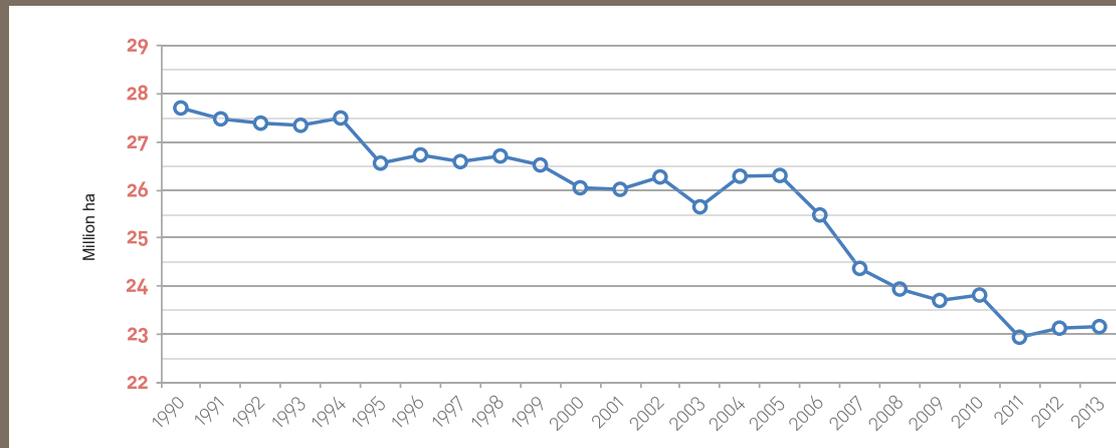


### Agricultural Areas

According to statistics of year 2009, the total area of farmland in Turkey together with the perennial area was 24.3 million ha. In the statistics of 2013, the total agricultural land declined to 23.80 million ha (Figure 2.23). According to statistics of 2013, of the 23.8 million ha total agricultural land, 15.60 million ha were planted, 4.20 million ha were fallowed, 808 thousand ha were used for vegetable farming and 3.20 million ha were used for fruit, olive grove and vineyard cultivation. As of 2011, areas for ornamental plant cultivation have begun to be compiled within the agricultural areas and in 2013 it was reported that the total areas with ornamental plant cultivation were 5 thousand ha (TurkStat\_h, 2014).

### Animal Presence

While there is a steady decrease in total number of large and small ruminants between the years 1990-2009 in Turkey, there was a steady increase between 2009 and 2013 (Figure 2.24). It is thought that these increases resulted from the supports such as the nurturing sheep and goat, nurturing and growing cattle, calves and milk support provided by the Ministry of Food, Agriculture and Livestock. Compared with 2009, it is seen that in 2013 significant increases occurred, as 80% in the number of goats, 35% in the number of sheep, 4% in the total number of cattle and 40% in total. In 2013, goat had a 17.30%, sheep had a 54.80% and cattle had a 27% share within the total number of large and small ruminants. Compared to 2009, despite a 11% decrease in 2013 in the total number of buffalo, horses, mules, donkeys and camels contained in the statistics, the share of the total of these animals in the total number of large and small

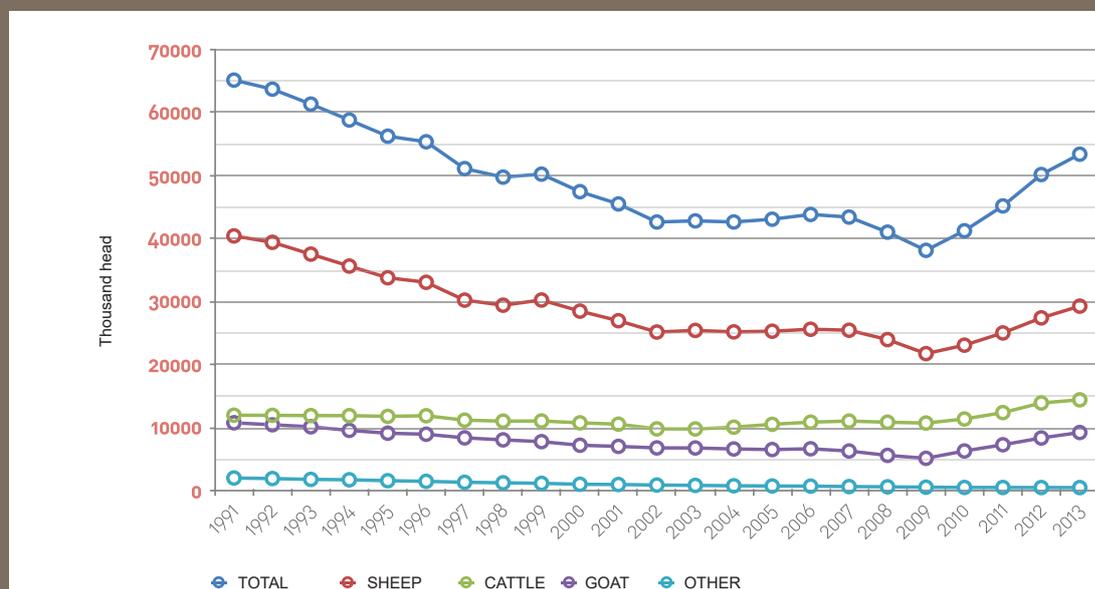


Source: TurkStat\_h, 2014

Figure 2.23 Change of the agricultural lands (1990-2013)

ruminants was only 0.90%. As of 2013, it was determined that there was 53.40 million large and small ruminants including approximately 29.30 million sheep, 14.4 million cattle, 923 thousand goats and 482 thousand other animals in Turkey (TurkStat\_i, 2014). When the size of the share of enteric fermentation within the agriculture sector-induced total greenhouse gas emissions are taken into account, it is clear that reaching a total number of 53.40 million animals in 2013 which was 38.10 million animals in 2009 will lead to significant effects in the agriculture sector-induced greenhouse gas emissions. On the other hand, due to the irregular storage of these animal's waste and manures, the greenhouse gas emissions from the manure management should be expected to increase (Cayir, Atilgan and Oz, 2012).

While the total number of poultry in Turkey has increased and decreased significantly over the years, the general orientation is towards the decline. When the number of poultry identified from 1990 until 2013 is reviewed, it observed that the maximum value is in 2006 with about 350 million poultry. However, a sudden break in the number of poultry occurred due to the avian flu outbreaks that was seen for the first time in the country in 2005 and that took place in the public in 2007 and 2008 (KGM, 2014) and the total number of poultry declined to 234 million in 2009. According to 2013 statistics, there was a total of 270 million poultry in Turkey, including 88.70 million laying hens, 177.40 million broilers, 2.90 million turkeys, 0.80 million geese and 0.40 million ducks (TurkStat\_i, 2014).



Source: TurkStat\_h, 2014

Figure 2.24 The number of animals by species and its change over the years (1991-2013)

## Organic Farming Practices

Data on organic farming which has started in 1984-85 in Turkey was started to be compiled as of 2002 by the Turkey Statistical Institute (TurkStat). In 2009, the interest in organic farming increased significantly and a 138% increase in the number of farmers, 201% increase in areas under organic farming, 86% increase in products derived from organic agriculture took place. In 2013, the number of products grown reached 213, the number of farmers reached 60.797, the areas under organic farming reached about 769 thousand ha and the production reached 1.60 Mton (TurkStat\_o, 2014).

## 2.12. Forestry

### Biodiversity and Protected Areas

Turkey's geo-morphological structure and geographical location have caused it to be effected by the natural climate changes caused by the ice ages. Therefore, Turkey is quite rich in biodiversity and about 2% of the species defined in the entire world show dispersion in Turkey (Table 2.11). Eight thousands of the species defined in Turkey (4 thousand plant and 4 thousand animal species) are endemic. In addition, up to 50 animal and up to 1,284 plant species are endangered. Eight animal species and 11 plant species are estimated to

be extinct in Turkey. Besides the diversity of species, in Turkey where genetic and ecosystem diversity is quite high, 7.90 million ha of areas are reserved as protected areas including the wetlands (GDNCNP, 2014). The protected areas in the terrestrial area is up to 6.30 million ha which is equivalent to 8.10% of the country's surface area (GDNCNP, 2014).

### Structure of the Forests

Turkey has very different climate characteristics due to its geomorphological features (mountains extending in parallel to the coasts, high mountainous areas, etc.) and this situation has affected the species composition and distribution of the forests. The mountain ranges that run parallel to the Black Sea and the Mediterranean Sea prevent the sea effect from reaching the inland and cause the climate to become terrestrial. Therefore, Turkey forests generally shows distribution in regions with more humid climates due to the influence of the sea or elevation. There are not a lot of forests in the Central Anatolia and Eastern Anatolia regions where the climate becomes drier and terrestrial as well as the Southeast Anatolia where the elevation is very high (Figure 2.25). In Turkey, forests are managed according to the sustainable forest management principles and the country is one of the few countries in the world that have increased their forest areas. The forest area which was 20.20 million ha in 1973 when first

Species	World		Turkey		Ratio (%)	
	Number of Described Species	Number of Threatened Species	Number of Described Species	Number of Threatened Species	Number of Described Species	Number of Threatened Species
Mammals	5,513	1,199	161	23	2.92	1.92
Birds	10,425	1,373	460	17	4.41	1.24
Reptiles	9,952	902	141 <sup>1</sup>	10	1.42	1.11
Amphibians	7,286	1,961			0.00	0.00
Fishes	32,800	2,172	716		2.18	0.00
Invertebrates (such as Butterflies, insects, Molluscs)	1,305,250	4,075	20,636		1.58	0.00
Mosses	16,236	76	910	2	5.60	2.63
Ferns	12,000	194	101	1	0.84	0.52
Gymnosperms	1,052	400	35	1	3.33	0.25
Flowering Plants	268,000	9,806	10,865	1,280	4.05	13.05
Algae	10,386	9	2,150	Unknown	20.70	
Other Species (Lichens, Brown Algae, Mushrooms)	51,623	9	1,000 <sup>2</sup>	Unknown	1.94	
<b>TOTAL</b>	<b>1,730,523</b>	<b>22,176</b>	<b>37,175</b>	<b>1,334</b>	<b>2.15</b>	<b>6.02</b>

Source: Compiled from GDNCNP, 2008 and IUCN, 2014

**Table 2.11** Numbers of described and threatened species by major groups of organisms in the World and Turkey

<sup>1</sup> Together with amphibians

<sup>2</sup> Only lichens

forest inventory was carried out increased to 21.9 million ha as of 2013 (GDF\_a, 2014) (Table 2.12 and Figure 2.25). Turkey's 21.90 million ha of forest area covers the forest roads, fire lines but does not include openings in the forest. In the National Greenhouse Gas Inventory Report and the National Communications on Climate Change prepared by Turkey, reporting is made according to national forest definition.

In the last 40-year period, not only the forest area also the growing stock and annual increment in the forests have also

increased steadily. The growing stock which was 0.94 billion m<sup>3</sup> in 1973 increased to 1.53 billion m<sup>3</sup> in 2013 and the 28.10 million m<sup>3</sup>/year annual increment increased to 43.10 million m<sup>3</sup>/year (Table 2.13 and Table 2.14; Figure 2.26 and Figure 2.27). 95% of this growing stock and annual increment occurs in productive forests. The coppice forest areas which were 9.30 million ha in 1973 declined to 3.80 million ha in 2013 as a result of the work of conversion the coppice forests to high forests. In the same period, high forest areas increased by 7.10 million ha (Figure 2.28).

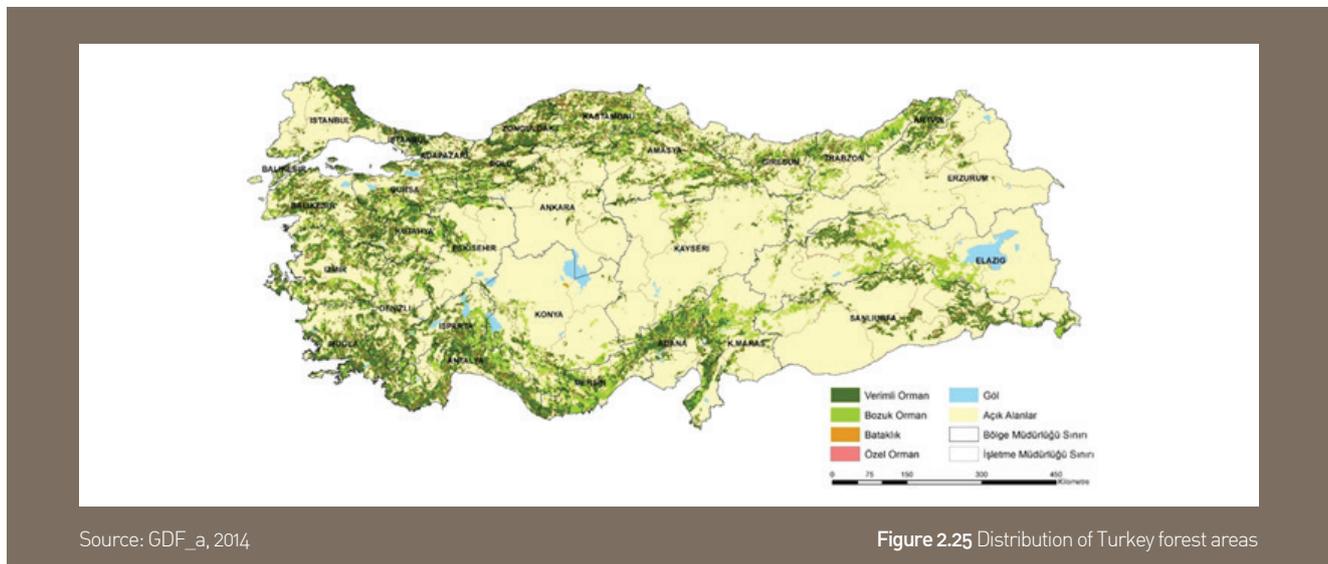
Tree Species Group	High Forest			Coppice Forest			General Total		
	Productive <sup>1</sup>	Degrade <sup>2</sup>	Total	Productive	Degrade	Total	Productive	Degrade	Total
Coniferous	7,859	5,599	13,458	0	0	0	7,859	5,599	13,458
Deciduous	3,054	1,554	4,608	1,078	2,743	3,821	4,132	4,297	8,429
<b>Total</b>	<b>10,913</b>	<b>7,153</b>	<b>18,066</b>	<b>1,078</b>	<b>2,743</b>	<b>3,821</b>	<b>11,991</b>	<b>9,896</b>	<b>21,887</b>

Source: GDF\_a, 2014

**Table 2.12** Turkey forest areas as of 2013 (1,000 hectares)

<sup>1</sup> Forest cover more than 10%

<sup>2</sup> Forest cover less than 10%



**Figure 2.25** Distribution of Turkey forest areas

Tree Species Group	High Forest			Coppice Forest			General Total		
	Productive <sup>1</sup>	Degrade <sup>2</sup>	Total	Productive	Degrade	Total	Productive	Degrade	Total
Coniferous	977,694	46,065	1,023,759	0	0	0	977,694	46,065	1,023,759
Deciduous	434,992	12,851	447,843	44,684	15,679	60,363	479,675	28,530	508,206
<b>Total</b>	<b>1,412,685</b>	<b>58,917</b>	<b>1,471,602</b>	<b>44,684</b>	<b>15,679</b>	<b>60,363</b>	<b>1,457,369</b>	<b>74,595</b>	<b>1,531,965</b>

Source: GDF\_a, 2014

**Table 2.13** Growing stock in Turkey forests as of year 2013 (1,000 m<sup>3</sup>)

<sup>1</sup> Forest cover more than 10%

<sup>2</sup> Forest cover less than 10%

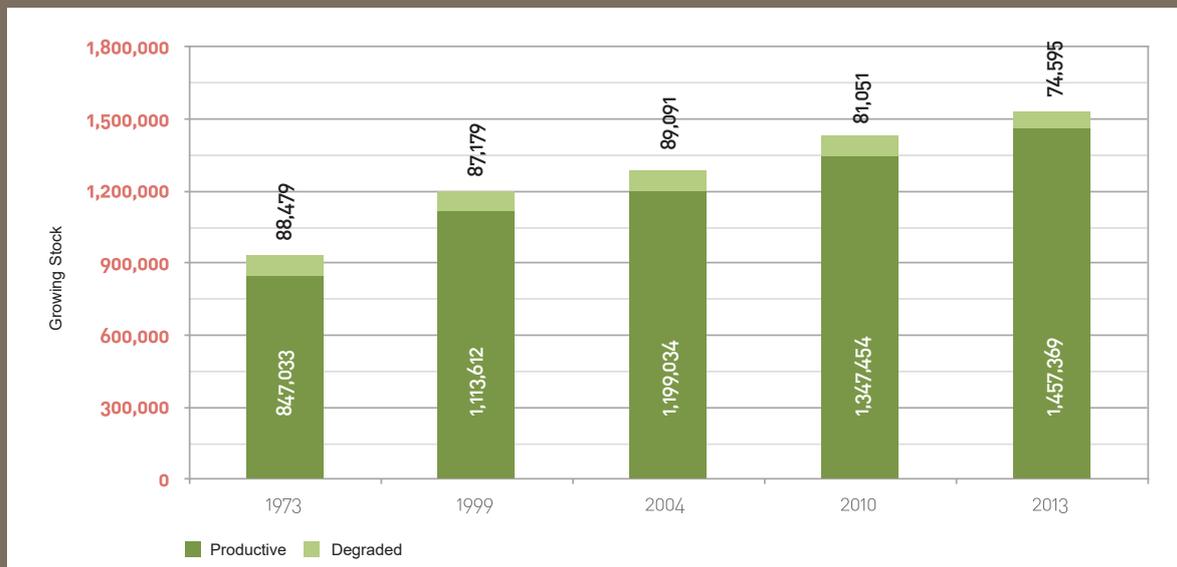
Tree Species Group	High Forest			Coppice Forest			General Total		
	Productive <sup>1</sup>	Degrade <sup>2</sup>	Total	Productive	Degrade	Total	Productive	Degrade	Total
Coniferous	27,312	1,097	28,409	0	0	0	27,312	1,097	28,409
Deciduous	11,629	292	11,922	2,094	673	2,767	13,724	965	14,689
<b>Total</b>	<b>38,941</b>	<b>1,389</b>	<b>40,330</b>	<b>2,094</b>	<b>673</b>	<b>2,767</b>	<b>41,035</b>	<b>2,062</b>	<b>43,097</b>

Source: GDF\_a, 2014

**Table 2.14** Annual increment in Turkey forests as of year 2013 (1.000 m<sup>3</sup>/year)

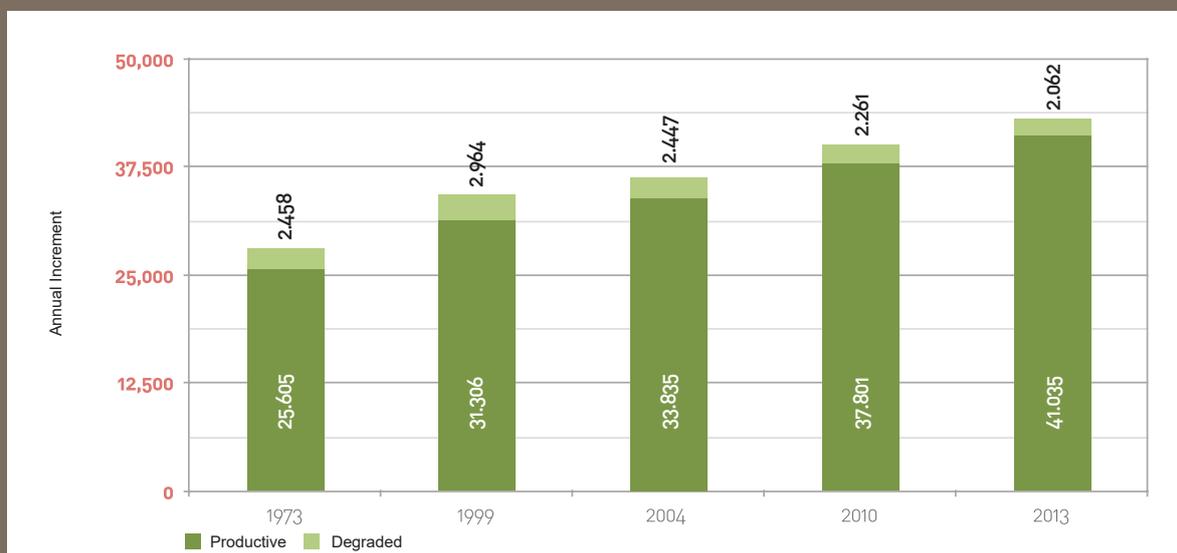
<sup>1</sup> Forest cover more than 10%

<sup>2</sup> Forest cover less than 10%



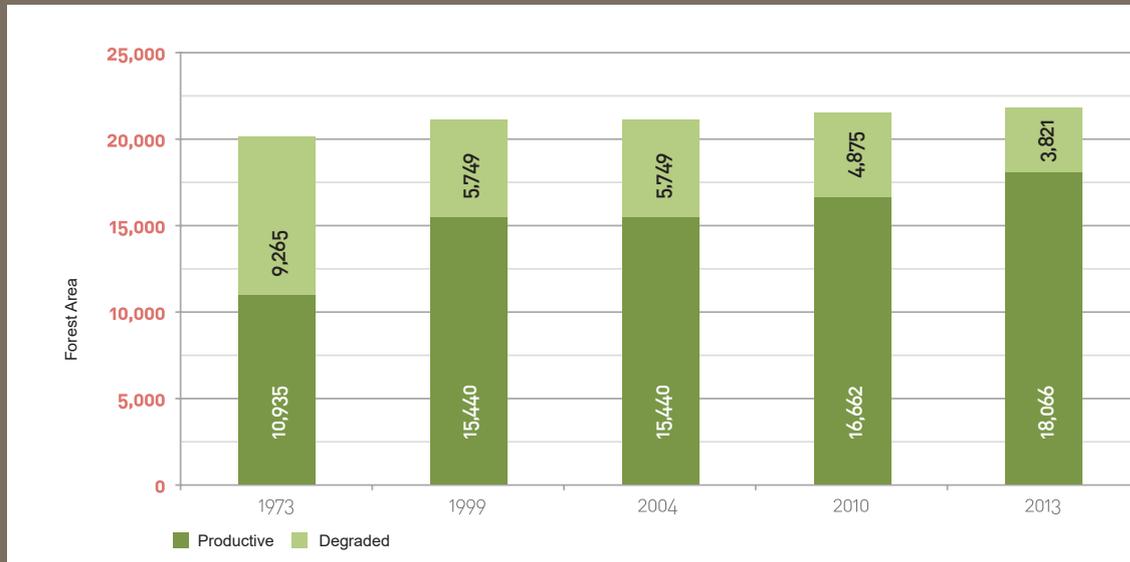
Source: GDF\_a, 2012; GDF\_a 2014

**Figure 2.26** Change of growing stock in Turkey forests between years 1973-2013 (1,000 m<sup>3</sup>)



Source: GDF\_a, 2012; GDF\_a 2014

**Figure 2.27** Change of annual increment in Turkey forests between years 1973-2013 (1,000 m<sup>3</sup>/year)



Source: OGM\_a, 2012; OGM\_a 2014

Figure 2.28 Change of high and coppice forest areas between the years 1973-2013 (1,000 ha)

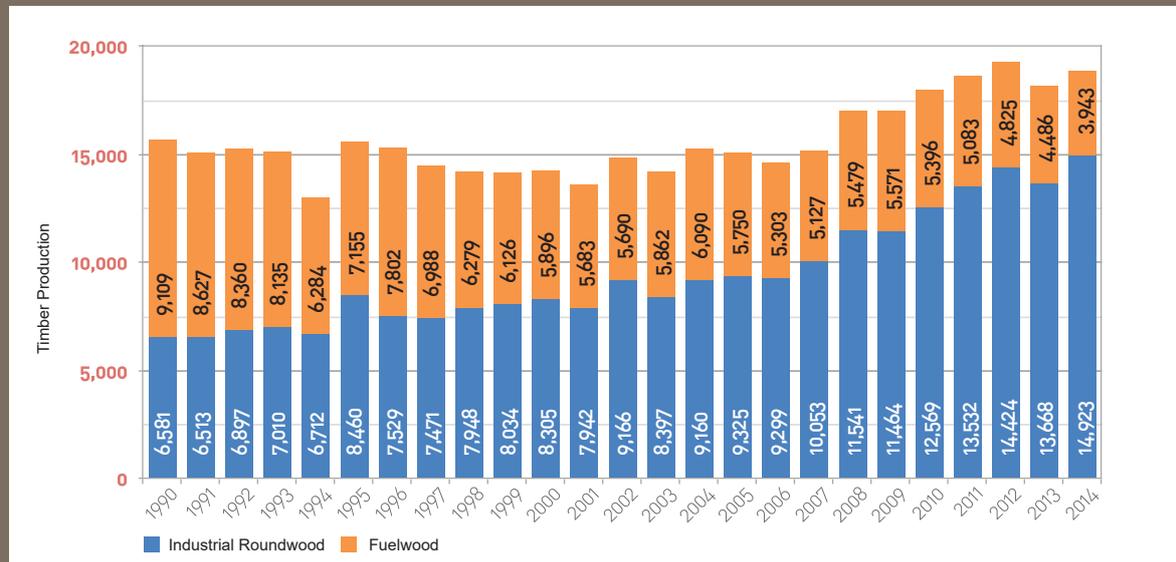
150 tree species show dispersion in Turkey forests (GDF, 2006). Turkish red pine (*Pinus brutia*) has the widest distribution with 5.80 million ha of land. Oak with 24 taxa in Turkey also shows distribution in 5.4 million ha.

In line with the principles of sustainable forest management in Turkey, forest certification works have been started in 2010. As of the 2014, forest areas with the forest management certificate have reached 2.40 million ha (FSC, 2014). From the certified forest area, approximately 3.50 million m<sup>3</sup> of wood production is made and this value corresponds to 18.50% of the amount of wood production.

The amount of wood production made in Turkey between 1990 and 2007 from the state forests was around 15 million m<sup>3</sup>/year and started to increase since 2008, and reached 19.25 million m<sup>3</sup>/year in 2012. In 2013 and 2014, the production volumes declined and in 2014 it was 18.87 million m<sup>3</sup>/year (GDF\_a, 2015) (Figure 2.29). The amount of timber production from forest corresponds to approximately 42% of the annual increment. 78% of the total timber production is industrial roundwood, while the remainder is fuelwood (Figure 2.29). Except the state forests, it is estimated that 3.30 million m<sup>3</sup>/year industrial roundwood and 1.50 million m<sup>3</sup>/year fuelwood are produced from lands that are privately owned and mostly poplar (GDF, 2013). Except this timber production carried out by the state and private sector, illegal cutting is also made from the forests. The illegal cutting

which was around 7.70 million m<sup>3</sup>/year in 1990s are estimated to have decreased to 3.50 million m<sup>3</sup>/year in the 2010s (SPO, 2001; GDF, 2013). Around 5.20 million m<sup>3</sup>/year wood is imported from abroad the majority of which is industrial roundwood (GDF\_b, 2015).

Great emphasis is given on afforestation efforts to increase the forest areas in Turkey. Between the years 1946-2014, a total of 2.29 million ha of afforestation were made by the General Directorate of Forestry (GDF). In the last 20 years (1994-2014), an area close to the 683 thousand ha were afforested (GDF\_a, 2015). In addition to the afforestation conducted by the GDF, private individuals and organizations have been given the opportunity to make afforestation in areas without forest or with a degraded forests with the various incentives provided. Afforestation carried out by private individuals and organizations in the years 1992-2014 amounted to 130 thousand ha (GDF\_b, 2015). Also, since about half of Turkey's forests' canopy cover is less than 10% and since they are degraded forests, rehabilitation of these areas has been accelerated in recent years. With these works that have begun in 1998, around 2.70 million ha of degraded forest lands were rehabilitated by the end of 2014 (GDF\_a, 2015).



Source: Data collected from General Directorate of Forestry, Forest Production and Marketing Department  
**Figure 2.29** Quantities of industrial roundwood and fuelwood produced from Turkey forests between 1990 and 2014 (1,000 m<sup>3</sup>/year)

In Turkey, forest fires are one of the most important factors threatening the forests. 60% of Turkey's forests, mainly the forest in the Aegean and Mediterranean regions are located in regions with fire sensitivity. A total of 52,970 thousand forest fires occurred between 1990 and 2014 (DGF\_a, 2015). In the same period, a total of 264,171 hectares of forest were damaged by fire. In 2008 with a record low precipitation, Turkey's largest forest fire occurred. Intense fighting is carried out by GDF for the prevention of forest fires and in the 1990-2014 period, annual average of burnt forest areas was 10.60 thousand ha and the amount of area burned per fire was 5.00 ha. As of the year 2014, forests have been monitored with 766 fire watchtowers. For firefighting activities, 24 helicopters and 7 aircrafts of which 6 were amphibious were leased. In addition, ponds where the helicopters can take water were made in the forests and the number of such ponds reached 2.862 by 2014. At the GDF car park, with regard to fire, 977 fire fighting, 534 first responder and 282 water supply vehicles are available. Except these, a large number of staff is assigned to the fire extinguishing works. In 2014, 259.20 million TL was spent to fight against the forest fires (GDF\_b, 2015).

Except forest fires, pests such as insects and fungi also cause damage in the forests. With the Monitoring of Forest Ecosystems Program established within the context of ICP Forests Program in Turkey, works have been carried out on

a 16x16 km systematic network since 2008. During this monitoring, the pests on the trees that are being monitored have been identified. The most common pests are pine processionary (*Thaumetopoea pityocampa* and *Thaumetopoea wilkinsoni*) on *Pinus brutia* and gypsy moth (*Lymantria dispar*) and green oak tortrix (*Tortrix viridana*) on oak species, common pine shoot beetle (*Tomicus piniperda*) and six-toothed bark beetle (*Ips sexdentatus*) from the bark beetles that show secondary hazardous character on coniferous species (Tolunay et al., 2013). The most common pests found after the insects is the mistletoe (*Viscum album*) which is a semi-parasitic plant. *Lophodermium pini*, observed in pine species and causing burns in needles, is the most common type among the fungal factors. Again *Armillaria mellea* causing root rotting in oak and *Cryphonectria parasitica* causing chestnut cancer have been observed (Tolunay et al., 2013). Against up to 50 harmful species found in Turkey forests, in 2014, a fight was carried out in 250 thousand ha of area and 3.61 million TL allowance was used (GDF\_b, 2015).

### Impact of Forestry to the Greenhouse Gas Emissions

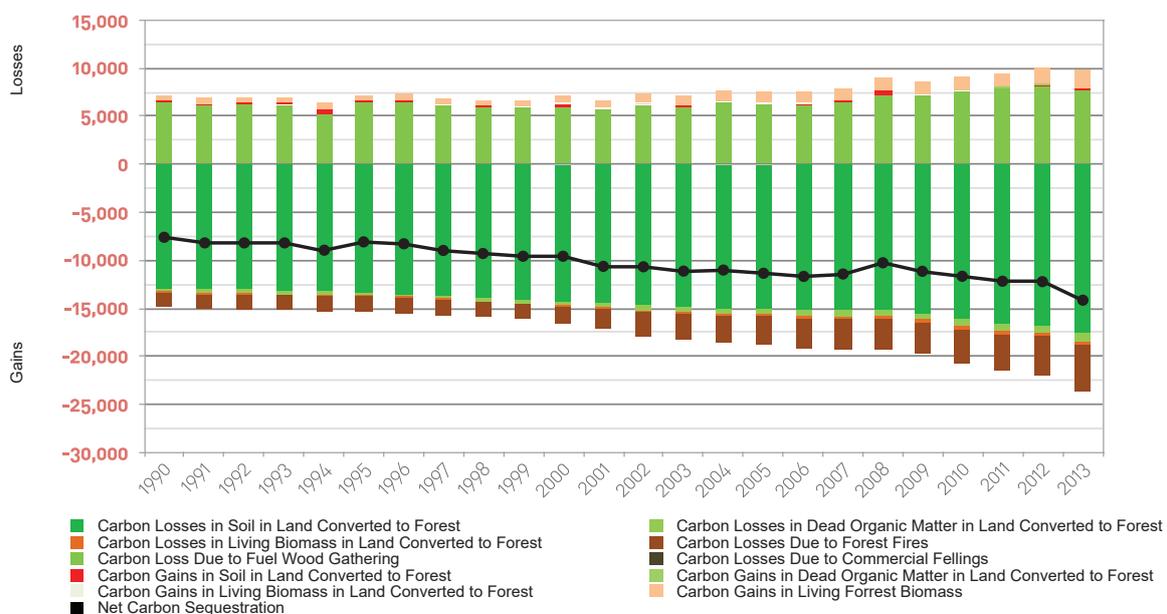
In Turkey, the national greenhouse gas inventory has been prepared every year since 2006 and sent to the UNFCCC secretariat. The carbon accumulation in forests in this inventory is estimated according to the Agriculture, Forestry and Other Land Use (AFOLU) Guide prepared by the Intergovernmental Panel on Climate Change (IPCC), since the calculations made

for 2013 (IPCC, 2006). In the AFOLU guide, it is determined that the change in carbon stocks of forest can be estimated using different approaches such as stock difference method, gain-loss method and modeling.

The contribution of the forest sector in Turkey to greenhouse gas emissions and removals from the atmosphere is estimated according to the gain-loss method using Biomass Conversion and Expansion Factors (BCEFs) developed specifically for Turkey (Tolunay, 2013). These factors were also updated in 2013 and included in the "Communique on the Preparation of Ecosystem Based Functional Forest Management Plans" prepared by GDF. Calculations in the forest areas of remaining forest are not made for all carbon pools specified in AFOLU Guide but only for living tree biomass. In other words, the amount of carbon accumulated in the understory, forest soils, litter and dead organic matter cannot be estimated due to lack of data. In addition, carbon stocks and annual accumulation in the maquis and heathland ar-

reas that cover large areas in Turkey cannot also be estimated since these areas are not considered forests according to the Forest Act. However, annual carbon losses and gains in biomass, litter and soils in areas converted to forest from other areas of use are estimated.

According to the last National Inventory Report covering the years 1990-2013, in Turkey forests, annual net carbon accumulation which was 7.65 Mton in 1990 (28.01 Mton of CO<sub>2</sub>-eq) increased to 13.94 Mton in 2013 (51.10 Mton CO<sub>2</sub>-eq) (TurkStat, 2015). 4.20 Mton of the accumulation in 2013 occurred in the trees, soils and litter in areas converted from other land uses (Figure 2.30). As of 2013, 58.70 Mton of CO<sub>2</sub>-eq greenhouse gases in the LULUCF sector were removed from the atmosphere. 87% of this value was provided by forests. The net amount of carbon removal in forests annually corresponds to 11.10% of all greenhouse gas emissions of Turkey.



Source: TurkStat, 2015

Figure 2.30 Carbon gains and losses of Turkey forests between 1990 and 2013 (1,000 ton C/year)

In the Turkey's National Inventory Report, there is no information about the carbon stocks in forests. However, with the BCEFs used in the inventory, living tree biomass carbon stock is estimated. Accordingly, in productive coniferous forests, there is 47.70 tons/ha carbon stocks in living tree biomass including the belowground biomass, 66.70 tons/ha in productive deciduous forests and 20.40 tons/ha in productive coppice forests. About 78% of this carbon stock is stored in the aboveground biomass. The biomass carbon stock in the degraded forests is quite low and around a total of 3.30 tons/ha.

In Turkey, there is no research on the carbon stocks, annual accumulation or emissions in soil and litter across the country. However, the studies by Tolunay and Comez (2008) nearly complete of which were carried out in productive forests were compiled and the carbon stocks per unit area within the forest land were tried to be estimated. As a result, it is estimated that in Turkey forests, there are a total of 83.80 tons/ha organic carbon stored including 78.00 tons/ha in the soils and 5.80 tons/ha in the litter (Tolunay & Comez, 2008). Among the other carbon pools in forests, studies on the carbon stocks stored in the understory and coarse woody debris are quite limited.

The amount of land converted to forest from other lands in the years 1994-2013 in Turkey is 1.26 million ha in total. The

amount of land converted from forest to other land uses is not given in the national greenhouse gas inventory. The reason of this situation is that according to the provisions of the Constitution and the Forest Act, despite the allocation to other uses, it is considered as forest. Therefore, in the national inventory of greenhouse gases, CO<sub>2</sub> and other greenhouse gas emissions from deforestation are not estimated. Instead, CH<sub>4</sub>, N<sub>2</sub>O, NO<sub>x</sub> and CO amounts occurred with forest fires are estimated for the period from 1990 to 2013. The amount of emissions of the gases listed above changes with the change in the number of the forest fires over the years and the burned areas. According to the National Inventory Report, the CH<sub>4</sub> emissions from forest fires in the years 1990 to 2013 ranges from 0.20 to 2.30 t/year, N<sub>2</sub>O emissions ranges from 0.01-0.13 t/year, NO<sub>x</sub> emissions ranges from 0.10-1.50 t/year and CO emission ranges from 4.40-52.60 t/year (TurkStat, 2015).

In the national greenhouse gas inventory report, non-methane volatile organic compounds (NMVOC) emissions are given. However, the inventory values do not contain the biogenic volatile organic compounds (BVOC) originating from plants. Turkey-specific emission factors were developed by Elbir et al. (2013) and the BVOC emissions resulting from the forests according to the year 2012 forest inventory results were estimated. According to this research, in Turkey, a total of 716.30 thousand t/year BVOC emission, 585.60 thousand t/year of which is monoterpenes emissions takes place (Table 2.15).

Geographical Regions	Isoprene	Monoterpenes	With-Oxygen Compounds	Sesquiterpenes	Oxygenated Sesquiterpenes	Total
Mediterranean Region	8,442	259,111	37,315	4,644	180	309,692
Aegean Region	3,015	162,012	23,183	2,728	121	191,059
Black Sea Region	6,050	73,383	14,488	1,507	79	95,507
Marmara Region	5,398	74,268	10,930	1,272	94	91,962
Central Anatolia Region	1,291	12,513	2,468	222	10	16,504
East Anatolia Region	2,219	2,445	1,052	57	15	5,788
Southeast Anatolia Region	3,455	1,873	367	54	21	5,769
Total	29,870	585,605	89,802	10,483	521	716,281

Source: Elbir et al., 2013

**Table 2.15** Regional distribution of BVOC emissions from forests for 2012 in Turkey (tons/year)

## 2.13. Tourism

According to World Tourism Organization data, Turkey has become one of the world's most important tourism centers by maintaining its 6th position in rankings of countries that attract tourists most in 2014 (UNWTO, 2014). The number of foreign visitors that came to our country in 2014 showed an increase of 5.20% compared to the previous year and reached 36,837,900 people (MCT, 2015). Distribution of the number of foreign visitors that came to Turkey over the years is shown in Figure 2.31.

Due to the increase in the number of foreign visitors that came to Turkey, it is seen that there is a significant increase trend in the tourism revenue in the recent years. In Figure 2.32, data on Turkey's tourism revenue and the place of this income within GNP are included. In 2002, the tourism revenue which was about 12.4 billion USD increased to about 34.3 billion US dollars in 2014. Tourism revenues for 2013 constitute 4.20% of the GNP (MCT, 2015; TURSAB, 2014).

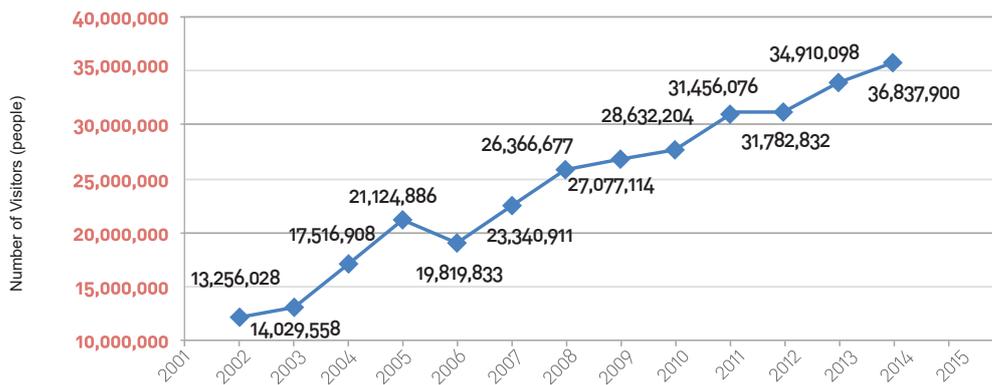


Figure 2.31 Number of foreign visitors that came to Turkey (2002-2014)

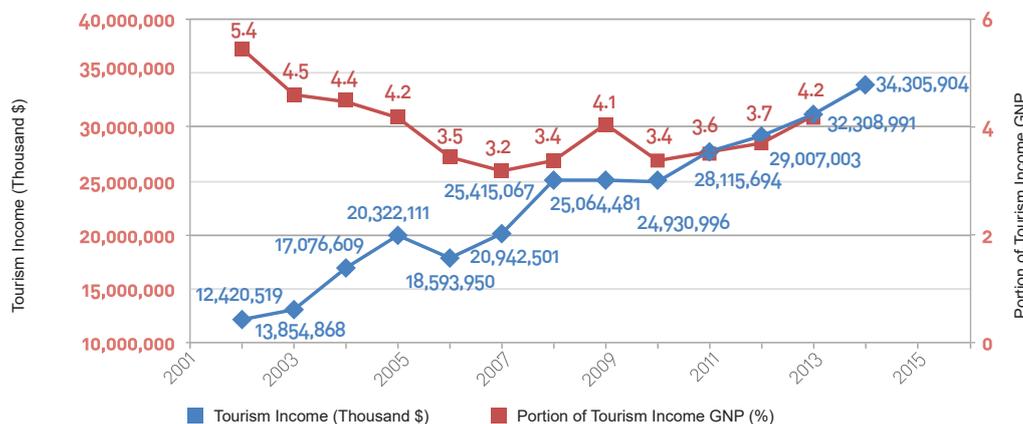


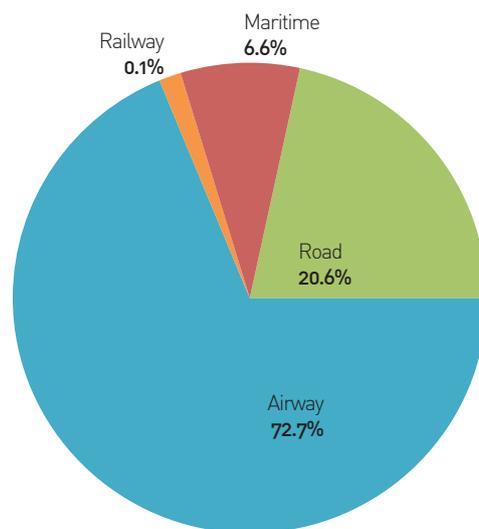
Figure 2.32 Turkey's tourism revenue (2002-2014)

Tourism sector interacts with 54 different sectors with the purchase of a total of 26 billion US dollars made within a year. For example, fishing industry makes 51% of its sales, food industry makes 20% of its sales and furniture industry makes 14% of its sales to the tourism sector (AKTOB, 2014).

According to data for 2013, the number of facilities with business certificate certified by the Ministry of Culture and Tourism is 2,982 and the total number of beds in these facilities is 749,299. Approximately 1,298,000 people are employed in the tourism sector and 56% of these work in the food and beverage services, 30% in the hospitality industry, 5.70% in the travel agencies, 7% in the entertainment and recreation services and 1.20% in the air transportation (AKTOB, 2014).

With 72.70% share, airline transportation comes first in the modes of transport with which the foreign visitors come to our country. In 2013, the number of scheduled flights that takeoff and land from/to airports of our country was 128,607. Antalya airport hosts 67% of the total scheduled flights with a number of 86,195 aircrafts that land and takeoff. Other modes used by the foreign visitors when entering in our country are road (20.60%), sea (6.60%) and rail only with a rate of 0.10% (Figure 2.33).

In the recent years, several studies are carried out in order to make tourism activities in Turkey sustainable. Some eco-labels are used to indicate that the tourism is sustainable. The most important of these are the Blue Flag and Green Star applications. Beaches, marinas and yachts are granted with a blue flag as an indicator to the fulfillment of certain criteria in practices such as water quality and environmental management by the International Foundation for Environmental Education. In Turkey, as of the year 2015 the number of beaches with blue flag is 436 and the number of marinas with blue flag is 22 and the number of yachts with blue flag is 14. Turkey ranks the 2nd with 578 blue flag beaches in the world after Spain (Blue Flag 2015). As an indication of that the accommodation facilities carry out sustainable tourism activities as well, these facilities are granted with a Green Star certification by the Ministry of Culture and Tourism. Green Star covers issues such as energy efficiency, use of alternative energy sources, water conservation, management of waste and hazardous chemicals, environmental compliance of the facility and environmental education. As of 30.06.2015, 233 facilities with the Ministry of Culture and Tourism business certificate have a Green Star Certificate (MCT, 2015).



Source: MCT, 2015

Figure 2.33 The arrival paths of foreign visitors (2014)

## 2.14. Water resources

Approximately 40% of the total precipitation in Turkey is seen in the winter, 27% in the spring, 10% in the summer and 24% in the autumn. Turkey's average precipitation which was measured as 564 mm in 2013 showed a 13% reduction compared to 1981-2010 normals. The regional areal average precipitation in 2014, precipitation averages and percentages of increase or decrease compared to normal are provided in Table 2.16. The highest precipitation in 2014 compared to the normals was seen in Marmara Region with a 28% increase. Our region which gets the least precipitation compared to normals is the Eastern Anatolia region with a 12% reduction (SMS\_a, 2015).

Region	Precipitation (mm)	Normal (mm)	Increase/decrease ratio according to the normal
Turkey in General	591.8	574.0	3.10
Marmara	841.4	658.2	27.80
Aegean	682.8	594.5	14.80
Mediterranean	653.2	667.1	-2.10
Central Anatolia	461.8	404.7	14.10
Black Sea	694.6	697.2	-0.40
East Anatolia	489.0	554.4	-11.80
Southeastern Anatolia	491.0	529.4	-7.30

Source: GDM\_a, 2015

**Table 2.16** Turkey's areal precipitation change in 2014 compared to regions and normals

According to the studies of General Directorate of the State Hydraulic Works (SHW), Turkey is divided into 25 hydrological basins. Firat- Dicle Basin has the largest precipitation area with 184,918 km<sup>2</sup>. Burdur Lake Basin has the smallest area with 6,374 km<sup>2</sup>.

The total average annual flow rate of basins is 186 billion m<sup>3</sup>. Approximately one-third of the average annual flow belongs to the Firat-Dicle Basin which is located in the east of the country. In Turkey, there are more than 120 natural lakes and 706 dam lakes. The largest and deepest natural lake is the Lake Van with 1,646 m elevation and 3,713 km<sup>2</sup> area.

Salt, Beysehir, Egirdir, Aksehir, Iznik, Burdur, Kus (Manyas), Ulubat, Eber and Cildir lakes constitute the natural lakes with more than 100 km<sup>2</sup> area. The dam lake with the largest surface area is the Ataturk Dam Lake with 817 km<sup>2</sup>. Many of the rivers in Turkey takes its resources from our land and disem-bogue into the seas surrounding our country. Kizilirmak, Yesilirmak, Istanbul, Filyos and Coruh disem-bogue to the Black Sea; Seyhan, Ceyhan, Asi, Tarsus and Dalaman disem-bogue to the Mediterranean Sea; Buyuk Menderes, Gediz and Meric disem-bogue to the Aegean Sea; Susurluk/Simav, Biga and Gönen river disem-bogue to the Marmara Sea. Firat and Dicle rivers disem-bogue to the Persian Gulf and Aras and Kura rivers disem-bogue into the Caspian Sea. Kizilirmak is the longest river with 1,355 km (SHW, 2014, TurkStat\_b, 2013).

### Water Potential and Water Quality

Turkey's consumable surface and ground water potential is 112 billion m<sup>3</sup> per year. Utilization rate of the current 112 billion m<sup>3</sup> of available water resources is still around 36%. The amount of water available per capita per year in Turkey is about 1,519 m<sup>3</sup>. 32 billion m<sup>3</sup> of the available water is used for irrigation, 7 billion m<sup>3</sup> is used for drinking and 5 billion m<sup>3</sup> is used in the industry. In this case about 74% of Turkey's water resources is used for irrigation, 11% is used for industry, 15% is used for urban consumption. These ratios are respectively 70%, 22%, 8% in the world and 33%, 51% and 16% in Europe (MFWA\_a, 2014).

Water quality is divided into four classes in the Surface Water Quality Regulation entered into force upon being published on the Official Gazette dated 30/11/2012 and numbered 28483. I. class water is high-quality water and can be used as drinking and tap water. II. class water is less polluted water but can be used as a drinking and tap water after purification process. III. class water is contaminated water and can be used after purification as is required by the intended use. IV. class water is heavily polluted water. In Figure 2.34, the distribution of quality class of the Turkey's water resources are given. When the maps are examined, it is seen that the water quality in the western region decreases.

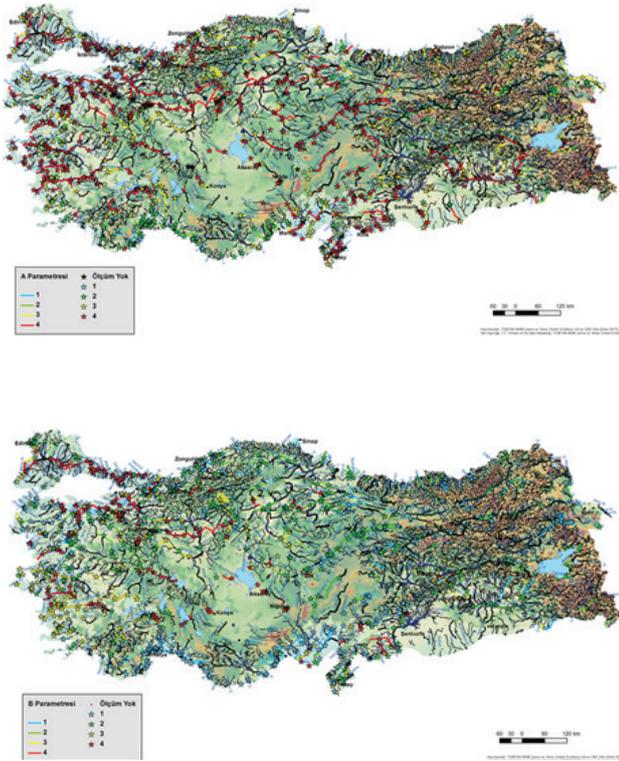


Figure 2.34 Quality classes of Turkey's water resources

In the figures, A represents the oxygenation parameters, B represents the nutrient parameters.

### Turkey's Hydropower Potential

Gross theoretical hydropower potential in Turkey is 433 billion kWh, the technically considerable hydroelectric potential is 216 billion kWh and the economic potential is 150 billion kWh/year and it is estimated that with the new projects it will increase further in the coming years and reach approximately 170 billion kWh/year. While Europe has around 17%, Turkey has around 2.30% of the world's economically utilizable hydropower potential. The share of total energy production of the hydropower plants in Turkey is provided in Table 2.17.

The share of hydropower in total energy consumption in 2013 was 24% and in 2014 due to severe drought conditions experienced a decrease and was recorded as 16%.

Yıllar	Share of the HEPPs within the total energy generation
2003	25%
2004	32%
2005	27%
2006	25%
2007	19%
2008	17%
2009	19%
2010	25%
2011	23%
2012	24%
2013	25%
2014	16%

Table 2.17 Share of the hydroelectric power station within energy production

### 2.15. Turkey's Special Circumstances

The 1992 United Nations Framework Convention (UNFCCC) established a system of annexes that divided countries into Annex I and II countries and non-Annex countries. The Annex I countries included the industrialized countries that were members of the OECD and the former countries of the USSR as "Economies in Transition" [EIT]. Annex II included the developed and industrialized countries. Turkey, a developing country, because of its membership with the OECD was included in both Annexes I and II. The non-Annex countries were considered as developing countries. However, the UNFCCC does not provide a definition of "developed" or "developing" countries. Turkey did not sign the UNFCCC when adopted in 1992 and in 1997 initiated the process to be deleted from Annexes I and II.

In 2001, at the Sixth Conference of the Parties held in Marrakesh, Decision 26/CP.7 was adopted and Turkey was removed from the list in Annex II. Parties were also invited to

recognize the “special circumstances of Turkey, which place Turkey, after becoming a Party, in a situation different from that of other Parties included in Annex I to the Convention.” The decision took note of FCCC/CP/1997/MISC.3, submitted by Turkey outlining its socio-economic status as a developing country. It was explained that GNP of the Turkey was \$2,700 and human-induced carbon dioxide emission was 2.3 tons per capita in 1993 and total 153 million tons was 1/10 of the Annex II countries in the submitted document. The decision further underlined the need for all Parties to protect the climate system for present and future generations, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Turkey’s position regarding its “special circumstances” is based on the principles of equity, common but differentiated responsibilities and respective capabilities, and the right to and duty to promote sustainable development in accordance with article 3 of the Convention. Further, different from other Parties included in Annex I, Turkey does not bear historical responsibility for climate change.

Turkey subsequently became a Party to the UNFCCC in 2004 and submitted its First National Communication as an Annex I Party. In accordance with the Report (FCCC/IDR.1/TUR, 3 December 2009) of the in-depth review of the first national communication of Turkey noted that Turkey had the lowest per capita primary energy consumption and the lowest per capita GHG emissions, among Annex I Parties. In spite of Turkey has national circumstances which follow the typical patterns of developing countries (e.g. relatively low per capita energy use and GHG emissions, high growth rates in population and GDP, when compared with other Annex I Parties), considerable efforts have been undertaken in selected areas to contribute to GHG mitigation.”

The World Bank lists Turkey as an upper middle income developing country. According to World Bank’s data in 2013, Turkey’s gross national income was \$10,950 per capita and carbon emission was 4.2 tons per capita. Because of this condition, Turkey is also eligible for official development aid under the OECD Development Assistance Committee list. (FCCC/TP/2013/3). Moreover, according to World Bank data, Turkey’s per capita and total carbon emissions are lower than many developing countries that are outside Annex I Parties.

The Conference of the Parties has taken other decisions concerning Turkey in the coming years. 16. The decree No

1/CP.16 adopted by the Conference of the Parties has recognized officially that Turkey’s national circumstances are different from Annex-I countries and has clearly approved that Turkey is in a different position from the developed countries and countries in transition to a market economy. This decision also requested from the Long-Term Cooperative Action Ad Hoc Working Group (AWG-LCA) established under the Convention to dwell upon for Turkey to have better access to the financing, technology and capacity-building opportunities to develop its ability to apply the provisions of the Convention more effectively.

In Durban, decision no. 2/CP.17 was taken to continue to further develop the Cancun decision on Turkey

***Decision No. 2/CP.17:***

*“Have agreed to continue the discussion on the procedures for providing support in mitigation, adaptation, technology development and transfer, capacity building and financing issues to assist in the implementation of the Convention...”*

Decision No. 1/CP.18 accepted in Doha reaffirmed the importance of the financial, technological and capacity-building supports to Turkey as an Annex I Party special circumstances of which is recognized by the Conference of the Parties so that it becomes able to implement the Convention more efficiently and encouraged the Annex II countries with appropriate conditions to provide financial, technological, technical and capacity-building supports to the Annex I countries with special position through multilateral agencies. The purpose of these supports are that these countries implement the climate change strategies and action plans in accordance with the decision no. 1/CP.16 and develop low-emission development plans. The aforementioned multilateral agencies term contains the concerned international organizations, international financial organizations, other collaborations, bilateral agreements, private sector and all types of institutional arrangements that may be deemed appropriate.

***Decision No. 1/CP.18:***

*Parties included in Annex I to the Convention whose special circumstances are recognized by the Conference of the Parties.*

*Reaffirming decisions 26/CP.7, 1/CP.16 and 2/CP.17, which recognized that Turkey is in a situation different from that of other Parties included in Annex I to the Convention;*

*Recalling that deep cuts in global greenhouse gas emissions are required and that closing the ambition gap is a matter of urgency;*

*Recognizing that various actions to address climate change can be justified economically in their own right and can also help in solving other environmental problems in accordance with the objectives of sustainable development;*

*Reaffirming the importance of financial, technological and capacity-building support to Parties included in Annex I to the Convention whose special circumstances are recognized by the Conference of the Parties in order to assist these Parties in implementing the Convention,*

*1. Urges Parties included in Annex II to the Convention which are in a position to do so, through multilateral agencies, including the Global Environment Facility within its mandate, relevant intergovernmental organizations, international financial institutions, other partnerships and initiatives, bilateral agencies and the private sector, or through any further arrangements, as appropriate, to provide financial, technological, technical and capacity-building support to Parties included in Annex I to the Convention (Annex I Parties) whose special circumstances are recognized by the Conference of the Parties in order to assist them in implementing their national climate change strategies and action plans and developing their low-emission development strategies or plans in accordance with decision 1/CP.16;*

*2. Requests the secretariat to prepare, for consideration by the Subsidiary Body for Implementation at its thirty-eighth session, a technical paper identifying opportunities for Annex I Parties whose special circumstances are recognized by the Conference of the Parties to benefit, at least until 2020, from support from relevant bodies established under the Convention and other relevant bodies and institutions to enhance mitigation, adaptation, technology, capacity-building and access to finance;*

*3. Also requests the Subsidiary Body for Implementation, on the basis of the technical paper referred to in paragraph 95 above, to develop recommendations on this matter at its thirty-ninth session for consideration by the Conference of the Parties at its nineteenth session.“*

In the decision of the Conference of the Parties, UNFCCC is requested to prepare a technical report identifying the opportunities that Turkey (Annex I Parties whose special circumstances are recognized by the Conference of the Parties) can benefit, at least until 2020, from support from

relevant bodies established under the Convention and other relevant bodies and institutions to enhance mitigation, adaptation, technology, capacity-building and access to finance, to be evaluated by the Subsidiary Body for Implementation (SBI) at the next conference. The technical report with no. FCCC/TP/2013/3 prepared by the secretariat states clearly that Turkey is an upper middle class rapidly growing country and that is appropriate for the official development assistance under the OECD Development Assistance Committee. According to the technical report prepared by the Secretariat, 20th Lima Conference of the Parties adopted the decisions similar to the decisions adopted in Doha at the 20th Conference of the Parties on the basis of the recommendations offered by the Subsidiary Body for Implementation (FCCC/TP/2013/3) (21/CP.20). According to this decision, the supports that can be received by Turkey until 2020 at the earliest from the bodies established in accordance with the bodies established in accordance with the Convention are defined and it is recommended that Turkey utilize these supports in order to ensure progress in areas such as mitigation, adaptation, technology and capacity building and finance. The Annex-II countries with appropriate status and jurisdiction have been invited to help Turkey with the implementation of national climate change strategies and actions plans and development of low-emission development plans and strategies in line with the decision no. 1/CP.16 by providing financial, technological, technical and capacity-building support thorough multinational institutions including the GEF. As previously defined, “multinational organizations” term contains the concerned international organizations, international financial organizations, other collaborations, bilateral agreements, private sector and all types of institutional arrangements that may be deemed appropriate.

***Decision No. 21/CP.20:***

*Reaffirming decisions 26/CP.7, 1/CP.16, 2/CP.17 and 1/CP.18, which recognized that Turkey is in a situation different from that of other Parties included in Annex I to the Convention,*

*Also reaffirming the importance of financial, technological and capacity-building support to Parties included in Annex I to the Convention whose special circumstances are recognized by the Conference of the Parties in order to assist these Parties in implementing the Convention,*

*1. Recognizes the opportunities for Parties included in Annex I to the Convention whose special circumstances are recognized by the Conference of the Parties to benefit, at least until 2020, from support from relevant bodies estab-*

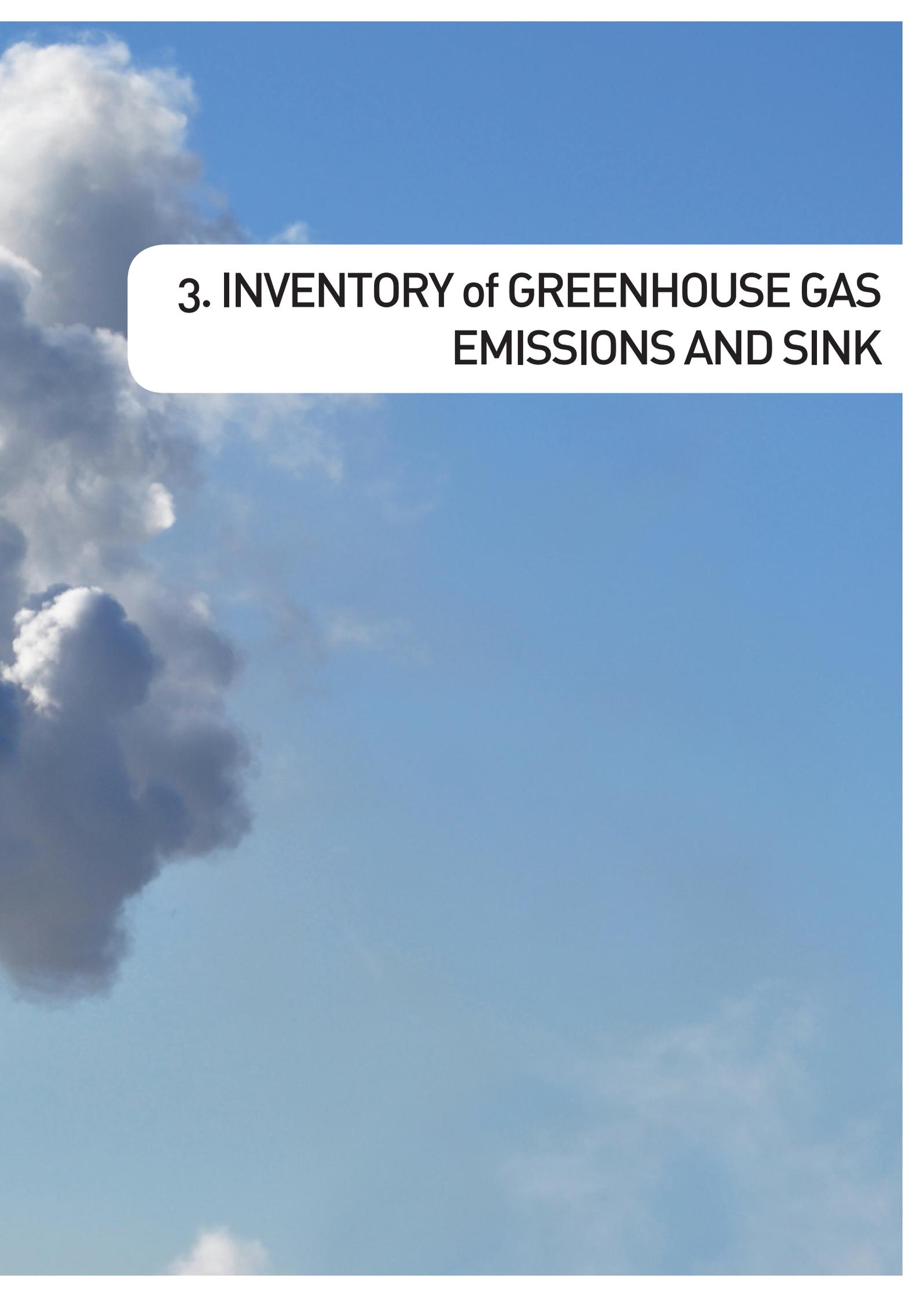
*lished under the Convention and other relevant bodies and institutions to enhance mitigation, adaptation, technology, capacity-building and access to finance;*

*2. Encourages Parties included in Annex I to the Convention whose special circumstances are recognized by the Conference of the Parties to fully utilize those opportunities;*

*3. Urges Parties included in Annex II to the Convention which are in a position to do so, through multilateral agencies, including the Global Environment Facility within its mandate, relevant intergovernmental organizations, international financial institutions, other partnerships and initiatives, bilateral agencies and the private sector, or through any further arrangements, as appropriate, to provide financial, technological, technical and capacity-building support to Parties included in Annex I to the Convention whose special circumstances are recognized by the Conference of the Parties in order to assist them in implementing their national strategies, actions and plans on climate change mitigation and adaptation, and in developing their low-emission development strategies or plans in accordance with decision 1/CP.16.*

The Conference of the Parties having recognized Turkey's special circumstances acknowledge that Turkey is an upper middle income developing country still undergoing rapid development in need of financial support to enable it to shift to a low emission and climate-resilient development pathways paradigm. Turkey's access to financial support available to other upper middle income developing Parties to the Convention fulfills the principles of equity, common but differentiated responsibilities, and the right and duty to promote sustainable development as stipulated by the decision no. 26/CP.7 dated 2001.





### **3. INVENTORY of GREENHOUSE GAS EMISSIONS AND SINK**

## 3. INVENTORY OF GREENHOUSE GAS EMISSIONS AND SINK

### 3.1. Inventory of Greenhouse Gas Emissions and Sink

Turkey's total greenhouse gas emissions in 2013 were 459.10 Mton of carbon dioxide equivalent (CO<sub>2</sub>-eq.) (excluding LULUCF). 67.8% of the total emission is caused by energy, 15.7% is caused by industrial processes and product use, 10.8% is caused by agriculture sector and 5.7% is caused by waste sector. The vast majority of the energy sector emissions is caused by the fuel combustion activities and 24.8% of this is due to the combustion of fuels in the energy industry, 15% is due to the combustion of fuels in the transportation, 13.6% is due to the combustion of fuels in the industry sector and 12.8% is due to the combustion of fuels in other sectors (commercial/institutional, residential and agriculture/forestry/fishing sub-sectors).

While GDP in Turkey increased by 139% between 2000 and 2013, 47.7% increase in the total greenhouse gas emissions indicates a positive trend in terms of that the economic development is being based on activities that will create less greenhouse gas emissions. Emissions between the years 1990-2013 show a steady increase except the years 1994, 1999, 2001, 2008 and 2013 when a negative growth rate was

observed. While the total greenhouse gas emissions per capita was 3.96 tons of CO<sub>2</sub>-eq in 1990, it increased to 6.04 tons of CO<sub>2</sub>-eq. in 2013. However, this value is below the OECD average which is 12.47 tons of CO<sub>2</sub>-eq. per capita and above the world average which is 4.88 tons of CO<sub>2</sub>-eq. per capita (IEA, 2014).

Land Use, Land Use Change and Forestry (LULUCF) sink value reached 58.70 Mton of CO<sub>2</sub>-eq. for 2013 and increased by 94.5% compared to the 1990 values. While LULUCF values vary with years, it is in a growing trend. 2013 total greenhouse gas emissions was 400.40 Mton of CO<sub>2</sub>-eq. including LULUCF.

Changes of emissions between the years 1990-2013 based on the sectors are provided in Figure 3.1. The energy sector has the highest share in the overall emissions (Figure 3.2). Since changes are seen as of years, generally an increasing emission trend is seen in all the sectors. When compared with data for 1990, the highest increase was observed in the energy sector with 136.6% in 2013 and the sector with the least increase was observed in the agriculture sector with 19.7%. The information contained in this section is taken from the Greenhouse Gas Emissions Inventory for years 1990-2013 submitted to the UNFCCC Secretariat in April 2015. 1990-2013 years. Inventory summary tables are presented in Appendix A.

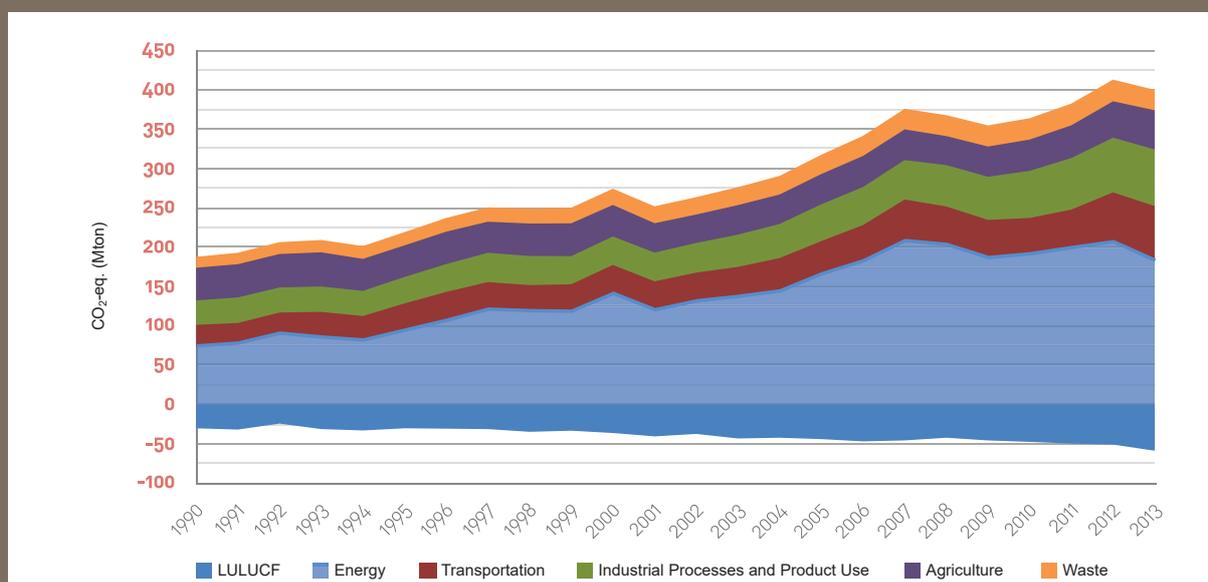


Figure 3.1 Sectoral greenhouse gas emissions, 1990-2013

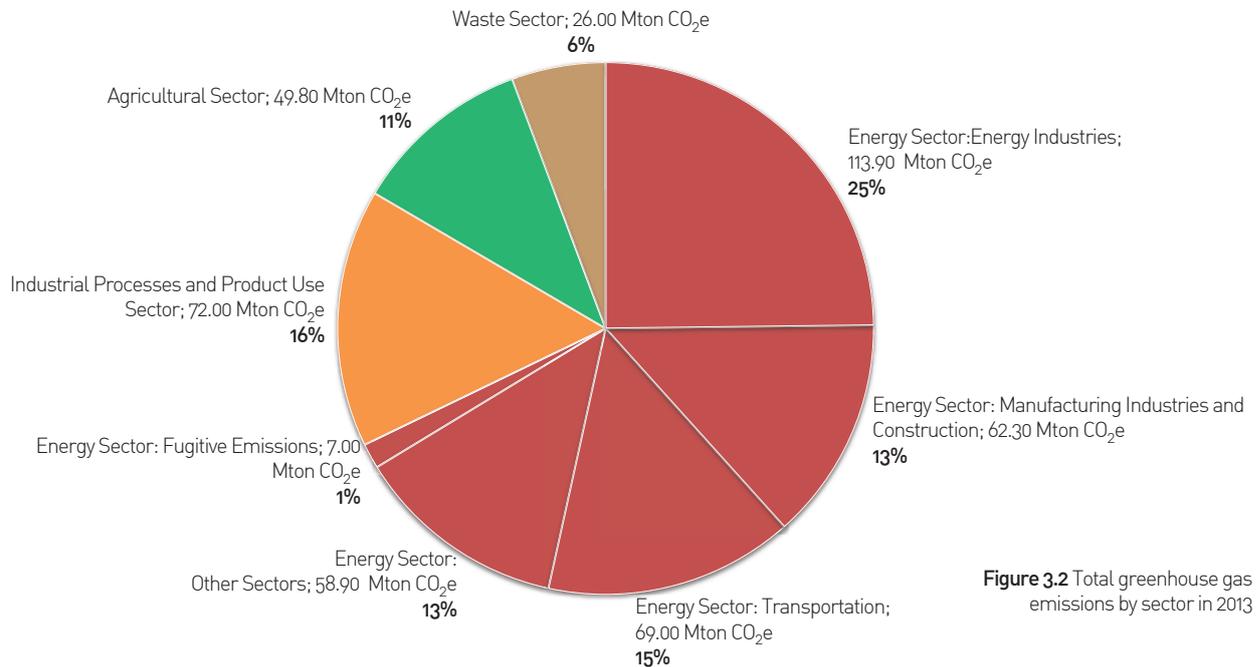


Figure 3.2 Total greenhouse gas emissions by sector in 2013

### 3.1.1 Changes in Greenhouse Gas Emissions by Type

Changes of the total emissions based on the type of greenhouse gases and time are provided in Figure 3.3. Accordingly, between 1990 and 2013, the greenhouse gas with the highest emissions was carbon dioxide (CO<sub>2</sub>) and it is followed by methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O) and F-gases. While an increase has been observed over the years, the least increase is seen in the N<sub>2</sub>O emissions. Breakdown of the 2013 greenhouse gas total emissions according to the

type of gas is as follows: CO<sub>2</sub> emissions 363.40 Mton (79.15%), CH<sub>4</sub> emissions 65.81 Mton CO<sub>2</sub>-eq. (14.33%), N<sub>2</sub>O emissions 23.23 CO<sub>2</sub>-eq. (5.06%) and F-gas emissions 6.67 Mton CO<sub>2</sub>-eq. (1.45%) (excluding LULUCF). When included removals from LULUCF sector, total emissions are 404.4 Mton CO<sub>2</sub>-eq.

In the 1990-2013 period, the share of the carbon dioxide (CO<sub>2</sub>) emissions in all the emissions increased from 70.5% to 79.15%, in the same period, the share of methane emissions decreased from 21.4% to 14.33%, the share of nitrous oxide emissions decreased from 7.78% to 5.06% and the share of F-gases reached from 0.28% to 1.45%.

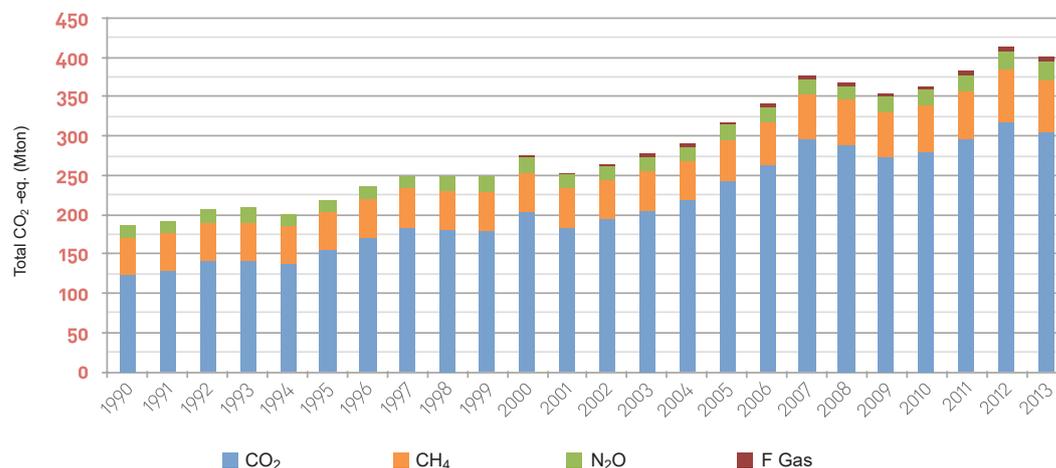


Figure 3.3 Share of total emissions by greenhouse gas types (Including LULUCF) (1990-2013)

### 3.1.2 General Factors Underlying Emission Trends

Over the last twenty-three years, Turkey's population has increased by a factor of 1.4, the GDP has increased by a factor of 3.4, and the electricity consumption per capita has increased by a factor of 1.7. The annual population growth rate of Turkey was 1.29% in 2013, well above that of the OECD countries average (0.57%). Primary energy supply per capita and greenhouse gas emissions per capita values are about half of the OECD countries and energy intensity of the economy is 30% lower than other OECD countries (Table 3.1).

Considering the change of Turkey's greenhouse gas emissions, it is seen that except the years of economic crisis, the greenhouse gas emissions have increased steadily until

2013 (Figure 3.1). While GDP increased by 139% between 2000 and 2013, only 47.7% increase in the total greenhouse gas emissions indicates that the economic growth has been based on activities that will create less greenhouse gases emissions. While the decrease in energy intensity of the economy was 37.5% in the years 2000 to 2013, the carbon intensity of the economy decreased by 39% and the carbon intensity of the energy supply decreased by 2.6% within the same years. This indicates that an important distance is covered in reducing greenhouse gas emissions from energy supply, but there are still actions that can be taken to reduce greenhouse gas emissions. On the other hand, 94.5% increase of greenhouse gas sinks between the years 1990-2013 has been a very important development.

Emissions changes and causes as sectoral and type of greenhouse gas are provided in detail in the following sections.

Type of indicator	Indicators	1990	2000	2013	1990-2013 (%)	2000-2013 (%)	OECD countries 2012*
SOCIOECONOMIC	GDP (PPP+, billion 2005 US \$)	411.1	589.6	1409.3	242.82	139.03	39,202
	Population (million people)	55.12	64.27	76.06	37.98	18.34	1,254
	GDP per capita (thousand US \$)	5.9	9.2	18.6	215.25	102.60	37,14
ENERGY	Total Primary Energy Supply (Mtoe)	52.9	80.5	120.29	127.39	49.43	5,25
	Primary Energy Supply Per Capita (Toe/person)	0.94	1.19	1.57	67.02	31.93	4.19
	Energy Intensity of the Economy (Toe/1000US\$, the year 2000 US\$-SGP)	0.13	0.14	0.09	-33.67	-37.48	0.13
CARBON	Total GHG emissions (Excluding LU-LUCF) (Mton CO <sub>2</sub> -eq.)	218.16	310.78	459.10	110.44	47.73	15,505.62
	CO <sub>2</sub> emissions from combustion of fuel (Mton CO <sub>2</sub> -eq.)	128.24	209.06	304.24	137.24	45.53	12,146
	Total Sinks (Mton CO <sub>2</sub> -eq.)	30.18	36.18	58.70	94.52	62.25	-
	Greenhouse Emissions Per Capita (ton CO <sub>2</sub> -eq. per capita)	3.96	4.83	6.04	52.52	24.83	12.36
	Greenhouse Emissions from Combustion Per Capita (ton CO <sub>2</sub> -eq. per capita)	2.33	3.25	4.00	71.94	22.98	9.68
	Carbon Intensity of the Economy (ton CO <sub>2</sub> -eq./2000 US\$)	0.31	0.36	0.22	-30.80	-39.12	0.31
	Carbon Intensity of the Energy Supply (ton CO <sub>2</sub> -eq./Toe)	2.42	2.60	2.53	4.33	-2.61	2.31

\*Purchasing Power Parity (PPP) in thousand (1000) US\$ with the prices of 2005

\*2012 figures

Source: IEA, 2014, TurkStat, 2015

**Table 3.1** Comparison of socio-economic, energy and carbon indicators of Turkey between the years of 1990-2013

## 3.2. Change in Emissions and Removals by Sector

### 3.2.1 Energy Sector

The energy sector is the sector which is Turkey's main source of greenhouse gas emissions with the emissions caused by the combustion of fuels for the power and industrial production rising based on the country's economic growth and population growth trends. According to the 2013 data, total greenhouse gas emissions resulting from the energy sector constitute 67.8% of total emissions with 311.25 Mton CO<sub>2</sub>-eq. (excluding LULUCF). Sub-sectors of the energy sector and the 2013 greenhouse gas emission values of these are provided in Table 3.2. Energy industry is the sub-sector with the largest share in this industry (24.81%). This is followed by transportation (15.04%), industrial sector (13.58%) and other sectors (12.84%).

Changes in emissions observed in the energy sector between the years 1990-2013 are provided in Figure 3.4. Compared to the year 1990, in 2013, an increase of 136.6% is observed in greenhouse gas emissions from the energy sector. In the economic crisis periods observed in 2001, 2008 and 2009, respectively 7.75%, 3.99% and 4.64% reductions were observed in greenhouse gas emissions compared to the previous year.

In Figure 3.5, the sectoral breakdown of greenhouse gases from the energy sector for the years 1990-2013 is provided. Accordingly, in 1990 while the largest shares were 1A1 Energy

Industry and 1A2 Manufacturing Industry and Construction with 26% share's, in 2013, it is seen that the largest share is 1A1 Energy Industry with 37%.

The 1A1 Energy industry where an average of 3.9 Mton CO<sub>2</sub>-eq. emission increase is observed per year is the sector with the highest increase observed with the rate of 236% in 2013 compared to 1990. One reason of this is the 25% decrease in the share of the hydroelectric power plants which do not generate carbon emissions in electricity generation in 2013 which was 40% in 1990. On the other hand, while the contribution of natural gas in electricity generation in 1990 was 18%, it reached 44% in 2013 and became the main energy source. In electricity generation, the use of coal which was 35% in 1990 decreased to 27% in 2013. As a result, the contribution of fossil fuels in electricity generation has increased continuously since 1990 and reached 72% in 2013.

The CO<sub>2</sub> emissions constitutes 96% of the energy sector emissions in 2013. The contribution of CH<sub>4</sub> emissions is 3.4% and the contributions N<sub>2</sub>O emissions is only 0.6%.

Data related with the energy consumption (fuel combustion) are taken from the Energy Balance Tables which prepared by the Ministry of Energy and Natural Resources. According to the information contained in the energy balance tables, sectoral breakdown of final energy consumption is provided in Figure 3.6. As can be seen, there is a clear parallel analogy in the total emissions estimated on the basis of years and the total electricity consumption.

The detailed explanations of each of the sub-sectors in the energy sector are presented in the following sections.

Energy sub-sectors	Greenhouse Gas Emissions (Gg CO <sub>2</sub> eq.)	Shares within the Total Energy Emissions (%)	Shares within the National Total Emissions (%)
<b>A. Fuel combustion</b>	<b>304,237.04</b>	<b>97.75</b>	<b>66.27</b>
1. Energy industries	113,903.62	36.60	24.81
2. Manufacturing industries and construction	62,332.89	20.03	13.58
3. Transport	69,040.64	22.18	15.04
4. Other sectors	58,959.89	18.94	12.84
<b>B. Fugitive emissions</b>	<b>7,009.80</b>	<b>2.25</b>	<b>1.53</b>
1. Solid fuels	4,812.72	1.55	1.05
2. Oil and natural gas	2,197.08	0.71	0.48
<b>C. CO<sub>2</sub> transport and storage</b>	<b>0.13</b>	<b>0.00</b>	<b>0.00</b>
<b>Energy Sector Total</b>	<b>311,246.97</b>	<b>100.00</b>	<b>67.79</b>
<b>National Greenhouse Gas Emissions Total (Excluding LULUCF)</b>	<b>459,102.27</b>		

**Table 3.2** Amounts of greenhouse gas emission resulting from the energy sub-sector in 2013 and their shares in total emissions

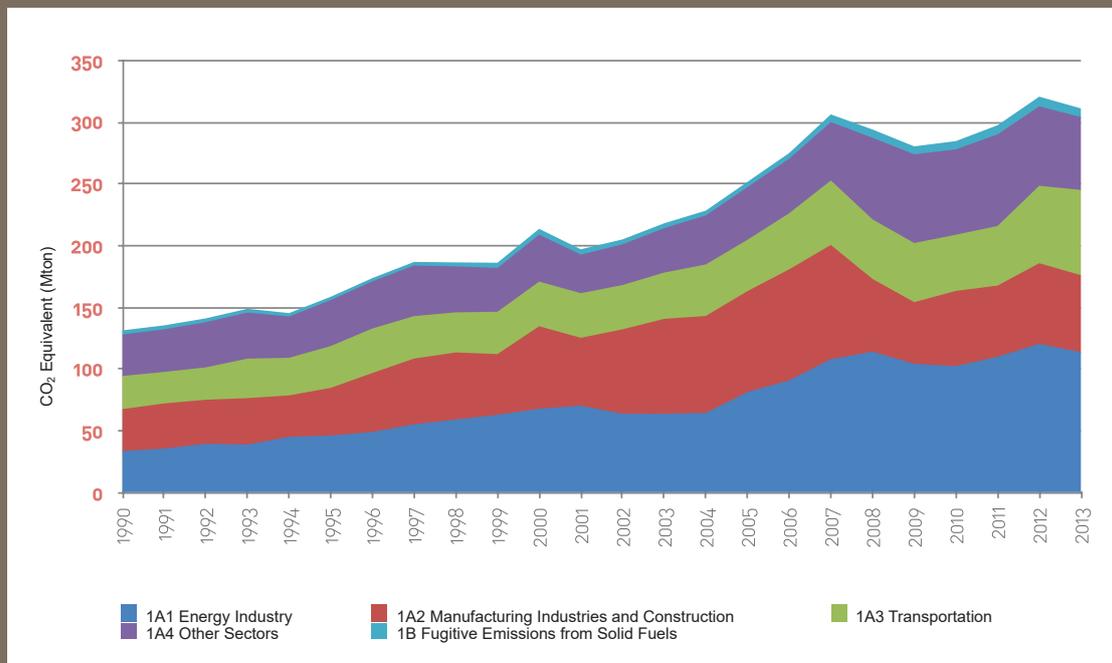


Figure 3.4 CO<sub>2</sub>-eq. emissions from the energy sector [Mton] (1990-2013)

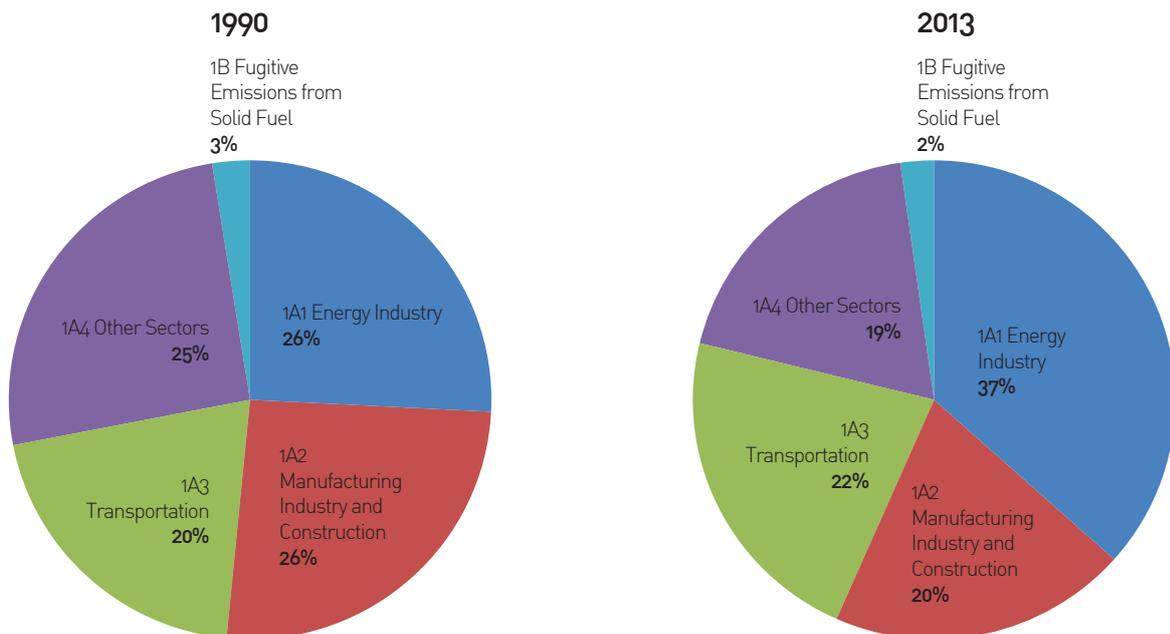
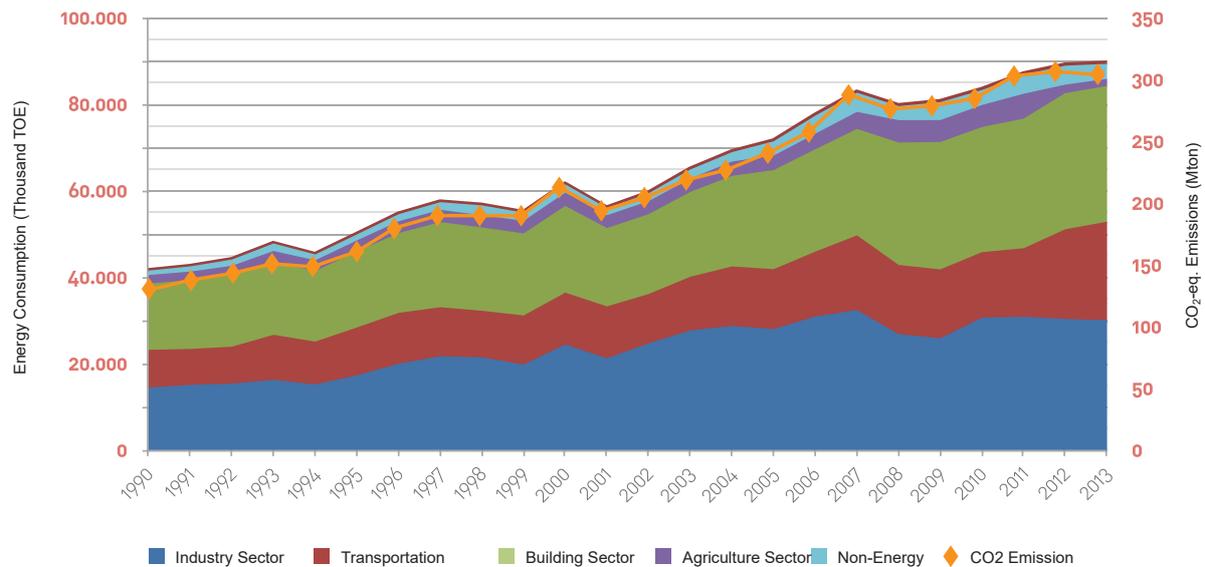


Figure 3.5 Sectoral breakdown of greenhouse gas emissions in the energy sector for 1990 and 2013



Source: MENR\_c, 2014

Figure 3.6 Change of energy consumption values and energy sector CO<sub>2</sub>-eq. emissions (1990-2013)

### 3.2.1.1 Energy Industries

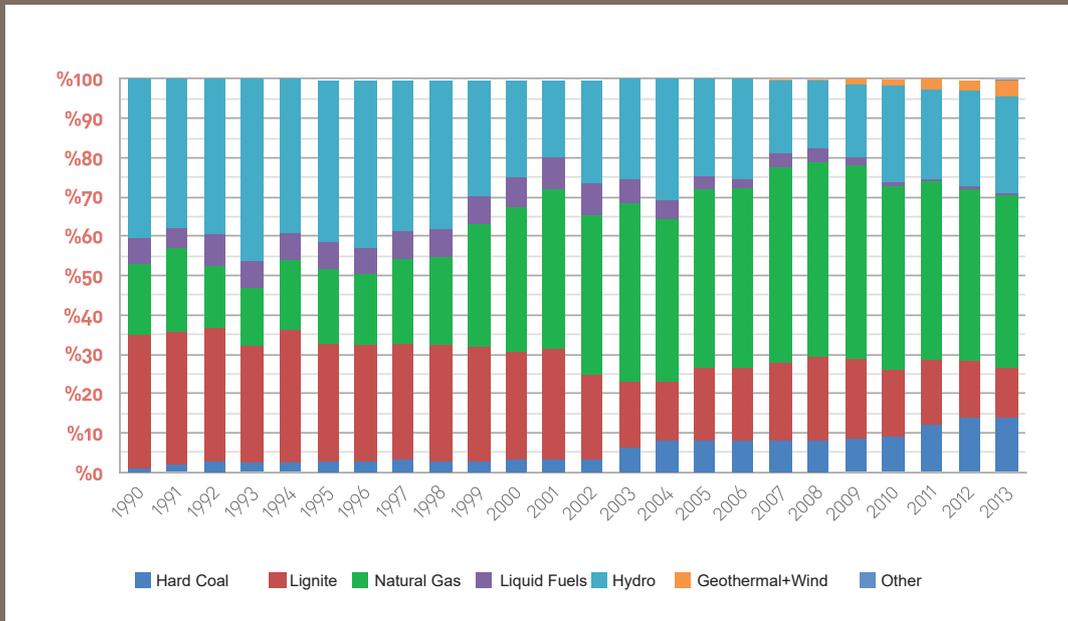
In the 1A1 Energy industry, including the energy generation facilities where every kind of fuels are burned for electricity and heat production, oil refineries and solid fuel manufacturing facilities, 94% of emissions in 2013 is caused by electricity and heat production, 4% by petroleum refining and 2% by solid fuel manufacturing.

In the last 10 years, electricity generation increased regularly and the capacity of power plants grew rapidly. In 1990, the share of thermal sources in the total installed capacity reached 60% (18% natural gas, 35% coal and lignite, 7% fuel oil) and the remaining 40% was supplied from the hydraulic resources. While the source share of the coal in electricity generation decreased from 35% to 27%, the share of natural gas reached from 18% to 44%. Total primary energy supply showed an increase of 127.39% between 1990 and 2013 and reached 120.29 Mtoe.

### 3.2.1.2 Manufacturing Industry

Emissions from fuel use during the production of manufacturing industry and construction materials have been named as 1A2 Industrial Sector. The industrial sector greenhouse gas emissions have a share of 20% in the energy sector total emissions. Non-metallic minerals (cement, ceramic and glass) sub-sector within this sector constitutes 42.7% of the emissions of this sector, chemical production constitutes 7.1%, food processing, beverages and tobacco sector constitute 4.9% and non-ferrous metals, paper and other industries constitute the remaining.

The increase annually observed in average in the industrial sector greenhouse gas emissions was approximately 1.7 Mton CO<sub>2</sub>-eq. between the years 1990-2013. This value corresponds to an increase of approximately 84% over the same period. As can be seen from Figure 3.8, in the economic crisis periods observed in 1994, 1999, 2001, 2008 and 2009, the most significant emission reduction trend is seen in the manufacturing industry and construction sectors. According to the 2013 figures of the Ministry of Energy and Natural Resources, the share of industrial facilities in energy use in Turkey is 34%.



Source: MENR\_c, 2014

Figure 3.7 Share of sources in electricity generation (1990-2013)

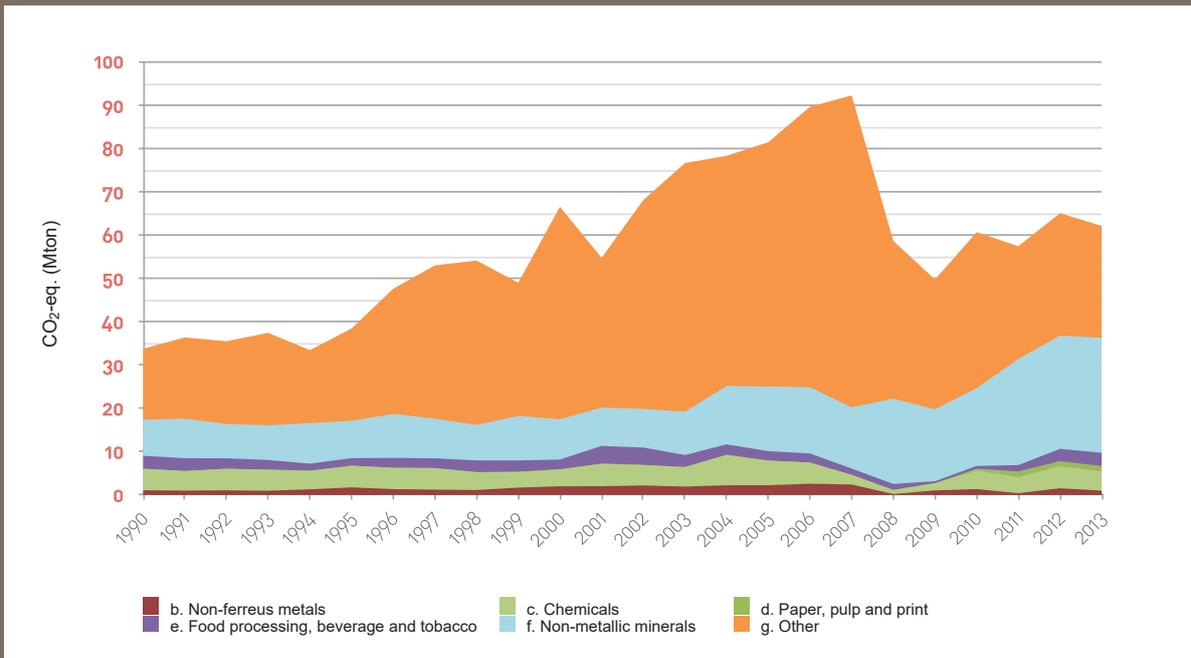


Figure 3.8 Industry sector CO<sub>2</sub>-eq. emissions (Mton) (1990-2013)

### 3.2.1.3 Transportation

The amount of greenhouse gas emissions caused by the 1A3 Transportation Sector is 69.0 Mton CO<sub>2</sub>-eq. and its share in the energy sector is 22.18% and the share in the national total emission is around 15.04%. The sector is one of the main gas emission sources for the N<sub>2</sub>O, NO<sub>x</sub>, CO and NMVOC gases resulting from the energy sector.

Road transportation is the primary greenhouse gas emissions source with 91% of the emission of the sector. Between the years 1990-2013, while the amount of CO<sub>2</sub>-eq. emissions originating from roads did not show any change, civil aviation increased from 3.4% to 5.4% and the share of railway decreases from 2.7% to 0.7%. The rapid increase in CO<sub>2</sub> emissions from road transport since 2012 is due to that the amount of fuel combusted in the agricultural sector was given under the title of road transport in the Energy Balance Table of 2012. Greenhouse gas emissions from transportation in Turkey increased by 157% between 1990 and 2013. The observed average annual growth trend in the transport sector was 1.4 Mton CO<sub>2</sub>-eq. and was lower than the energy and industry sectors (respectively 3.88 and 1.7 Mton CO<sub>2</sub>-eq.). The main reasons for this low-rise is that even though at low levels there was an increase in the new vehicle and engine technologies, use of alternative fuels and carrying out incentives for removing the vehicles with 1990 and older model from traffic such as minibus, vans, buses, trucks, tanker and towing truck which are defined with Communiqués No. 49, 53, 56, 57, 62, 63 and 66 regarding the removing some road vehicles from the market through General Directorate of Road Regulation between 2007-2013.

Between the years 1990-2013, greenhouse gas emissions caused by rail transport were at very low levels and showed a downward trend overall based on years. The railway network which grew rapidly until 1946 as a state policy, ended the standstill period it entered afterwards in 2003 and high-

speed train rails have begun to be laid in the last 12 years. A new period has been entered in the railway sector as a result of the policy where restructuring of the rail freight which started in 2003 and involving the private sector to the rail transport more are envisaged. The total railway length which was 8,699 km until 2008 was rapidly increased until now and reached 10,087 km (TurkStat\_e, 2014). During this time, a large part of the existing railways were renovated, Ankara-Eskisehir and Ankara-Konya and Ankara-Istanbul lines have been completed and Eskisehir-Istanbul, Ankara-Istanbul lines are under construction. Dissemination of urban rail public transport services, railway lines projects that will connect Asia to Europe are under construction. The increase in the share of rail in passenger and freight transportation is important in the sense that it will lead to reductions in greenhouse gas emissions caused by transportation.

### 3.2.1.4 International Air and Maritime Transportation

In 2013, the total greenhouse gas emissions of the fuels consumed by international air and maritime transportation activities caused 11.6 Mton CO<sub>2</sub>-eq. emission. In 2013, the international transport emissions increased by 1,138% compared to 1990. Approximately 75% of the international transport emissions for 2013 were caused by air transport and 25% thereof were caused by maritime transport.

99% of the international transport emissions consists of CO<sub>2</sub> emissions. The contribution of CH<sub>4</sub> ve N<sub>2</sub>O emissions is only 1%.

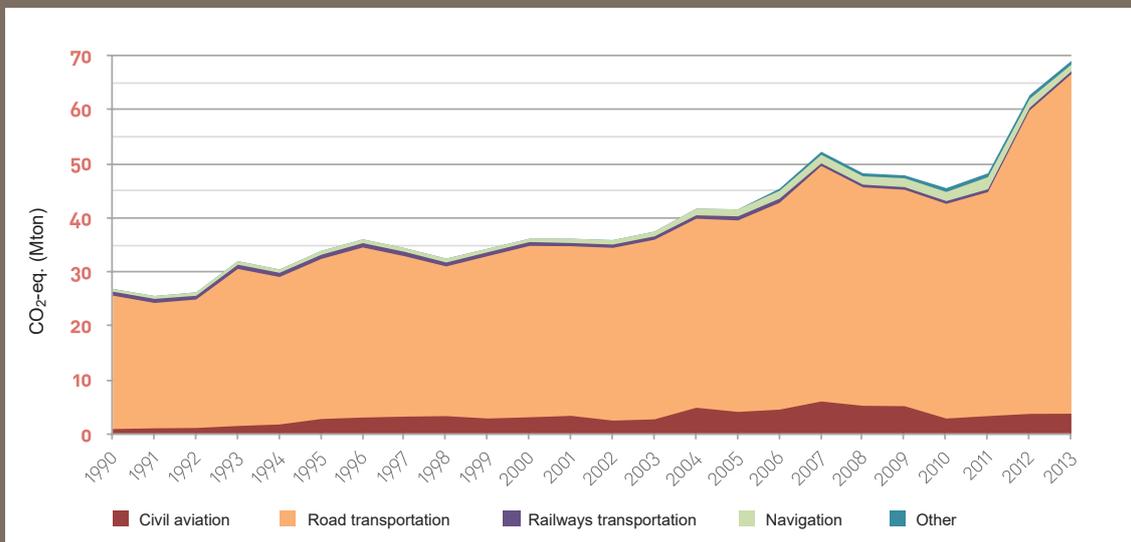


Figure 3.9 Changes of the CO<sub>2</sub>-eq. emissions in the sub-sectors in the transportation sector (1990-2013)

### 3.2.1.5 Other Sectors

The share of the other sectors (1A4) sub-sector including the emissions from combustion of fuels in heating of sectors of commercial/institutional, residential and agriculture within total energy emissions in 2013 is 18.94%. 96% of the emissions in this sub-sector consists of the combustion of fuels in commercial/institutional, residential and 4% consists of the combustion of fuels for agriculture/forestry/fishing activities.

Emissions from the combustion of fuels in commercial/institutional, residential and agricultural sectors increased by 75.66% in 2013 compared to 1990. There is a rapid increase in the energy consumption of the commercial/institutional, residential sector with reasons such as rapidly growing population, income levels, living standards and urbanization rate (Figure 3.10).

Due to the financing gap necessary and the implementation problems for the application of insulation and other saving methods in the residential sector, heating density is higher than that of developed countries. In the energy consumption of residential and commercial sector, 15.36 Mtoe electricity use in 1990 showed a large increase and reached 31.40 Mtoe in 2012 (MENR\_c, 2014).

### 3.2.1.6 Fugitive Emissions

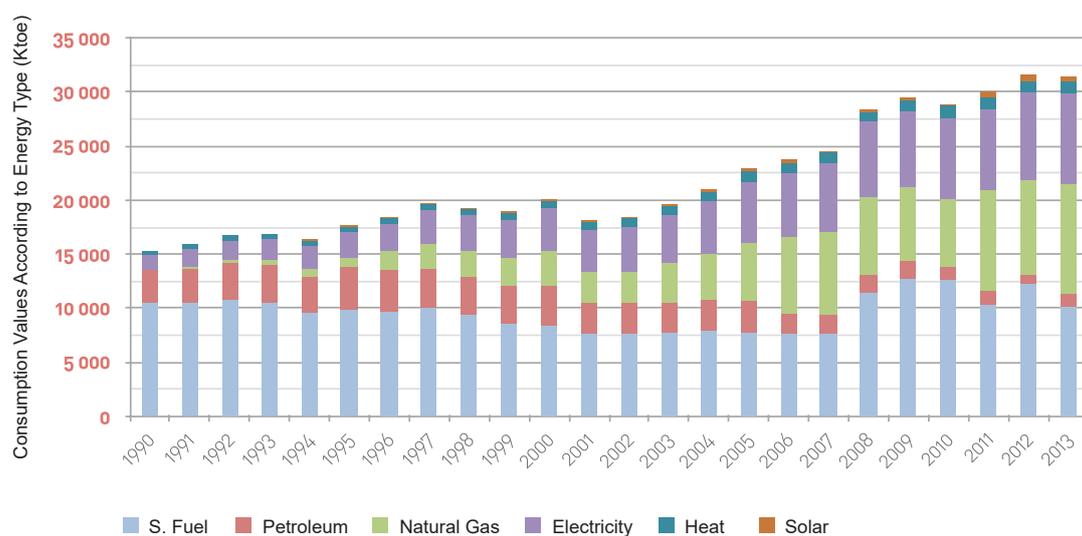
The share of the fugitive emissions caused by the fuels within the energy sector is 2.25%. In this sector emissions, an

increase of 110.82% was observed in 2012 compared to 1990. The increase can be explained by the increase in the production in the coal mining which is mainly contained in this sub-sector.

## 3.2.2 Industrial processes and product use

For 2013, total greenhouse gas emissions resulting from the Industrial processes and product use sector constitute 15.7% of total emissions with 72.03 Mton CO<sub>2</sub>-eq. (Table 3.3). Compared to 1990, an increase of 131.8% is observed in greenhouse gas emissions from the industrial processes and product use. The sectoral breakdown of greenhouse gases from the industrial processes sector for the years 1990-2013 is provided in Figure 3.11. Accordingly, it is seen that the largest share belongs to the 2A Mineral Products in where the cement, lime, ceramic and glass production processes take place with 48% and 57% respectively both in 1990 and in 2013. The highest annual increase in greenhouse gas emissions in this sector are observed in mineral products with 1 Mton. The annual greenhouse gas emissions increase observed in metal production was 0.27 Mton, the increase in greenhouse gas emissions resulting from the use of the Ozone Depleting Substances (ODS) products was 0.40 Mton/year.

Between 1990 and 2013, the changes observed in the share of greenhouse gas emissions in the industrial processes sector is provided in Figure 3.12.



Source: MENR\_c, 2014

Figure 3.10 Consumption values in commercial and residential sector by energy type

Industrial processes and product use sub-sectors	Greenhouse Gas Emission [Gg CO <sub>2</sub> -eq.]	Shares in the Total Industrial Process Emissions (%)	Shares within the National Total Emission (%)
A. Mineral Industry	41,323.25	57.37	9.00
B. Chemical Industry	2,616.93	3.63	0.57
C. Metal Industry	20,888.10	29.00	4.55
D. Non-energy products from fuels and solvent use	528.4	0.73	0.12
E. Electronics Industry	-	-	-
F. Product use as substitutes for ODS	5,705.87	7.92	1.24
G. Other product manufacture and use	963.49	1.34	0.21
<b>Industrial Processes Total</b>	<b>72,026.05</b>	<b>100.00</b>	<b>15.69</b>
<b>National Greenhouse Gas Emissions Total</b> (Except LULUCF)	<b>459,102.27</b>		

Table 3.3 Amounts of greenhouse gas emission resulting from the industrial processes and product use sub-sectors in 2013 and their shares in the total emissions

According to the inventory of 2013, 89% of the process-induced greenhouse gas emissions of the industrial processes sector consists of CO<sub>2</sub> and 9% consists of F gases (HFC, and SF<sub>6</sub>) (Figure 3.13). 53% of CO<sub>2</sub> emissions is caused by the cement sector and 32% is caused by the iron and steel production. 75% of CH<sub>4</sub> gas is caused by the production of ferro-alloys and 18% is caused by the iron and steel production. SF<sub>6</sub> from the F gases is used for insulating purposes and fire-extinguishing gas in the devices produced in the electromechanical sector. The other F gases are used in the air-conditioning systems and vehicle air conditioners with the refrigeration and air conditioning devices produced in the white goods sector.

The emissions due to the use of SF<sub>6</sub> and HFC in the industry only depends on the amount that is imported since these gases are not produced within the country. Refrigerators, fire extinguishers and air conditioning sector where HFC gases are consumed is one of the areas showing rapid growth in

our country. This sector causing 0.40 Mton CO<sub>2</sub>-eq. emissions growth per year is expected to improve in the coming years.

SF<sub>6</sub> emissions from electrical equipment industry has been recorded since 1996. SF<sub>6</sub> emissions on a continuous upward trend except the economic crisis periods increased by 170% between 1996 and 2013. PFC emissions from aluminum production were not included in the inventory since 2007 due to being confidential information.

In Turkey, the HFCs used as substitutes in place of chlorofluorocarbons within the scope of Montreal Protocol have been started to be used since 2000. All HFCs used in the production processes are consumed in the refrigeration industry. The use of HFCs is at 60% level in general F gases. The emissions from HFCs due to the termination of the use of substances that deplete the ozone layer in air conditioners and refrigerators increased by 534% from 0.90 Mton to 5.71 Mton CO<sub>2</sub>-eq between 2000-2012 (Figure 3.14).

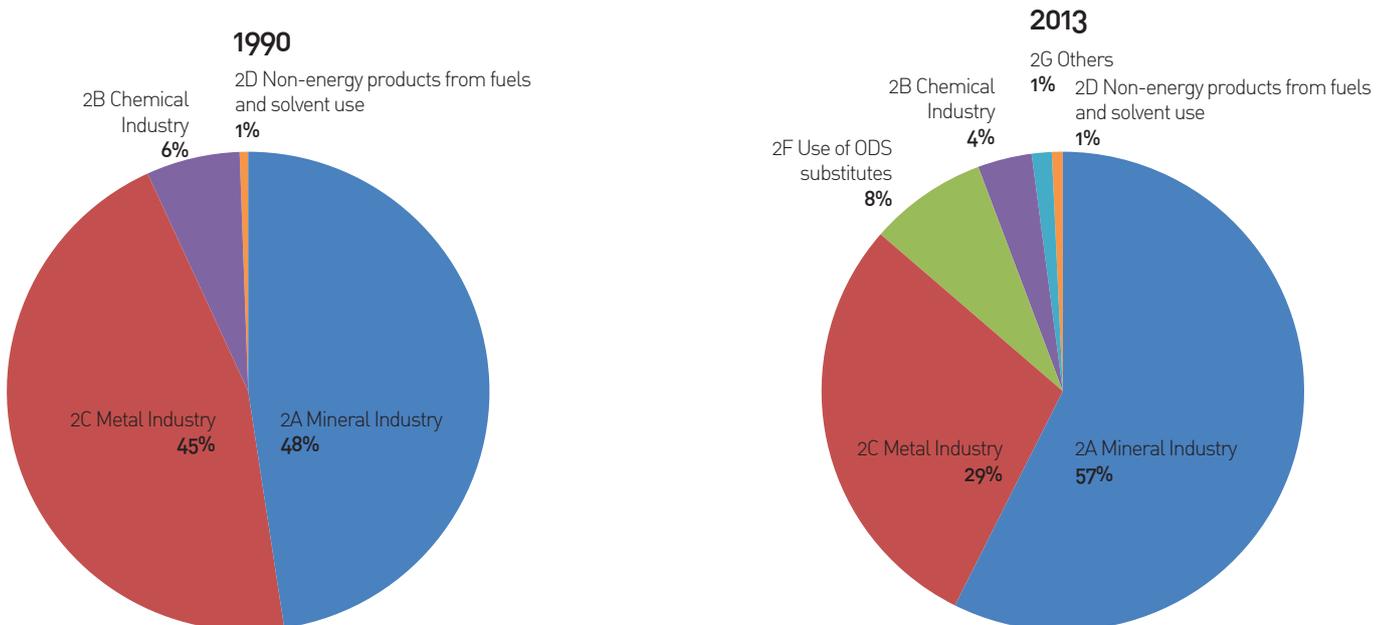


Figure 3.11 Sectoral breakdown of greenhouse gas emissions in the industrial processes and product use sector for 1990 and 2013

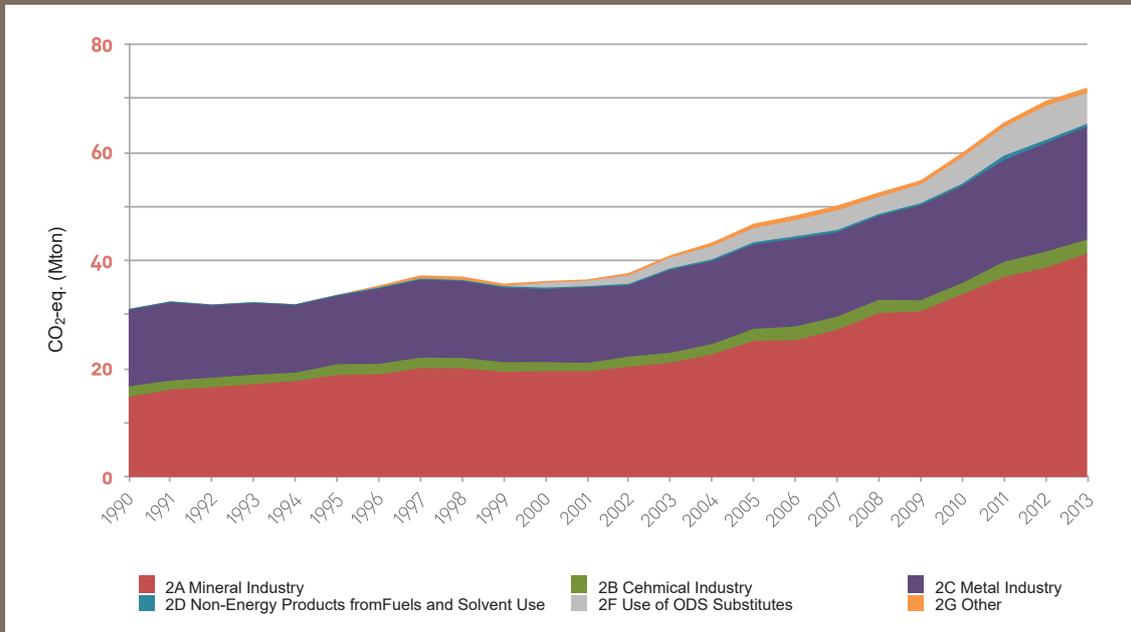


Figure 3.12 CO<sub>2</sub>-eq. emissions from the Industrial Processes and Product Use (Mton) (1990-2013)

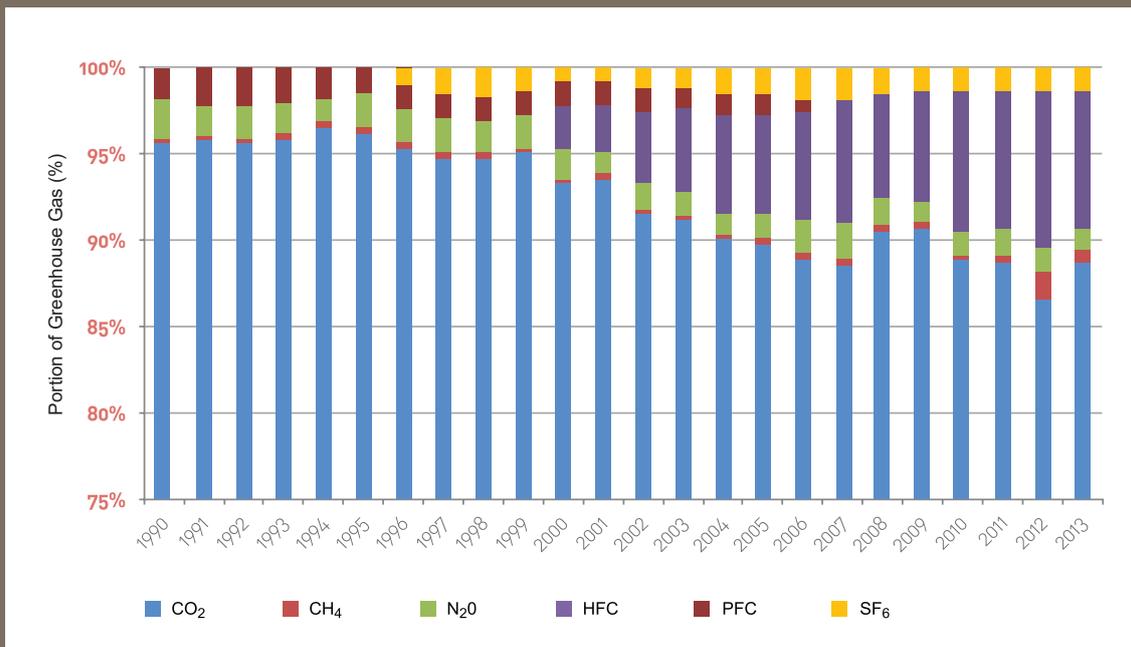


Figure 3.13 Share of greenhouse gas types contributing to industrial processing sector (1990-2013)

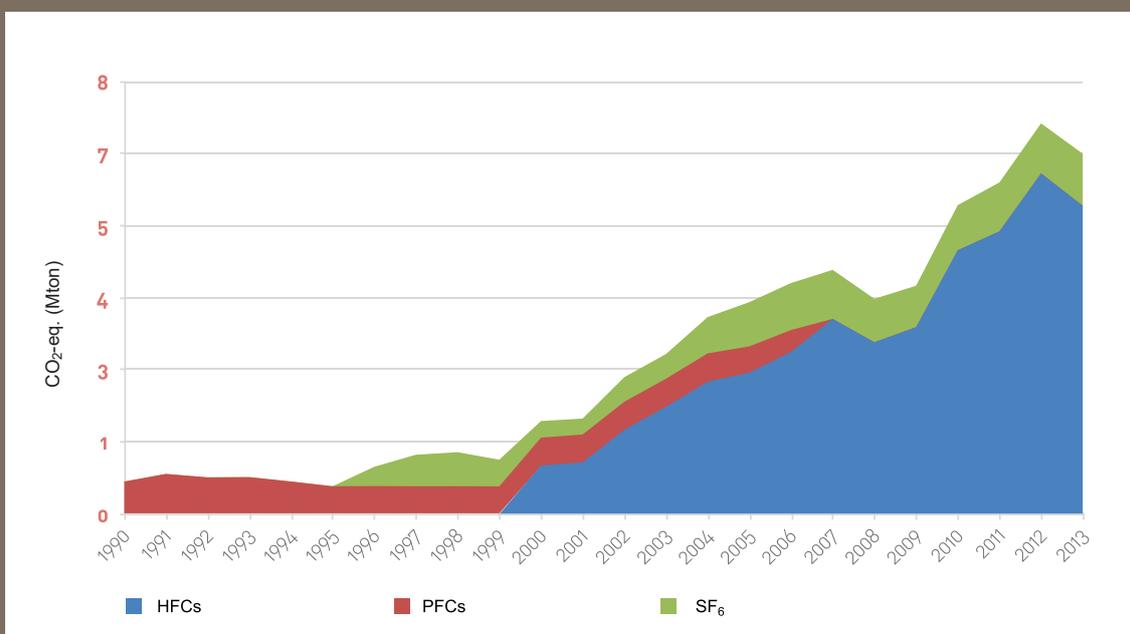


Figure 3.14 Total CO<sub>2</sub>-eq emissions from the use of F gases (1990-2013)

### 3.2.3 Agriculture

Greenhouse gas emissions originating from agricultural activities in Turkey are caused by production and processing of agricultural products, number of livestock (enteric fermentation, manure management), rice cultivation, field burning of agricultural residues and agricultural soils. According to

the inventory data on country's greenhouse gas of the country in 2013, agricultural activities form approximately 10.8% of total anthropogenic greenhouse gas emissions. When the greenhouse gas emissions of the industries are reviewed, the greenhouse gas emissions caused by agricultural activities between 1990 and 2013 has a more stable trend compared to the severe increases in greenhouse gas emissions of oth-

Agriculture	Greenhouse Gas Emissions (Gg CO <sub>2</sub> -eq.)	Shares in Total Agriculture Emissions (%)	Shares in National Total Emissions (%)
A. Enteric Fermentation	27,195.62	54.60	5.92
B. Manure Management	6,026.96	12.10	1.31
C. Rice Cultivation	190.64	0.38	0.04
D. Agricultural Soils	15,218.42	30.55	3.31
E. Prescribed Burning of Savannas	NO	-	-
F. Field Burning of Agricultural Residues	368.07	0.74	0.08
G. Liming	NE	-	-
H. Urea Application	807.30	1.62	0.18
<b>Total Agriculture</b>	<b>49,807.00</b>	<b>100.00</b>	<b>10.85</b>
<b>National Greenhouse Gas Emissions Total (excluding LULUCF)</b>	<b>459,102.27</b>		

NE: Not Estimated NO: Not Occurring.

Table 3.4 Amounts of greenhouse gas emissions resulting from agriculture industry in 2013 and their shares in the total emissions

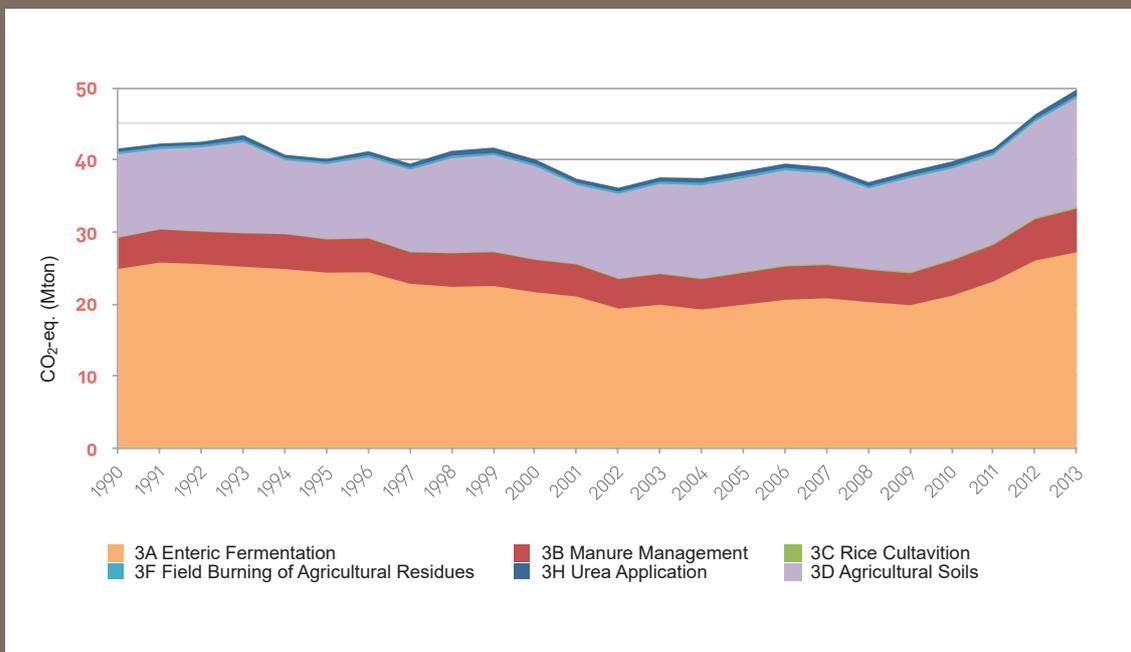


Figure 3.15 CO<sub>2</sub>-eq. emissions originating from Agriculture (Mton) [1990-2013]

er industries. The decreasing trend observed between 1990 and 2008 turned around and started an upwards trend after 2008 due to the studies on improvement of livestock husbandry carried out by the Ministry of Food, Agriculture and Livestock (Figure 3.15). While the greenhouse gas emissions of agricultural activities were 41.60 Mton of CO<sub>2</sub>-eq. in 1990, in 2013, the emissions increased by 19.7% and reached to 49.81 Mton CO<sub>2</sub>-eq. level (Table 3.4) [Excluding LULUCF].

According to the inventory of 2013, 54.6% of the greenhouse gas emissions occurred were caused by enteric fermentation of animals, 30.6% were caused by agricultural soils, 12.1% were caused by manure management and the remaining 2.7% were caused by urea application, rice production and field burning of agricultural residues.

Distribution of greenhouse gas emissions originating from agricultural activities according to industries, an increase of 9.3% in enteric fermentation and 40% in manure management is observed compared to 1990. In 2013, 61.4% of the total CO<sub>2</sub>-eq. emissions originating from agriculture industry consists of CH<sub>4</sub> and 37% consists of N<sub>2</sub>O.

While there has been an annual average decrease of 0.34 Mton CO<sub>2</sub>-eq. in agriculture industry between 1990 and

2005, an increasing trend of 2.57 Mton CO<sub>2</sub>-eq. was observed between 2008 and 2013. Primary reason for the change in agriculture industry emissions is the change in bovine and ovine livestock numbers as shown in Figure 2.24. According to the statistics prepared by Turkstat, between 1991 and 2013 the bovine livestock asset of the country (cattle, cultivated, cross-breed, buffalo) decreased until 2003, however, it increased after 2003 (TurkStat\_j, 2014). While the share of agriculture within GDP was 25% in 1980, 16% in 1990 and 10.1% in 2000, this decrease continued constantly as 7.6% in 2008 and 7.4% in 2013 (TurkStat\_k, 2014). Main reason why the share of agriculture industry in GDP of Turkey decreases constantly is that the growth in industry and service sectors is faster, as also seen in all other developing countries (Figure 2.22).

Agricultural lands form 33 million hectares, which is 41% of Turkey's total land asset of 79.6 million hectares (CORINE, 2006). While the total agricultural land was 40.97 million hectares in 2001, it has decreased down to 38.42 million hectares in 2013 (TurkStat\_k, 2014). 17% of the total plantation is used for irrigated farming and the remaining 83% is used for dry land farming. Due to the draught that occurred in 2007 and 2008 and the increase in manure prices reaching up to 150%, the manure consumption which was about 5 Mtons declined to

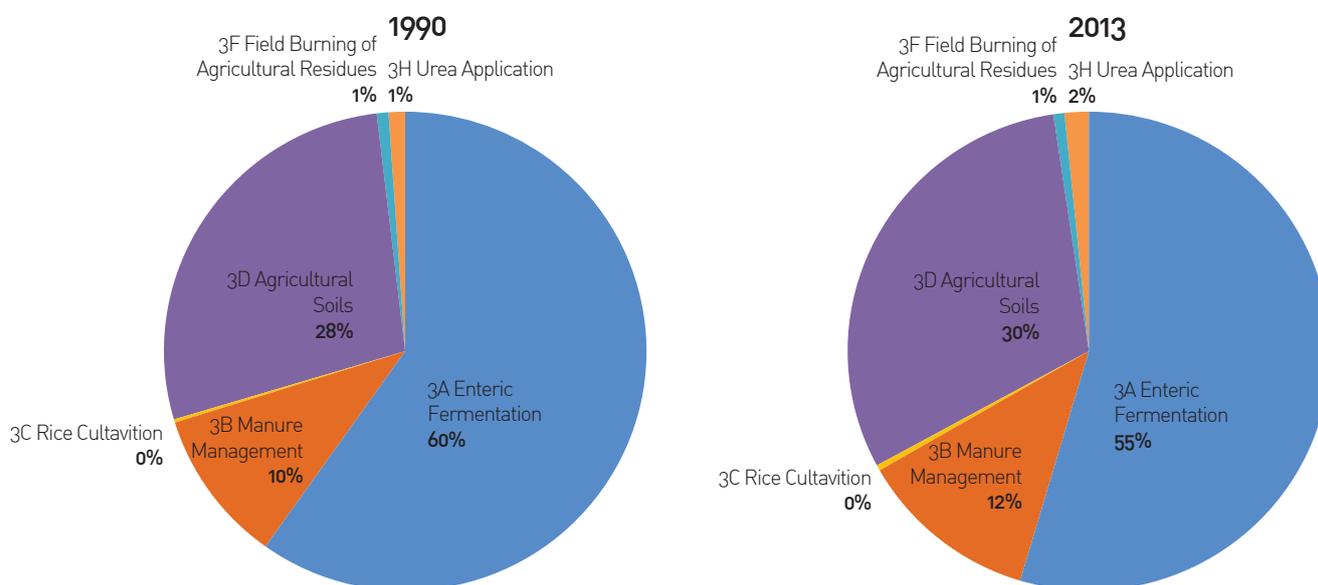


Figure 3.16 Sectoral breakdown of greenhouse gas emissions in Agricultural Sector for 1990 and 2013

4,100,000 tons, therefore a decrease of 15% in greenhouse gas emissions in 4D Agricultural soils was observed in 2008 compared to 2006. As of 2009, thanks to the decrease in manure prices and sufficient precipitation, manure consumption rose again and reached 5.8 Mtons in 2013, which brought together an increase in greenhouse gas.

The decrease in greenhouse gases originating from agriculture industry is expected to continue in the years to come as a result of the best practices initiated by the Ministry of Food, Agriculture and Livestock listed below:

- Developing less or no tillage farming practices and providing governments support for their practices with suitable machines. Also providing decrease in energy consumption by increasing use of machine combinations which carry out more than one activities at the same time.
- Decreasing emissions in parallel to the progress in studies on generating energy via biomass instead of field burning of agricultural residues.
- Increase in fruit orchard facilities and sink areas due to subsidies for certified saplings and fruit facilities.

### 3.2.4 Land use, Change in Land Use and Forestry

According to greenhouse gas emissions inventory data of Turkey in 2013, Land use, Change in Land Use and Forestry (LULUCF) industry forms a sink equivalent to approximately

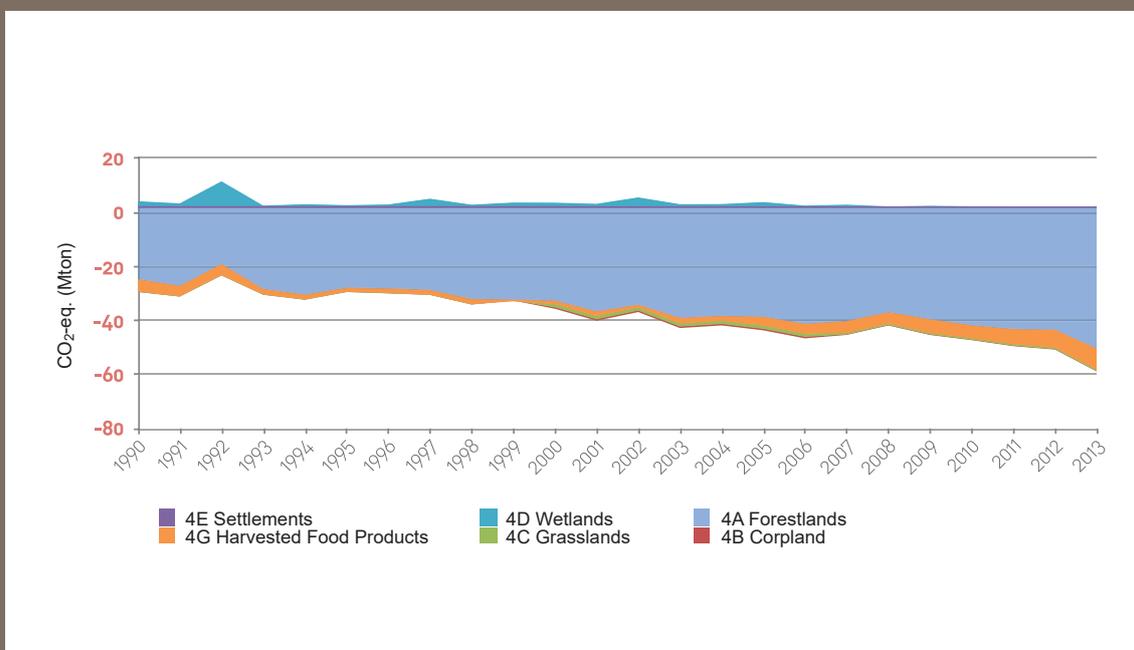
12.8% of total anthropogenic greenhouse gas emissions (Table 3.5). Forests are the only sector with net carbon accumulation and the amount of net carbon accumulated annually in forests is equal to 11.1% of all greenhouse gas emissions. Greenhouse gas emissions accumulated in harvested wood products amount to 1.6% of all emissions. The contribution to total greenhouse gas emissions due to conversion of agricultural land to settlements is about 0.12%.

As a result of land use and change in Turkey between 1990 and 2013, an increase of carbon hold equivalent to annual emissions of 1.1 Mton CO<sub>2</sub>-eq. was observed. Improvements in sustainable forest management, afforestation, rehabilitation of degraded forests, efficient forest fire management and protection activities are the main reasons of the increasing trend of removals by LULUCF sector. This increase in sinks was caused substantially by the increasing forest assets (Figure 3.17). Annual carbon hold of Turkey's forests shows a regular increase. CO<sub>2</sub> uptake of forest lands, which was 28.06 Mtons in 1990 raised to 51.10 Mtons in 2013 with an increase of 82%. A total area of 2.42 million ha has been afforested between 2008 and 2013 within the context of National Afforestation Campaign initiated in Country basis. The annual average hold of forests equivalent to 0.80 Mton CO<sub>2</sub>-eq. shows that forestry industry can be a very good sink for decreasing greenhouse gas emissions in our country.

LULUCF sub-sectors	Greenhouse Gas Emissions (Gg CO <sub>2</sub> eq.)	Shares in Total LULUCF Emissions (%)	Shares in National Total Emissions (%)
A. Forest land	-51,095.10	87.05	-11.13
B. Croplands	-137.13	0.23	-0.03
C. Grasslands	-528.07	0.90	-0.12
D. Wetlands	NE,NO	-	-
E. Settlements	570.61	-0.97	0.12
F. Other lands	NO,NE	-	-
G. Harvested wood products	-7,509.27	12.79	-1.64
Land Use, Land Use Change and Forestry Total	-58,698.97	100.00	-12.79
National Greenhouse Gas Emissions Total (except LULUCF)	459,102.27		

NA: Not Applicable; NE: Not Estimated; NO: Not Occurring.

**Table 3.5** Greenhouse gas emissions and total emission shares from LULUCF (2013)



**Figure 3.17** The amount of CO<sub>2</sub>-eq. removal from LULUCF sector (Mton) (1990-2013)

In plantations, the hold of 0.05 Mton CO<sub>2</sub>-eq. in 1990 increased until 2013 and reached 0.14 Mtons. Land use changes in meadows and ranges contributed to decrease of total greenhouse gas emissions by 0.11% in 2013. Between

1990 and 2013, carbon emissions are observed due to carbon loss in live biomass because of conversion of the land to settlement. In 2013, due to conversion of land to settlement, CO<sub>2</sub>-eq. emissions value reached to 0.57 Mton.

### 3.2.5 Waste

Greenhouse gas emissions of waste industry contains emissions that occur due to management and disposal of solid waste, hazardous waste and medical waste and the emissions originating from formation and disposal of treatment sludge in wastewater treatment plants.

As of 2013, the share of Turkey's waste industry in total greenhouse gas emissions is 26.02 Mton CO<sub>2</sub>-eq. (5.7%)

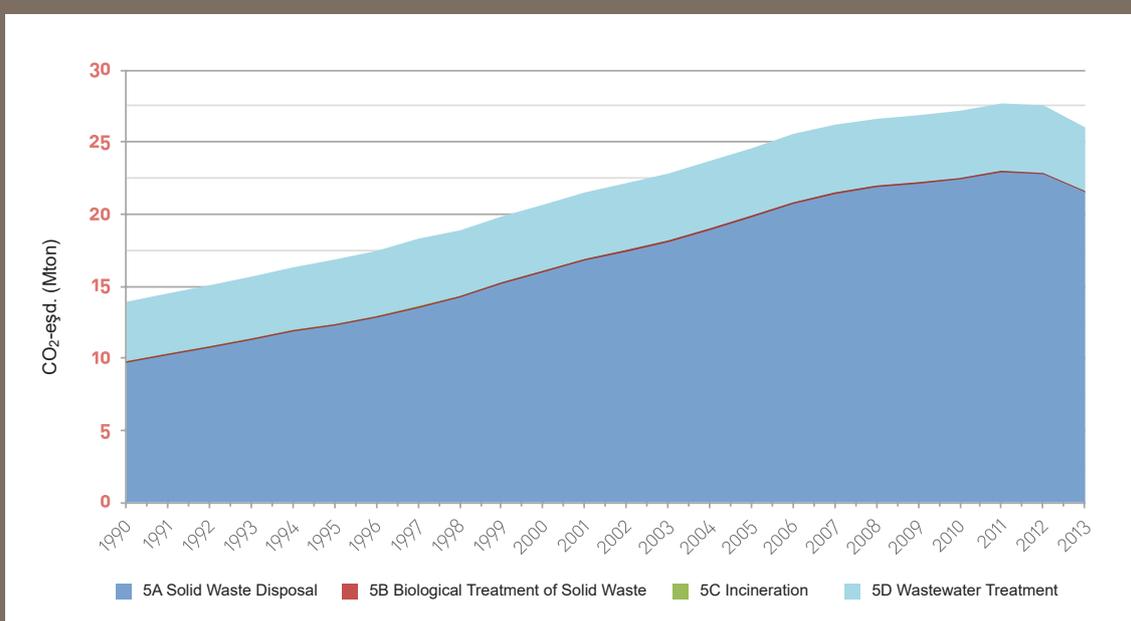
and it is 4<sup>th</sup> after energy, industrial processes and agriculture sectors (except LULUCF). In Turkey, 82.7% of waste industry greenhouse gas emissions originate from regular and irregular (uncontrolled) solid waste storage areas, and the rest originates from domestic and industrial wastewater treatment (Table 3.6).

Change in greenhouse gas emissions in Turkey originating from waste industry between 1990 and 2013 is given in Figure 3.18. Greenhouse gas emissions of waste industry increased by 86.9% between 1990 and 2013 compared to 1990.

Waste Industry	Greenhouse Gas Emissions (Gg CO <sub>2</sub> eq.)	Shares in Total Waste Emissions (%)	Shares in National Total Emissions (%)
A. Solid waste disposal	21,529.02	82.7	4.69
B. Biological treatment of solid waste	30.30	0.12	0
C. Incineration and open burning of waste	13.94	0.05	0
D. Wastewater treatment and discharge	4,448.98	17.13	0.97
E. Other	NA	-	-
Waste Sector	26,022.25	100.00	5.66
National Greenhouse Gas Emissions Total (except LULUCF)	459,102.27		

NA: Not Applicable.

**Table 3.6** Amounts of greenhouse gas emissions originating from waste sector and their shares (2013)



**Figure 3.18** CO<sub>2</sub>-eq. emissions originating from waste sector (1990-2013)

In 2013, CH<sub>4</sub> formed 93% and N<sub>2</sub>O formed 7% of the greenhouse gas emissions of waste industry (Figure 3.19). While methane gas originates from waste storage units and wastewater treatment plants, nearly all nitrous oxide emissions are generated by wastewater treatment plants.

According to the waste inventory carried out by TurkStat, the amount of urban solid waste collected as of 2012 is 25,845 tons/year (1.12 kg/person.day) and 83% of the country's population benefit from waste collection services. While 60% of the waste collected from municipalities is sent to storage area regularly, 36% is disposed of by irregular (uncontrolled) storage method. In Waste Management Action Plan (2008-2012) of the Ministry of Environment and Urbanization, disposal of 70% of the municipal population waste in regular storage areas is aimed for 2012.

When the data on municipal waste amount between 1994 and 2012 is reviewed, it is observed that, as of 1998, the increase in waste amount decreased compared to the previous years and became fixed and the daily waste amount per person decreased year by year after 1998 (Figure 3.20) (TurkStat\_I, 2014). Since 1997, total amount of solid waste reached to a saturation point annually at about 25 Mtons except for the 3.6% decrease in 2008.

With the Regulation on Regular Storage of Wastes entering into effect on 01/04/2010, targets regarding mitigation of biodegradable wastes were established and the provision for collecting the gases originating from regular storage fields and using them directly or by processing in energy production or in case where use of generated storage gas in energy production is not economic, burning it on torches was put into effect. The provisions of this regulation aims to process the generate gases and mitigate the share of greenhouse gas emissions originating from waste industry.

'Energy from Storage Gas' projects were initiated in our company in order to dispose of and make use of the storage gas originating from the closed sections of the regular storage areas and the closed down irregular storage areas. These projects provide mitigation of carbon emissions as well as energy production.

According to the results of the latest TurkStat inventory, 45% of the 4.07 billion m<sup>3</sup> wastewater collected through sewage networks was discharged into the sea, 44% into the rivers, 2.8% was discharged into dams, 1.8% was discharged into lakes-ponds, 0.87% was discharged into land and 4.5% was discharged into other recipient environments. 3.26 billion m<sup>3</sup> of 4.07 billion m<sup>3</sup> wastewater discharged from sewage network

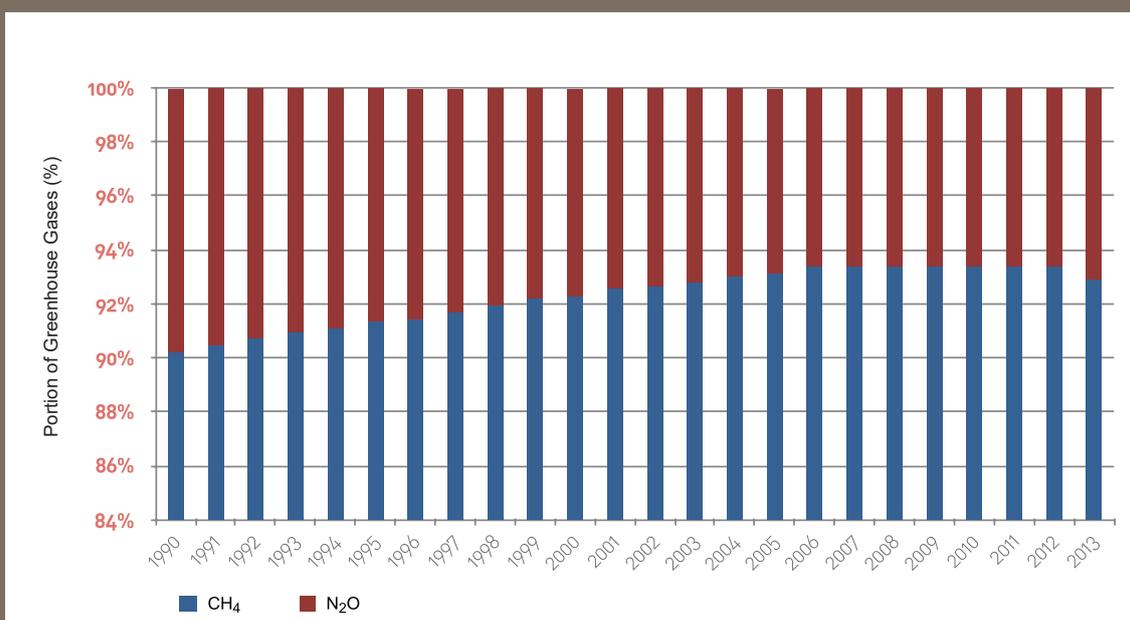
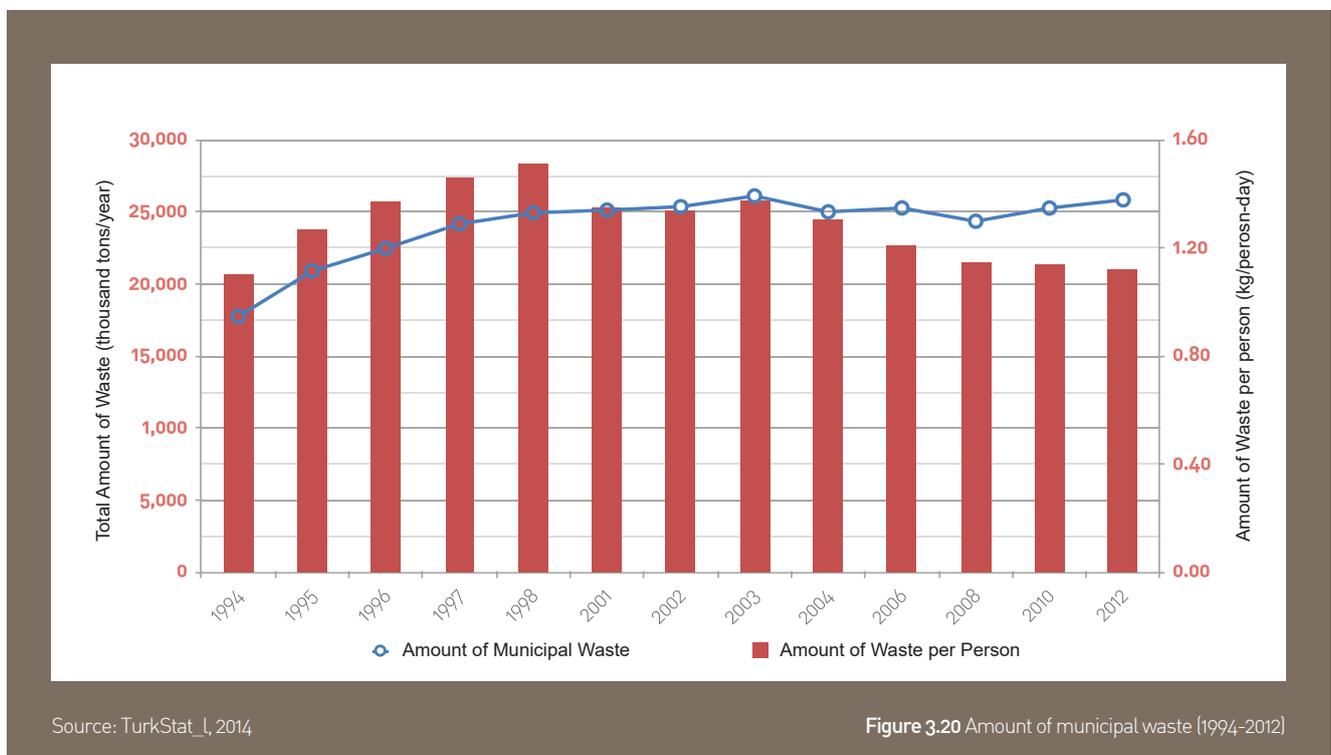


Figure 3.19 Shares of greenhouse gas emissions of waste sector over time

was treated in wastewater treatment facilities. 38.3% of the wastewater was treated with advanced methods, 32.9% was treated with biological treatment, 28.5% with physical treatment and 0.27% was treated with natural treatment. 80% of the discharged wastewater is treated. In 2012, share of the municipal population serviced by a sewage network within Turkey's population was determined as 78% and the share within the total municipal population was determined as 92%.

According to 2012 data, the rate of municipal population serviced with wastewater treatment facilities is 58% within Turkey's population and 68% within total municipal population.



### 3.3. Changes in Emissions According to Greenhouse Gas Types

#### 3.3.1 Carbon Dioxide Emissions

During the 1990-2013 period, national CO<sub>2</sub> emissions increased by around 136% from 153.83 Mtons in 1990 reached up to 363.40 Mtons in 2013 (Figure 3.21). Energy industry is the most important industry which causes 82.2% of the total CO<sub>2</sub> emissions in 2013. Similarly, in 1990, energy industry was also determined to cause 80.3% of the emissions (excluding LULUCF). Shares of the source sub-groups that caused the highest CO<sub>2</sub> emissions in energy industry be-

tween 1990 and 2013 and their change over time are given in Figure 3.22.

The sub-sectors with the highest share of CO<sub>2</sub> emissions within the energy industry in 2013 are observed as Energy Industry with 31.2%, Transportation with 18.6%, Industry Sector with 17.1%, Other Sectors with 15.2% and Mineral Products with 11.4%.

Share of CO<sub>2</sub> emissions originating from transportation sector within the total emissions in Turkey increased from 17% in 1990 to 18.6% in 2013. In 2012, 24% CO<sub>2</sub> emissions in European Union (EU) and OECD countries originated from transportation sector, and in some developed countries, this rate is over 40%. (EU, 2015).

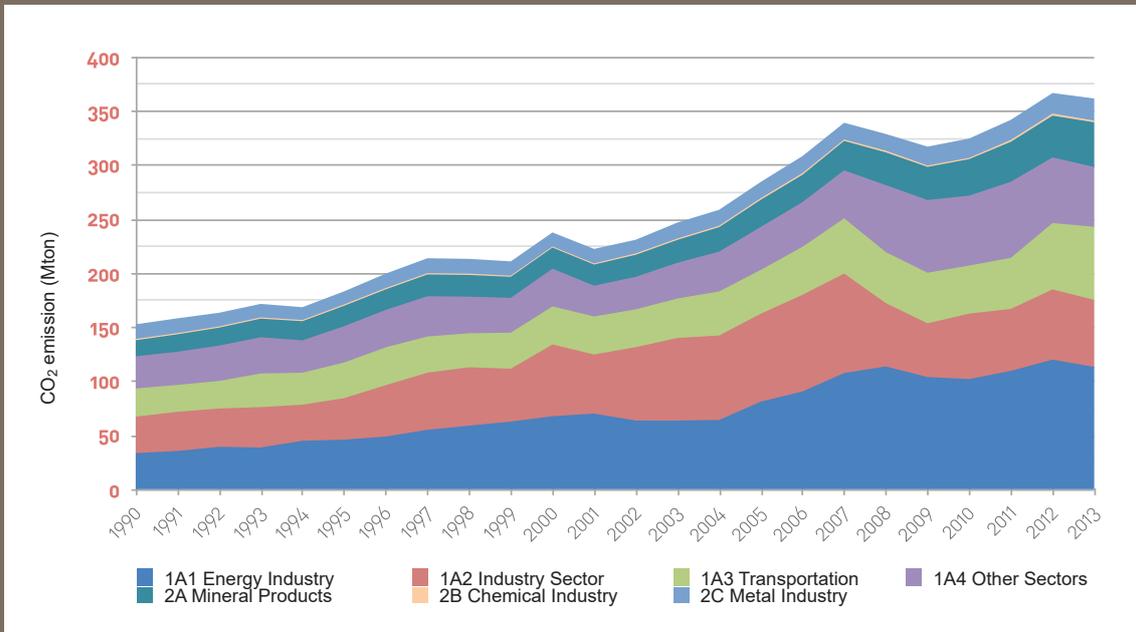


Figure 3.21 Sources of CO<sub>2</sub> emissions and their contributions as temporal variations (excluding LULUCF)

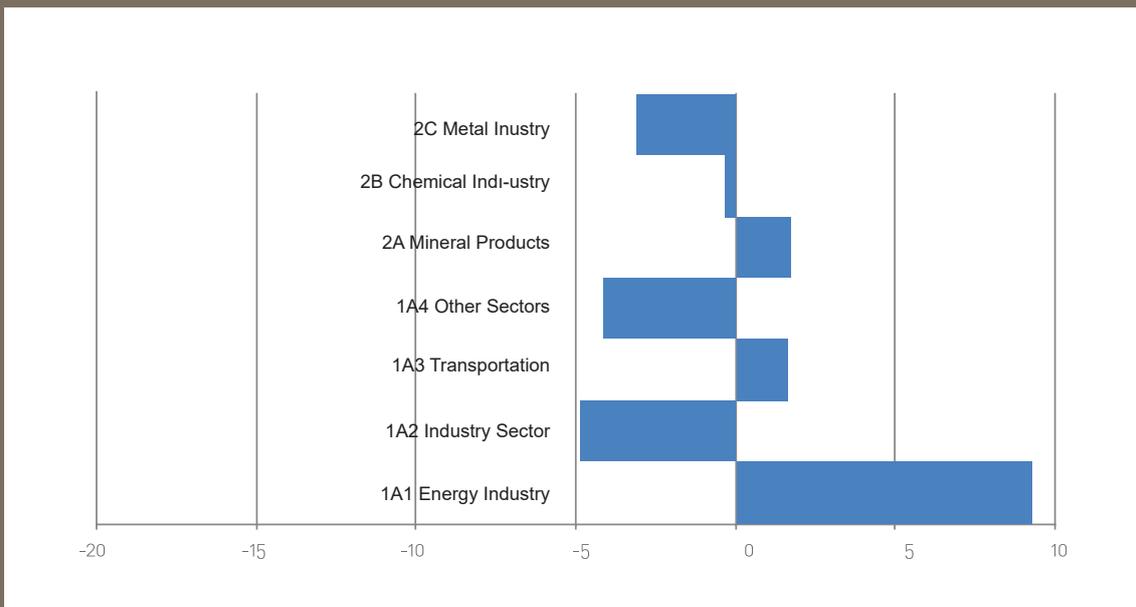


Figure 3.22 Change in the contribution of sectors to CO<sub>2</sub> emissions between 1990 and 2013 [%]

### 3.3.2 Methane Emissions

In 1990, methane emissions in Turkey were 1.871 Mton (46.76 Mton CO<sub>2</sub>-eq.) increasing by 40.7% to reach 2.63 Mtons (65.81 Mton CO<sub>2</sub>-eq.) in 2013 (Figure 3.23). While the most important methane sources in 1990 were 3A Enteric Fermentation (55%) and 5A Solid Waste Disposal (21%), in 2013 methane emissions originating from solid waste disposal increased to 34% and enteric fermentation dropped to 43% (Figure 3.24).

Figure 3.25 shows the change of sectoral shares of the source groups causing methane emissions between 1990 and 2013. It is observed that the largest change is in solid waste disposal and enteric fermentation.

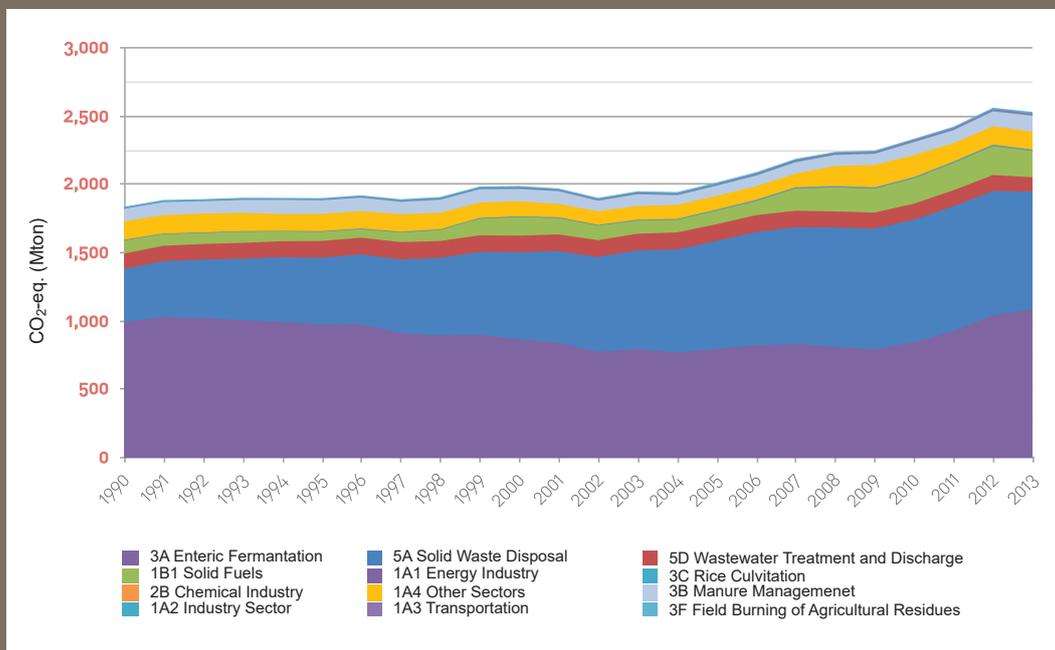


Figure 3.23 Sources of CH<sub>4</sub> emissions and their contributions as temporal variations

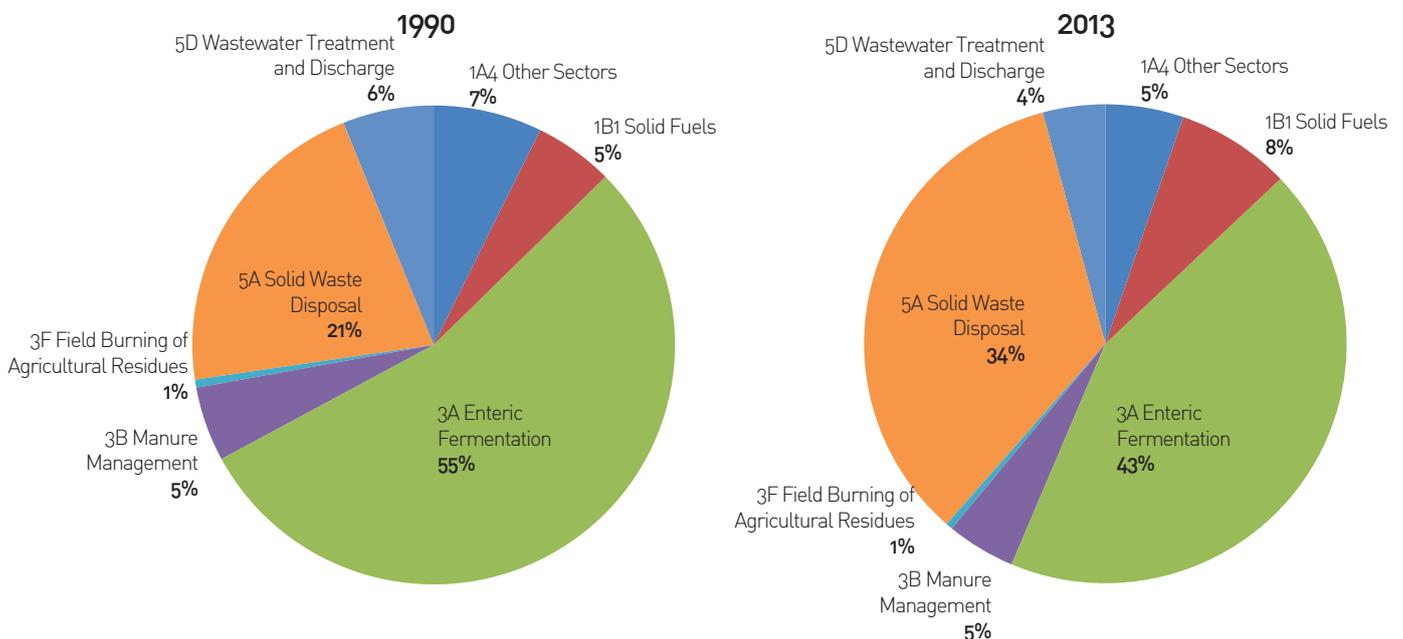


Figure 3.24 Sectoral distribution of CH<sub>4</sub> emissions in 1990 and 2013

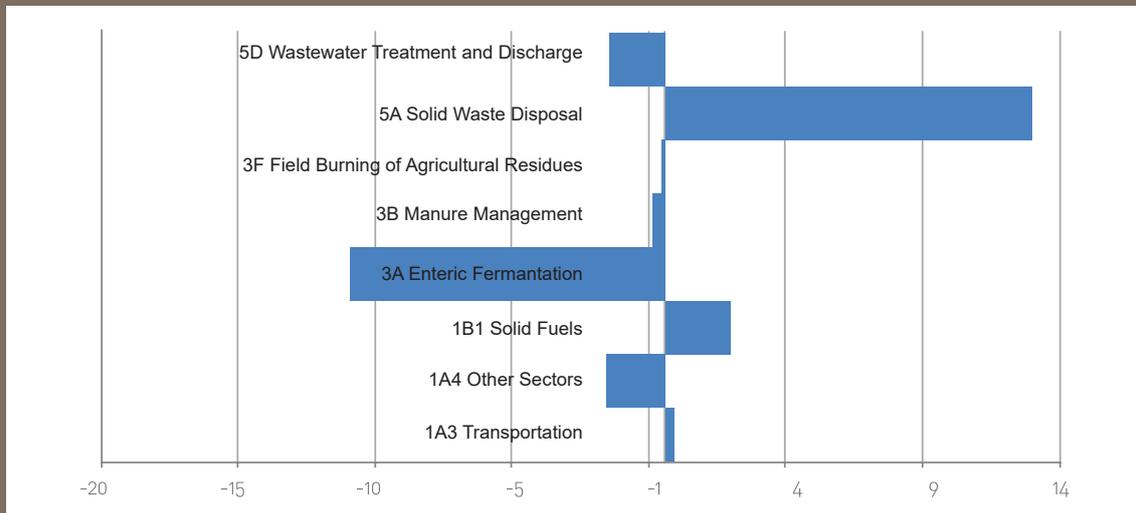


Figure 3.25 Changes in the contribution of sectors to CH<sub>4</sub> emissions between 1990 and 2013 (%)

### 3.3.3 Nitrous Oxide Emissions

In 1990, nitrous oxide emissions were 56.95 Gg (16,97 Mton CO<sub>2</sub>-eq.) increasing by 37% to 77.94 Gg (23,23 Mton CO<sub>2</sub>-eq.) in 2012 (Figure 3.26). Use of nitrous fertilizers in agricultural soils in agriculture and animal wastes forms the most important nitrous oxide source (Figure 3.27). While the important nitrous oxide sources in 1990 were 3D Agricultural Soils (68%), 3B Manure management (12%) and 5D Wastewater Treatment and Discharge (8%), in 2012, the nitrous oxide emissions originating from agricultural soils decreased to 66%, manure management increased to 14% and wastewater treatment rate (8%) did not change.

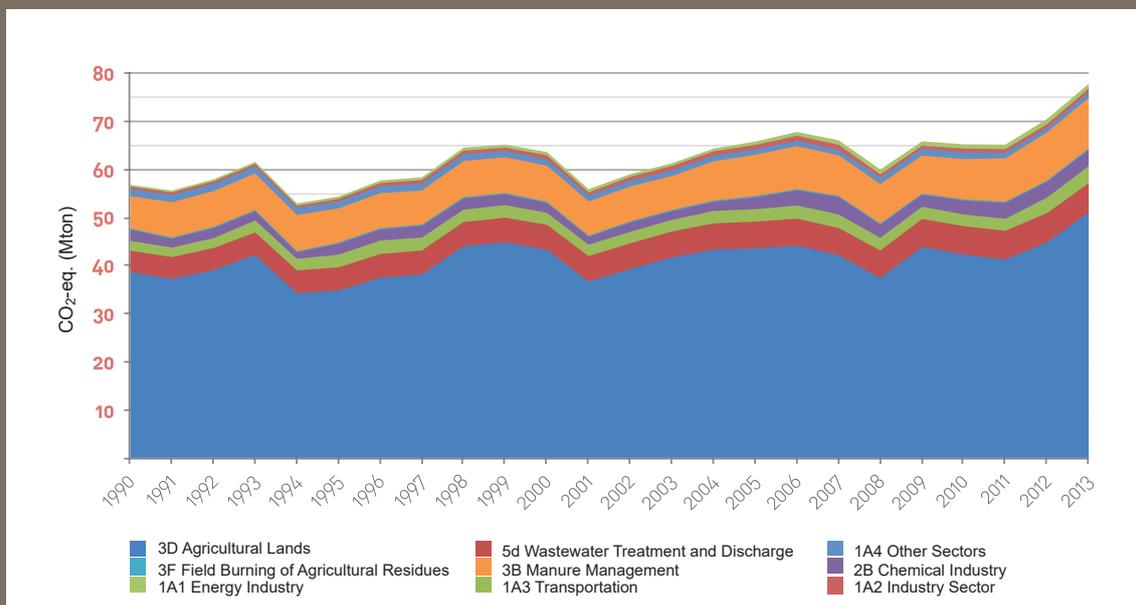


Figure 3.26 Sources of N<sub>2</sub>O emissions and their contributions as temporal variations

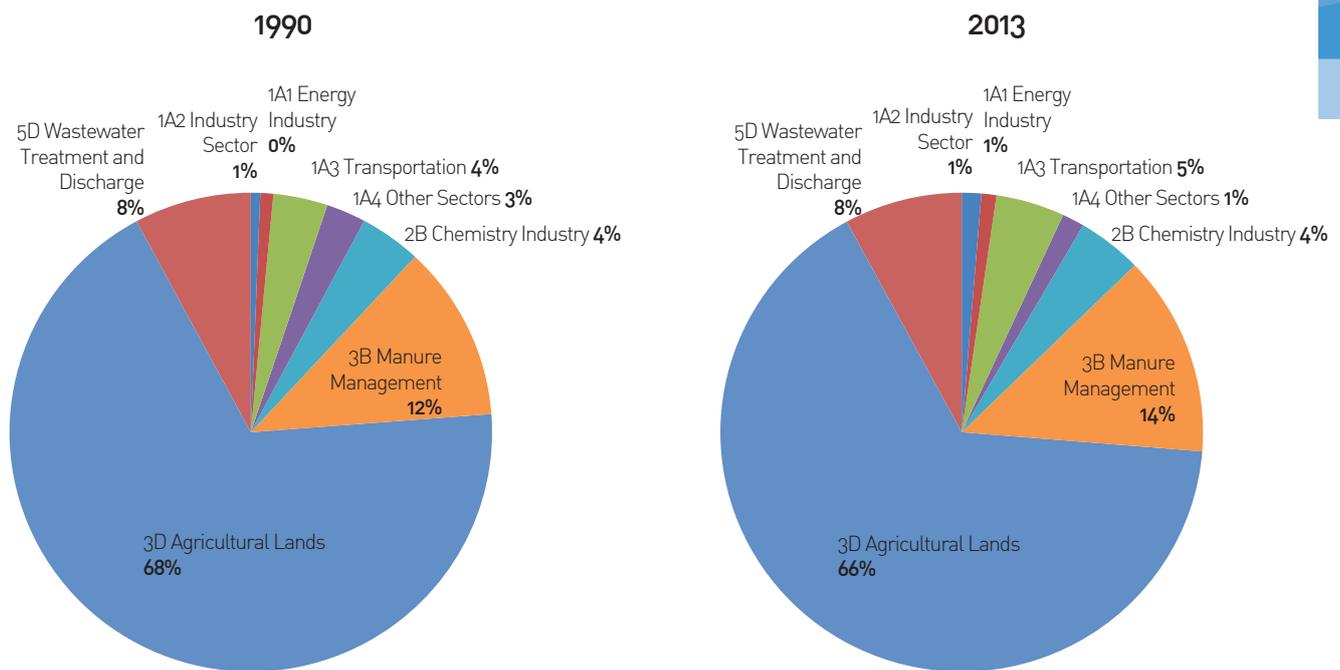


Figure 3.27 Sectoral distribution of N<sub>2</sub>O emissions in 1990 and 2013

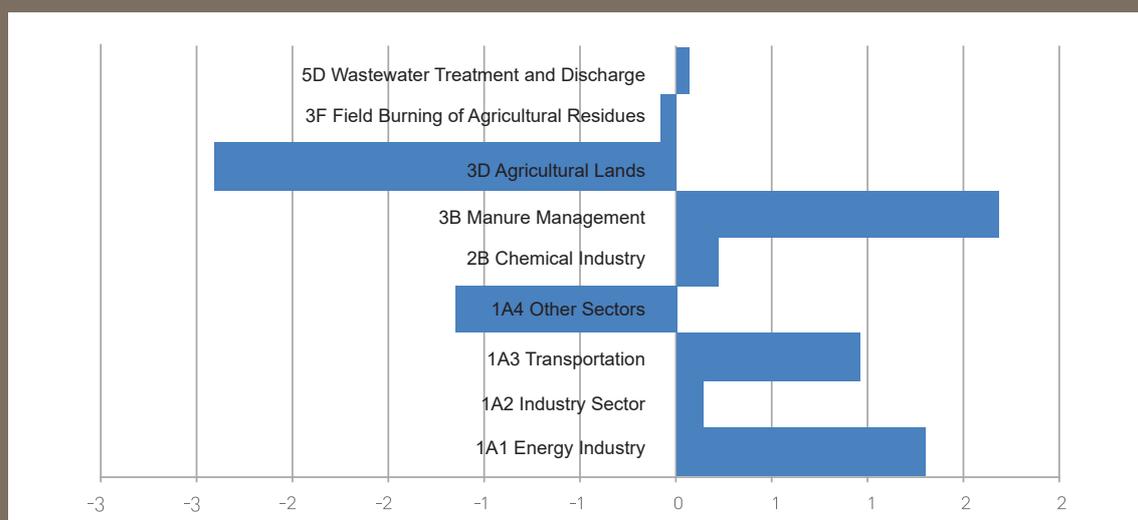


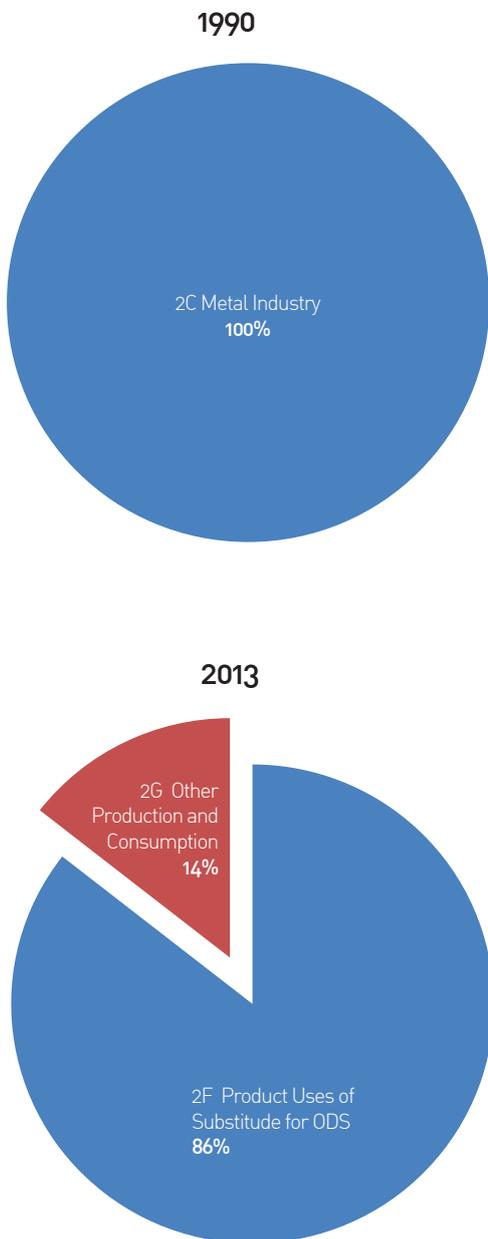
Figure 3.28 Changes in the contribution of sectors to N<sub>2</sub>O emissions between 1990 and 2013 (%)

### 3.3.4 HFC<sub>s</sub>, PFC<sub>s</sub> ve SF<sub>6</sub> Gases Emissions

The most important cause of F gases emissions is the consumption of substitutes of ODS and SF<sub>6</sub> which is used in electronic devices. Total F gases equivalent CO<sub>2</sub> emissions, which was 0.603 Mtons in 1990 have reached to 6.67 Mtons as CO<sub>2</sub>-eq. emissions in 2013 with 845.6% increase. The sub sectors that cause F gases emissions in 2013 consist of SF<sub>6</sub> which is used in devices produced in electromechanics sector, for isolation and in fire extinguishers and HFC gases used in refrigerators and air conditioners. In 1990, source of F gases are the PFCs originating from Aluminum Producti-

on facility, emissions of which is not included in the inventory as of 2007 due to being "classified information".

HFCs that are consumed in an increasing amount since 2000 only decreased during the crises of 2008 and 2009 and went back into increase trend after that. Highest PFC emissions were observed between 1990 and 1994 due to the low quality tar used in aluminum production. As of 1995, a high quality tar was imported which increased effectiveness of the production and PFC emissions in the facilities were reduced, and as of 2007, information regarding this facility is not included in inventory due to confidentiality. SF<sub>6</sub> emissions which is used in fire extinguishers and electronic devices, increased over time.



**Figure 3.29** Shares of sources in halocarbons and SF<sub>6</sub> emissions between 1990 and 2013

### 3.4. Comparison of the Inventory with Previous Inventories

Turkey has prepared a total of 10 National Greenhouse Gas Inventories, first of which was for years 1990 to 2004 and last of which is for years 1990 to 2013 and presented to United Nations Framework Convention on Climate Change. Previous inventory was prepared for years 1990 to 2013 and the comparison of this section was made over this inventory.

Except for the last one, the national greenhouse gas emission inventories are prepared using Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, IPCC Good Practice Guidance, Uncertainty Management in National Greenhouse Gas Inventories (2000) and IPCC Good Practices Guidance for LULUCF (2003). According to the decision of UNFCCC Secretariat for use of 2006 IPCC Guidelines for National Greenhouse Gas Inventories by Annex-1 countries as of 2015, the inventory for years 1990 to 2013 prepared in 2015 was prepared and presented within the framework of the criteria stated by 2006 IPCC Guidelines. In this context, in relation to the emissions of years 1990 to 2013, the greenhouse gas emissions originating from energy, industrial processes and product use, agriculture, forestry and other land use and waste sectors were revised.

Changes carried out in relation to previous years in the inventory prepared for years 1990 to 2013 and the sectors/sub-sectors for which re-calculations are made are listed below:

- In energy sector; activity data for each facility and country specific carbon contents for fuels were used in calculation of emissions. Carbon dioxide transportation, injection and geological storage categories were included.
- Within the context of industrial processes and product use; in iron-steel industry, ammonia production, nitric acid production, carbide production, data was obtained at facility level.
- In agriculture sector; cattle category was extended, emissions for buffalos were calculated separately. The milk yield of cattle was used in calculation of livestock emissions.
- In calculation of LULUCF, new sub-categories were added. Most of the emission/sink calculations in the sub-categories were made at the local level.
- In waste sector; in direction of the suggestions in guideline documents, a transition to IPCC FOD (First Order Decay) method was established. Emissions from industrial wastewater treatment and discharge, waste composting and open burning of waste were included in the inventory. In domestic wastewater treatment and discharge category country specific emission factors were used.

### 3.5. National System

Turkey became a party to UNFCCC on May 24, 2004 and in accordance with the 4<sup>th</sup> and 12<sup>th</sup> articles of the Convention and the decisions of the related Conference of Parties (COP), Turkey has undertaken to prepare greenhouse gas emissions inventory and report annually and national communication on climate change every 4 years. First national greenhouse gas inventory was prepared in direction of the Revised IPCC (Intergovernmental Panel on Climate Change) Guidelines published in 1996 (1997), IPCC Best Practice Guidelines, Uncertainty Management in National Greenhouse Gas Inventories (2000) and IPCC Best Practice Guidelines for LULUCF (Land Use, Land Use Change and Forestry) (2000 and 2003) and presented to UNFCCC in 2006. Finally, the National Greenhouse Gas Emissions Inventory covering the period between 1990 and 2013 prepared according to 2006 IPCC Guidelines was presented to UNFCCC Secretariat in 2015.

National Emission Inventory System is outlined in Figure 3.30. National system contains, in a nutshell, collecting, processing and verifying of data, determination of methods and emission factors for emission estimations, calculation of emissions, determination of key greenhouse gas emission sources and evaluation of results. According to the national system, related common reporting format (CRF) tables for each sub-source category are prepared by the related institution, after; transfer of this data to the system, determination of key greenhouse gas emission sources and evaluation of uncertainty analysis results, TurkStat report all of these to the UNFCCC Secretariat.

Activity data sources for 1990-2013 National Greenhouse Gas Emissions Inventory are;

- Energy balance and petroleum balance tables - Ministry of Energy and Natural Resources,
- Emissions originating from thermal power plants - Ministry of Energy and Natural Resources,
- Transportation emissions - Ministry of Transport, Maritime Affairs and Communication, TurkStat,
- Industry production data - TurkStat,
- Aluminum production amount - TurkStat, General Directorate of ETİ Alüminyum A.Ş.,
- Cement and clinker production amount - TurkStat, Turkish Cement Manufacturers' Association,
- Iron-Steel production amount - Facilities,

- Nitric Acid production amount - Facilities,
- Limestone production amount - TurkStat, Limestone Industry Association,
- HFC, PFC and SF<sub>6</sub> consumption amount - Ministry of Customs and Trade,
- Livestock asset and agricultural production data - TurkStat,
- Temperature data - General Directorate of Meteorology,
- Sinks and emissions arising out of land use, land use changes and forestry - Ministry of Food, Agriculture and Livestock and Ministry of Forestry and Water Affairs,
- Waste data - TurkStat.

2006 IPCC Guidelines are used as the main source in selection of emission factors.

Emission amounts of the IPCC categories estimated using confidential data are collected in upper categories if possible, or not at all included in the inventory. Industrial production data is sent by the industries to TurkStat by filling in the seasonal and annual questionnaires. Production information is also collected from the associations of industries with substantial greenhouse gas emissions such as Turkish Cement Manufacturers' Association, Automotive Manufacturers Association and Limestone Industry Association. The created database is electronic, calculations are made automatically by transferring to an excel based program directly and CRF tables are prepared in the desired format. Emission factors and the activity data can be seen from the program and calculations can be checked. Responsibilities for selection of data collection, determination of methods and emissions factors, sink calculations and reporting for land use, land use change and forestry (LULUCF) sector lies with the Ministry of Food, Agriculture and Livestock and the Ministry of Forestry and Water Affairs. All calculations related to LULUCF sector and preparation of LULUCF section of the National Inventory are carried out by these institutions, TurkStat provides for preparation and submission to Secretariat of CRF tables. F gases emissions are calculated by the Ministry of Environment and Urbanization.

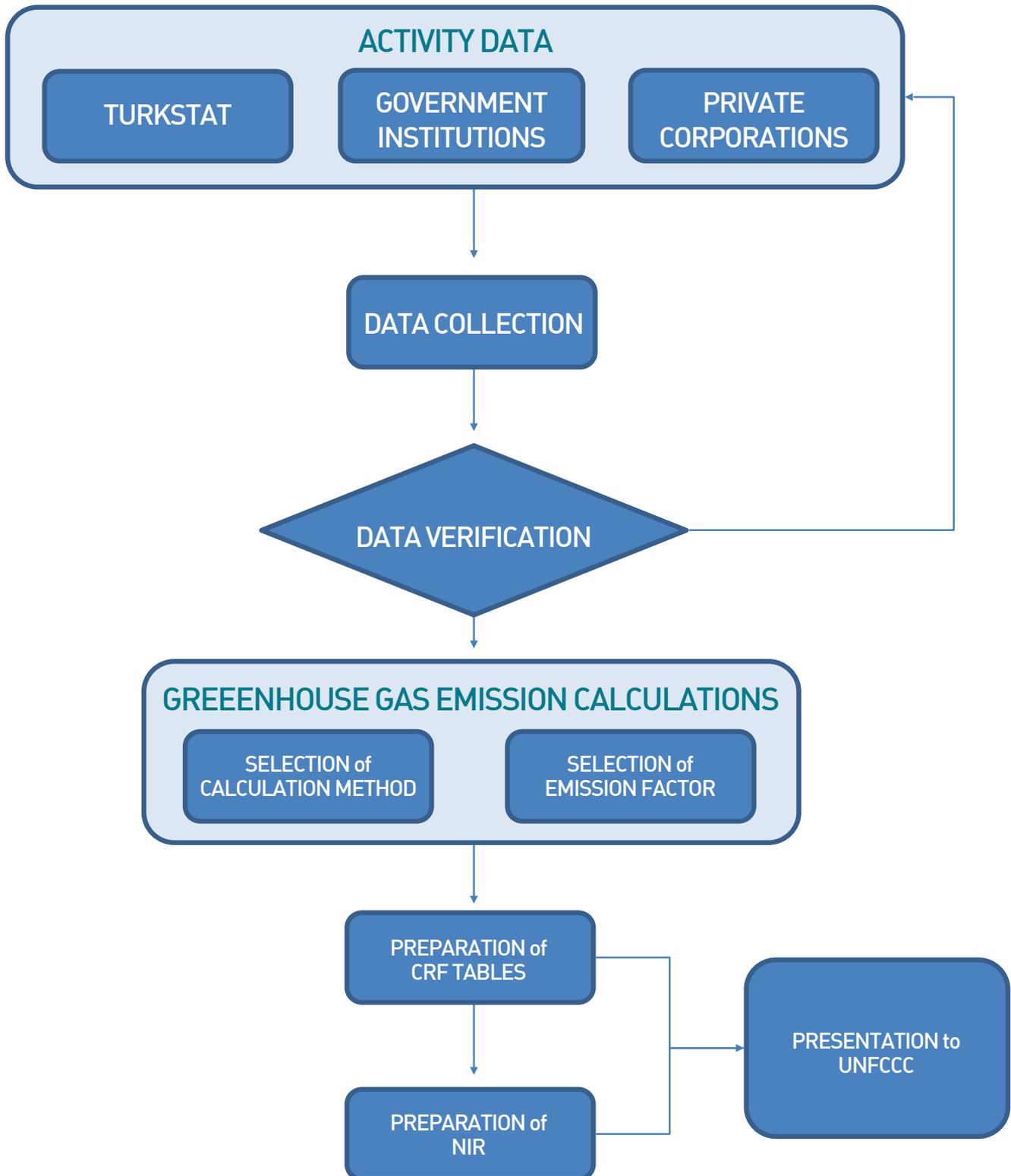


Figure 3.30 National Emissions Inventory System

### 3.5.1 Quality Assurance and Quality Control

Turkey presents its national inventory reports and CRF Tables to UNFCCC Secretariat since 2006. In 2013, Greenhouse Gas Emissions Inventory working group has prepared a Quality Control/Quality Assurance (QC/QA) plan in accordance with the 2006 IPCC Guidelines and the plan was accepted and put into effect by Coordination Board on Climate Change and Air Management on May 7, 2014.

Sector specialists responsible for national greenhouse gas emissions carried out quality control processes within the context of the QC/QA Plan during preparation of the inventory for years 1990 to 2013.

QC processes are applied as general inventory quality control processes a category-specific quality control processes within the context of QC/QA Plan.

#### **General Inventory QC Processes;**

Sector specialists responsible for the category for all categories in general inventory quality controls

#### **Data collection, input and data processing activities: quality control**

1. Accuracy control of data entries for activity data
2. Accuracy control of the formulas used in calculation pages

#### **Data documentation: quality control**

3. Completeness control of inventory files
4. Activity data control according to data sources
5. Control of placement of references stated in calculation tables also in the inventory document
6. Completeness control of calculation tables and inventory
7. Control of parallelism of assumptions and selection criteria for data, emission factors and other calculation parameters with the IPCC Guidelines
8. Control of documentation of the changes in data or methodology together with their grounds
9. Control of admissibility of information given in calculation tables and inventory document

#### **Control of emission accounts and calculations**

10. Control of existence of all calculations in the archive
11. Control of accurate determination of units, parameters and conversion factors
12. Control of completely correct and accurate calculation
13. Correctness control of conversion factor
14. Accurate use control of correction factors
15. Accuracy control of some calculations manually or electronically
16. Consistency control of time series in cases where data or method changed
17. Control of whether there are unexplained or extraordinary changes in time series data
18. Consistency control of the time series of implied emission/sink factors

General inventory QC processes are applied by the sector specialists of the related institutions and organizations. QC specialist carries out the general inventory quality controls for the related sector in accordance with the control list given in Annex II of QC/QA Plan. Control list includes findings of QC specialist and the explanations on the issues that need to be done in the future and that continue as problems.

#### **Category-specific QC processes; Quality control of emission data**

1. Emission comparisons: control of historical data for sources and important sub-sources
2. Control with independent calculations or calculations carried out with alternative methods
3. Comparison with reference calculations
4. Completeness control

#### **Quality control of emission factor**

5. Control of compliance of emission factors with country conditions and similar emission data
6. Comparison with alternative factors (IPCC default factors, factors of other countries, literature)

#### **Quality control of activity data: national level activity data**

7. Control of trends
8. Comparison with different reference sources

9. Control of data applicability

10. Compliance control of methods used to complete the time series of defective data

Category-specific QC processes are applied by the sector specialists of the related institutions and organizations. QC specialist carries out the category-specific quality controls for the related sector in accordance with the control list given in Annex III of QC/QA Plan. Control list includes findings of QC specialist and the explanations on the issues that need to be done in the future and that continue as problems.

National inventory reports and CRF tables presented to the UNFCCC Secretariat are reviewed by international specialists. CRF tables presented to Secretariat until today were reviewed by international specialists and the suggested corrections were considered by TurkStat and calculations were repeated. First quality control within the context of QC/QA plan was carried out with 1990-2013 greenhouse gas inventory.

### 3.5.2 Uncertainties

Calculation of uncertainty under emission inventory carried out in accordance with error propagation method (approach 1) for combining uncertainties, as outlined Volume 1, Chapter 3 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The uncertainty of the 1990-2013 Turkish Greenhouse Gas Inventory was established as 10.55%, while including LULUCF. The most important sources for uncertainty are methane emissions emitted during coal mining (6.7%) and nitrous oxide emissions emitted by agricultural soils (5.2%).





## **4. POLICIES and MEASURES**

## 4. POLICIES and MEASURES

### 4.1. Policy Framework and Policy-Making Process

#### 4.1.1 Sustainable Development

##### Five Year Development Plans

On September 30th 1960, Former State Planning Organization was established to put Turkey's development in a faster and more planned manner, use resources efficiently and provide economic, social and cultural planning services in a rapid and well organized system. The First Five Year Development Plan covering from 1963 to 1967 are prepared based on the subjects of increasing national savings, directing investments for the benefit of society and realizing economic, social and cultural development through democratic means. After publishing the first development plan, five year plans were prepared and published regularly. Ten development plans have been prepared so far.

When considering the establishment objectives of State Planning Organization, even though it does not directly aim environmental and climate change issues the statement of "more efficient use of resources" indirectly indicates prevention of environmental pollution and therefore fight against climate change. However, the first development plan to include direct targets for fight against environmental pollution based on "sustainable development principle" is the Sixth Development Plan prepared for years 1990 to 1994. Hence, this principle afterwards formed the basis for the policies to be prepared in relation to climate change. The concept of sustainable development which was present in Local Agenda 21 and National Environment Action Plan as well as the Sixth Development Plan has gained importance especially with European Union harmonization process. In this direction, the "National Sustainable Development Report" prepared by the former Ministry of Environment and Forestry in 2002 has established the objectives, principles and policies of the sustainable development concept. In 2005, "National Sustainable Development Commission" was established in order to monitor application and dissemination of the concept.

Although there were always concepts related to environmental pollution and therefore climate change through targets like "effective use of resources" even if not directly in all five years plans starting from the first published five years development plan, the issue of climate change was clearly stated for the first time in Eighth Five Years Development

Plan. This Plan states that regulations will be carried out for increasing energy efficiency in order to mitigate greenhouse gas emissions with the works on being a party to UNFCCC.

In 2012, the Ninth Development Plan which covered years 2007 to 2013 was in effect. Ninth Development Plan was prepared for a period in which there was an intensive competition and global change throughout the world, especially rapid changes were observed in economy. Ninth Development Plan was prepared with the vision of "Turkey, which grows in stability, shares its revenues more fairly, which has global competitive power and which has completed the harmonization process for full membership to European Union" based on the principles of Long Term Strategy (2001-2023) document (SPO, 2006).

Ninth plan covering the starting year of the development plans that act as a driver for Turkey's development and therefore growth of its industry also contains targets on industrial competitive power, environment and climate change. The first axis for development established in order to continue constant economic growth and social development within the period of the Ninth Development Plan was stated as "Increasing competitive power" (SPO, 2006). The plan also states that;

- A national action plan that states the policies and measures for mitigating greenhouse gas with the participation of the related parties pursuant to Turkey's conditions will be prepared, responsibilities regarding UNFCCC will be fulfilled,
- More efficient production and less wastes will be achieved by applying environment-friendly technologies in industry and increasing effectiveness in raw-materials use.



- Sustainable growth by considering the harmony of industry and environment policies and production by applying the human health and environment protection rules will be provided. (SPO, 2006).

The latest five year plan, which is still active, is the Tenth Five Years Development Plan covering from 2014 to 2018. The aim of the Tenth Development Plan which was prepared in a period when the risks and uncertainties persist in global economy and the effects of the global economic crisis experienced in 2008 still have impact especially on the developed countries is stated as “increasing our country’s international position and our people’s prosperity through structural transformations to be carried out based on the basic values and expectations of our nation in the re-shaping world”. One of the main principles of Tenth Development Plan is to carry our country to the top position in international value chain hierarchy. The means of raising to the top position in international value chain hierarchy is to manufacture products and services which have higher added value. The Plan sees technology and the R&D policies as main actors for both efficiency of the existing sectors and transformation to a structure where the highly efficient sectors are dominant for reaching this goal. Tenth Development Plan also states that the growth model based on “green growth” concept to achieve the sustainable development targets gains importance and that it is possible to provide protection of environment and increase competition at the same time with cleaner production and eco-efficiency studies in production.

### Medium-term Program

Several strategy documents and programs has been prepared in direction of the principles of development plans in order to make Turkey’s development well organized and planned. One of these programs is the Medium-Term Program covering from 2016 to 2018. Main objective of the Medium-Term Program is stated as “Maintaining macroeconomic stability, reducing current operations deficit and inflation, and therefore increasing the growth via structural reforms and making it more inclusive” in the introduction of the program. The program includes actions such as “improving energy efficiency”, “increasing water use in agriculture”, “using natural resources more effectively”, and “making economic gains from waste” to challenge climate change.

### 4.1.2 Climate Change Policy

Foundation of Turkey’s policies regarding climate change was laid with the Eighth Five Years Development Plan. In 2000, Climate Change Special Expertise Commission Report was published within the context of Eighth Development Plan. The Ninth and Tenth Five Years Development Plans prepared after that have added objectives for development of the process. While it was stated that the studies for the process of being a party to UNCCFC will be carried out in Eighth Five Years Development Plan, it was also stated that regulations will be carried out in energy efficiency field for reduction of greenhouse gas. As foreseen in Ninth Five Years Development Plan, another step has been taken towards the fight against climate change and a “Climate Change National Action Plan” showing the policies and measures for greenhouse gas reduction in accordance with Turkey’s conditions was prepared. The Tenth Five Years Development Plan which was prepared last and which is still in effect states that “green growth” concept is taken as a basis in order to reach sustainable development targets.

“Coordination Board on Climate Change (CBCC)” which includes representatives from public and private sectors and the non-governmental organizations was established in 2001 in order to coordinate various units’ studies on challenging climate change. The Board was restructured 4 times in 2004, 2010, 2012 and 2013. Within the context of the amendments made in 2013, which was the final structuring added weather management to the board’s fields of activity and the board was renamed as “Coordination Board on Climate Change and Air Management (CBCCAM)”. The Board consists of twenty institutions and organizations, which are; Ministry of Environment and Urbanization (coordinator), Ministry of European Union Affairs, Ministry of Science, Industry and Technology, Ministry of Foreign Affairs, Ministry of Economy, Ministry of Energy and Natural Resources, Ministry of Food, Agriculture and Livestock, Ministry of Internal Affairs, Ministry of Development, Ministry of Finance, Ministry of National Education, Ministry of Forestry and Water Affairs, Ministry of Health, Ministry of Transport, Maritime Affairs and Communication, Undersecretariat of Treasury, Turkish Union of Chambers and Commodity Exchanges, Turkish Industry and Business Association, Independent Industrialists’ and Businessmen’s Association, Disaster and Emergency Management Authority and Turkish Statistical Institution. The coordination board has seven work sub-groups as well as CBCCAM Consultancy and secretariat, organizational scheme of which is given in Figure 4.1. Aside from this, institutions and organization within the board have related units or specialists related to climate change.

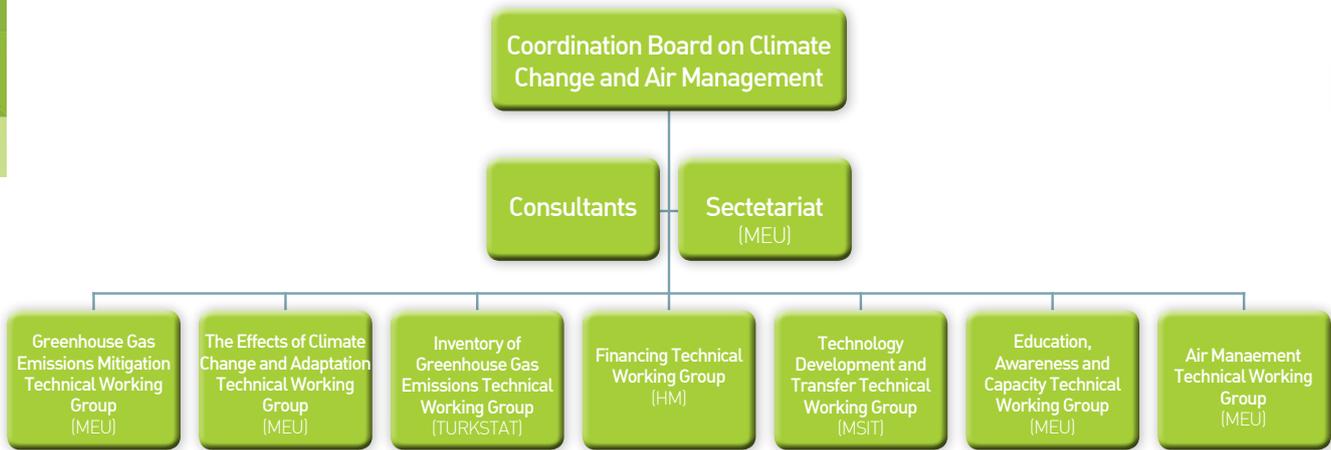


Figure 4.1 CBCCAM organizational scheme

Main document used for generation of policies regarding climate change studies is the “National Climate Change Strategy Document” covering years 2010 to 2020. Document was prepared in coordination of the former MoEF with a widely participated study containing CBCC members, related public and private sector representatives, universities and NGOs and approved by Higher Planning Council on May 3, 2010.

#### National Climate Change Strategy Document (2010-2020)

It was prepared to guide the studies to be carried out on climate change between 2010 and 2020 and to determine the key policies in this field. Document contains the mitigation, compliance, financing and technology policies that Turkey can realize with the help of national and international resources based on the “common but differentiated responsibilities” principle. Detailed information related to the Document is provided in 5<sup>th</sup> Climate Change Report of Turkey.

#### National Climate Change Action Plan (2011-2023)

Climate Change National Action Plan was prepared in accordance to the Ninth Development Plan and National Climate Change Strategy Document in coordination of the Ministry of Environment and Urbanization with a wide group containing CBCC members and other stakeholders and was published in July 2011. Plan provides actions for control of greenhouse gas emissions and compliance studies within the context of National Climate Change Strategy Document and defines the responsibilities and timing for application of these actions. Detailed information related to the Plan is provided in 5<sup>th</sup> Climate Change Report of Turkey.

### 4.1.3 Institutional Structure in Combatting Climate Change

Since climate change is a multi-disciplinary subject, climate change studies have been studied by various institutions and organizations. Therefore, Coordination Board on Climate Change, which was renamed as “Coordination Board on Climate Change and Air Management” with the final structuring in 2013. Within the context of Board’s responsibilities arising out of its agreement for European Economic Commission’s

Convention on Long-range Transboundary Air Pollution with UNFCCC, the protocols subject to these conventions and the internal legislation, it has two key roles as taking the necessary measures for fight against climate change and prevention of air pollution and coordinating studies for determination of appropriate internal and foreign policies considering the specific conditions of our country.

Directorate General of Climate Change, which continues its activities under Ministry of Environment and Urbanization Directorate General of Environmental Management consists of four branches, namely; Policy and Strategy Development Branch, Greenhouse Gas Monitoring and Emissions Trade Branch, Climate Change Compliance Branch and Ozone Layer Protection Branch.

Separate branches were founded for climate change compliance, draught management and flood management issues under the Ministry of Forestry and Water Affairs - General Directorate of Water Management (GDWM) to determine the impact of climate change on water resources and to carry out compliance planning for managing possible impacts on river basins. Main activity fields of these branches are to prepare sectoral compliance plans, draught management plans and flood management plans in basins basis.

Basin management plans are prepared by Basin Management Branch and these plans consider suitable compliance measures and the impacts of climate change on water resources. Climatology Branch, which operates under Research Department of General Directorate of Meteorology which operates under the Ministry of Forestry and Water Affairs also carries out climate analysis and climate change studies.

The Environment and Climate Change Department was established under General Directorate of Foreign Affairs and European Union of the Ministry of Transport, Maritime Affairs and Communication, which is another member of the Coordination Board on Climate Change and Air Management in order to carry out studies on environment, energy, greenhouse gases and climate change issues and to provide coordination of studies in this context. Similarly, Environment and Climate

Change Branch was established under General Directorate of Industry of the Ministry of Science, Industry and Technology in order to follow the progress in environment and climate change, evaluate them for preparing industry policies and to help in taking the necessary measures, to coordinate ministry's units in these issues and to take place in national and international processes on these issues.

There are work groups or expertise groups carrying out studies related to climate change in other member institutions of Coordination Board on Climate Change and Air Management.

#### 4.1.4 Monitoring and Evaluation

Turkey is a Party to the Kyoto Protocol and it has no reduction commitments. For this reason, the monitoring studies aim to monitor and evaluate its policies and targets regarding climate change. Necessary legal regulations and monitoring and evaluation activities related to climate change are carried out by the related ministries. Regulation on Monitoring of Greenhouse Gas Emissions was published on Official Gazette No. 29003 on May 17, 2014 and entered into effect in order to regulate the studies for monitoring and reporting greenhouse gases. After this, two communiques, which are

the Communique on Monitoring and Reporting Greenhouse Gases (published on Official Gazette No 29068 on July 22, 2014) and the Communique on Verification of Greenhouse Gas Emission Reports and Authorization of Verification Institutions (published on Official Gazette No 29314 on April 2, 2015) were published in order to clarify the implementation principles of regulation's provisions. Also, a network based monitoring and evaluation system is established in order to monitor the issues included in National Climate Change Action Plan.

#### 4.1.5 Financing

In Turkey, financing needs for the policies and measures related to climate change are substantially supplied by national resources. Usage rates of international funds are relatively very low compared to use of national resources. However, there will be more need for benefiting from international funds in order to promote the existing measures for reduction and compliance and to take additional measures.

#### 4.2. Crosscutting Policies and Measures

Policies and measures that overlap among the institutions related to studies on fight against climate change are given in Table 4.1.

Policy/Measure	Objective	Effected Greenhouse Gas	Type of Policy/ Measure	Status	Executing Institution or Organization
Economic means (Voluntary Emissions Trade, renewable energy supports, government aids)	Reducing fossil fuel consumption	All	Economic	In effect	Ministry of Environment and Urbanization
EU Candidacy Period	Harmonization of legislation, infrastructure investments and implementations	All	Legal, financial	In effect/ Planned	Ministry of Environment and Urbanization and other related ministries
National Climate Change Strategy and Action Plan	Reduction of emissions in energy, industry, transportation, waste, buildings and forestry sectors	All	Legal, economic, financial, research, information	In effect	Ministry of Environment and Urbanization and other related ministries
Local Climate Policies	Measures to reduce emissions in transportation, waste, energy and forestry issues	All	Legal, economic	In implementation	Local administrations
Voluntary Applications of the Private Sector and NGOs	Improving collaboration in fight against climate change, raising awareness, emissions reduction, investment	All	Voluntary	In implementation	Private sector and NGOs

**Table 4.1** Overlapping policies and measures among institutions

## 4.2.1 Carbon Market in Turkey

### Partnership for Carbon Market Readiness (PMR) Project

World Bank has implemented a technical support program called “Partnership for Carbon Market Readiness (PMR)” to provide the necessary capacity improvement for the developing countries and rising economies to benefit from the market mechanisms actively.

Multi-donor Fund for Grant Agreement Partnership for Carbon Market Readiness (PMR) for Market Readiness Offer” No. TF010793 made by the World Bank and Undersecretariat of Treasury was published in Official Gazette No 28165 on January 6, 2012 and “Grant Agreement for Implementation Fund Grant No TF015591 for Partnership for Carbon Market Readiness” was published on Official Gazette No. 28910 on February 11, 2014. A grant of 3,350,000 USD was allocated by the Ministry of Environment and Urbanization with the contracts. Ministry of Environment and Urbanization was determined as the Implementing Institution on the aforementioned Grant Agreement.

Pilot study for implementation of “Regulation on Monitoring of Greenhouse Gases (MRV)” in voluntary sectors, analytical studies for supporting decision making processes for using carbon market mechanisms, capacity improvement, awareness and training studies will be carried out within the context of the project in coordination with all related stakeholders.

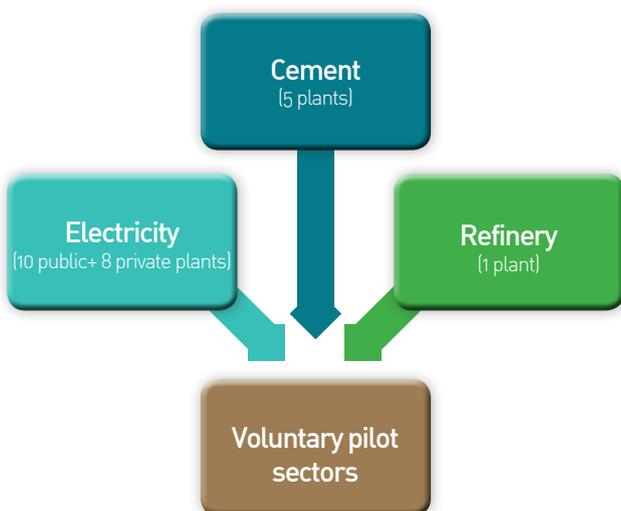


Figure 4.2 Voluntary pilot sectors

Voluntary facilities from electricity, cement and refinery sectors were determined for the pilot study on implementation of “Regulation on Monitoring of Greenhouse Gases (MRV)” (Figure 4.2). This element has been initiated on October 2014, and studies regarding pilot facilities will be completed in 2015.

Studies for market based mechanisms, which are the second element of the project, are planned to be initiated on October 2015 and continued until the beginning of 2017.

### Voluntary Carbon Markets

Although Turkey does not benefit from the flexibility mechanisms of the Kyoto Protocol, projects for Voluntary Carbon Market founded in Turkey around environmental and social responsibility principles and operates independent from these mechanisms have been developed and implemented for a long time.

Turkey hosts projects that develop certificates traded in Voluntary Carbon Markets since 2005. Although the Voluntary Carbon Market represents a very small percentage within the World Carbon Market, Turkey’s current effective use of this market presents an important opportunity for its future participation in the carbon markets.

In current status, there are 308 projects traded in our country’s Voluntary Carbon Market. These projects are expected to realize an annual greenhouse gas emissions reduction of over 20 Mtons CO<sub>2</sub>-eq. Information for the projects on this issue as of April 2014 are given in Table 4.2.

Project Type	Number of Projects	Annual Greenhouse Gas Reduction (ton CO <sub>2</sub> -eq/d)
Hydroelectricity	159	8,747,634
Wind	106	7,951,391
Geothermal	6	405,309
Energy Efficiency	10	432,081
Energy Production from Waste	27	3,069,273
<b>Total</b>	<b>308</b>	<b>20,605,688</b>

Table 4.2 Projects for Turkish Voluntary Carbon Markets with reduction rates

## 4.3. Energy

### 4.3.1 General Policies and Strategies

In parallel to its economic and social development targets, Turkey is one of the most dynamic energy economies of the world with the increase in its energy demand. As one of the countries that having the highest energy demand increase among the OECD countries, energy demand of Turkey is expected to double in the upcoming 10 years<sup>1</sup>.

Various policy documents are published in the recent years for Turkey's energy policy. The targets of completing privatization, improving market operation, initiating nuclear power plant construction, expediting local and renewable resources in order to reduce excessive dependency on natural gas, increasing energy efficiency in production and consumption, making Turkey a transit route and terminal country for transporting petrol, natural gas and electricity resources are the targets that are included in this document for solution of the energy problem.

Mentioned energy policies and strategies of Turkey are included in the documents listed below;

- 2015-2019 Strategic Plan of the Ministry of Energy and Natural Resources (2014)
- Medium Term Program (2014-2016)
- 10<sup>th</sup> Development Plan 2014-2018 (2013) and Energy Efficiency Improvement Program Action Plan and Production Based on Local Resources Program Action Plan (2014)
- Supreme Council for Science and Technology 26<sup>th</sup> Meeting Decisions, (2013)
- TÜBİTAK Energy Efficiency Technology Roadmaps (2013)
- Energy Efficiency Strategy Document, (2012)
- Electricity Market and Supply Security Strategy Document (2009)
- Climate Change Strategy (2010-2023)
- Climate Change Action Plan (2011-2023)

#### Energy Efficiency Improvement Program Action Plan

Program's Objectives are to carry out studies for improvement of energy efficiency in some sectors and fields chosen in accordance to the Energy Efficiency Strategy Document (2012 - 2023) that entered into effect in 2012, promote some existing applications, introduce best practices and raise public awareness and finally to contribute to demand management.

#### Program's Targets

1. Reducing Turkey's primary energy intensity which was 0.2642 TEP/1000 USD with climate correction and with dollar prices of 2000 at the end of 2011 under 0.243 TEP/1000 USD value
2. Reducing the energy consumption in government buildings by 10% in the level of indicators based on year 2012 and with efficiency increase practices until 2018

**Performance indicators** between 2013 and 2018 were determined as; reducing primary energy density from 0.270 (TEP/1000 USD) to 0.243 and reduction (decrease of increase) in energy consumption of government buildings. Program has 6 elements. All of these elements support both Energy Efficiency Strategy and the Law on Energy Efficiency. Elements of the program are listed below.

- Improving Administrative and Corporate Capacity for Energy Efficiency
- Developing Sustainable Financial Mechanisms for Financing Energy Efficiency Studies and Projects
- Increasing Energy Efficiency in Industry
- Improving Energy Efficiency in Buildings
- Increasing Energy Efficiency in Transportation

- Promoting on-site production, Co-generation and Microgeneration Systems in Electricity Production

#### Production Based on Domestic Resources Program Action Plan

**Program's Objective's** are to assess all local resources, especially renewable energy resources in aspects of both primary energy supply and electricity production in order to provide for high and stable growth of Turkish economy and therefore to decrease external dependency.

#### Program's Targets

1. Increasing the share of local resources in primary energy production which was 27% at the end of 2012 to 35% at the end of 2018
2. Increasing the local coal based electricity power production which was 32 billion kWh in 2013 to 57 billion kWh at the end of 2018
3. Engaging an additional hydraulic capacity of 10,000 MWs within the plan period

As of 2018, Performance Indicators were foreseen as; Increasing electricity production from local coal from 32 TWh to 57 TWh, petrol and natural gas production from 72,000 barrels/day to 121,600 barrels/day, electricity production from hydraulic energy from 59 TWh to 91 TWh, electricity production from renewable resources (Wind, solar, geothermal and biomass) from 10 TWh to 29 TWh. Elements of the program are listed below.

- Assessment of Local Coals for Electricity Production
- Increasing Domestic and International Petrol and Natural Gas Explorations
- Assessment of Water Resources for Electricity Production
- Assessment of Renewable Resources Except Water

<sup>1</sup> Speech Text of Mr. Taner Yıldız, the Ministry of Energy and Natural Resources Presenting the Budget for Year 2015 to the Plan and Budget Commission of Grand National Assembly of Turkey

Main goal of Turkey's general energy policy is determined as to supply the necessary energy in order to support economic growth and social development in time, in a reliable and cost-effective manner, in reasonable prices and in an environmentally sensitive way. In this context, Turkey's main strategies and policies based on the energy supply security are outlined as:

- Providing resource diversity by prioritizing local resources,
- Increasing the share of renewable energy resources in energy supply,
- Increasing energy efficiency,
- Giving full operability to free market conditions and improving the investment environment,
- Providing resource diversity in petrol and natural gas fields and taking the measures to mitigate the risks arising out of import,
- Becoming an energy corridor and terminal within the context of regional collaboration processes using the geostategic position effectively,
- Providing for environmentally sensitive execution of activities in energy and natural resources,
- Increasing contribution of natural resources to the country's economy,
- Increasing production of industrial raw materials, metal and non-metal minerals and providing for their domestic use,
- And to make energy accessible for consumers in cost, time and amount aspects.

### 10<sup>th</sup> Development Plan's Objectives and Targets

"Based on resource diversification in energy provision and supply of energy to end consumer constantly, with quality and with minimum cost, the main objective is to reach a competitive energy system which makes use of the local and renewable energy resources at the highest level, foresees use of nuclear technology in electricity production, supports decreasing economy's energy-intensiveness, mitigates loss and environmental impact of energy and empowers the country's strategic position in international energy trade." The plan foresees that will affect the greenhouse gas emissions are included in the plan as seen below.

- Construction of Akkuyu NPP's first unit will be completed substantially within the plan period. First construction of a second NPP in Sinop will be initiated. Within the plan period,

area determination, preliminary feasibility and investment preparations of a third 5,000 MW NPP will be initiated.

- Local coal resources will be converted to electricity energy using environment-friendly and highly efficient technologies by the private sector. Afşin-Elbistan basin lignite reserves will be used for electricity production. Use of coal deposits with small reserves in regional energy production facilities will be provided.
- Energy Efficiency Strategy will be implemented effectively and efficient use of energy in all industries will be provided. Rehabilitations of the thermic and HPPs that are foreseen to remain in government will be completed, their loss-leakage rates will be mitigated to lowest possible level.

Two programs were declared within the context of objectives and targets of the 10<sup>th</sup> Development Plan. These programs are "Energy Efficiency Improvement Program Action Plan" and "Production Based on Domestic Resources Program Action Plan.

### Medium Term Program - 2014-2016

The following measures and actions mentioned in all other strategy documents for solution of energy problem are repeated also in Medium Term Programs;

- Concentrating on use of domestic coal and renewable energy resources in electricity production,
- Continuing nuclear power plant investments without delay,
- Increasing energy production based on local resources by carrying out plant rehabilitations,
- Continuing energy efficiency studies in order to decrease energy-intensiveness of the economy
- Observing priorities for saving in energy consumption and the fight against climate change in determination and implementation of tax policies
- Increasing the resources saved for investments in minerals, energy raw materials, renewable energy and nuclear energy substantially and mitigating external dependency in energy (MTP 2015-2017).

## 2015-2019 Strategic Plan of the Ministry of Energy and Natural Resources

Objectives and targets of this strategy plan were collected under 8 themes to determine the strategies.

**Theme 1:** Energy Supply Security

**Theme 2:** Energy Efficiency and Energy Saving

**Theme 3:** Good Governance and Stakeholder Interaction

**Theme 4:** Regional and International Effectiveness

**Theme 5:** Technology, R&D and Innovation

**Theme 6:** Improvement of Investment Environment

**Theme 7:** Raw Material Supply Security

**Theme 8:** Effective and Efficient Use of Raw Materials

## Decisions of the Supreme Council for Science and Technology (BTYK)<sup>2</sup>

26<sup>th</sup> meeting of the Supreme Council for Science and Technology (BTYK) held on June 11, 2013 was conveyed with the agenda of "Energy", it was decided to implement 7 programs with the coordination and contribution of related institutions in order to support development of local technologies, increased use of renewable and local resources and increase of energy efficiency.

## Energy Efficiency Strategy

The Energy Efficiency Strategy, which entered into effect in February 2012 with the Decision of Higher Planning Council,

aims to reduce the energy amount consumed per GDP (energy intensiveness) by at least 20% compared to the value of 2011 (basis value not provided).

The following issues were determined as strategic goals and activities were foreseen depending on these goals.

- Decreasing energy intensiveness and energy losses in industry and services sector,
- Decreasing energy demand and carbon emissions of the buildings; promoting sustainable and environmentally friendly buildings that use renewable energy resources,
- Providing exchange of energy-efficient products in market
- Increasing efficiency in electricity production, transfer and distribution; decreasing energy losses and harmful environmental emissions,
- Decreasing unit fossil fuel consumption of motor vehicles; increasing the share of railways and urban mass transportation in load and passenger transportation; preventing unnecessary fuel consumption in urban transportation and decreasing emissions harmful for the environment,
- Efficient and effective use of energy in public establishment,
- Enhancement of corporate structures, capacities and collaborations; increasing use of advanced technology and awareness raising activities; establishing sustainable financing environments except government subsidies.

### Decisions of the Supreme Council for Science and Technology (BTYK):

**Improvement of Domestic Thermic Power Plant Design and Production Ability (MILTES) [2013/201]:** Improvement of local thermic power plant design and production ability and to reach the goal of 80% localness in fluidized bed boiler technology within 5 years by collaboration of the public and private sectors

**Improvement of Hydroelectric Energy Technologies (MILHES) [2013/202]:** Providing design and production abilities for hydroelectric energy technologies to our country, reaching the goal of 80% localness in power plants with first 5 MW and then 20 MW capacity within 5 years by collaboration of the public and private sectors

**Improvement of Wind Energy Power Plan Technologies (MILRES) [2013/203]:** Reaching the target of 20 GW installed power goal foreseen for WEPPs in 2023 with 80% indigenous technology in wind turbine systems (500 kW and 2.5 MW) to be developed by collaboration of the public and private sectors

**Bringing Solar Energy Technologies in Our Country (MILGES) [2013/204 :]** Bringing solar energy technologies in our country and reaching the goal of 80% total localness in sub-system technologies design within 5 years by collaboration of the public and private sectors

### Improving Indigenous Design and Production Ability in Thermic Power Plant Stack Gas Treatment Technologies (MILKAS) [2013/205]

Improving indigenous design and production ability in thermic power plant stack gas treatment technologies, reaching the goal of 80% localness by collaboration of the public and private sectors

### Improvement of Coal Gasification and Liquid Fuel Production Technologies [2013/206]

Bringing the coal gasification and liquid fuel production from the obtained synthesis gas technologies in our country, reaching the goal of 75% localness within 5 years by collaboration of the public and private sectors

### Studies for Increasing Energy Efficiency [2013/207]

In order to provide more efficient use of energy in heat insulation in buildings, regional heating systems, waste recovery, street lighting, electrical home appliances, transportation means, electricity motors and compressors;

- Development of business model and support packages in coordination of the Ministry of Energy and Natural Resources,
- Carrying out regulatory legislation studies,
- Necessary support from the related Ministries and institutions

<sup>2</sup>26<sup>th</sup> Meeting of the Supreme Council for Science and Technology Dated June 2013

## Electricity Market and Supply Security Strategy Document -2009

Within the context of decreasing energy import share by engaging local resources and environmental sensitivities, Electricity Market and Supply Security Strategy Document was published in 2009. Strategy document aims to make the share of renewable resources in electricity energy at least 30% in 2023.

To this end, until 2023, it is aimed to:

- Increase the installed wind energy power to 20,000 MW,
- Provide for use of all hydroelectric potential that can be used technically and economically in electricity energy production,
- Engage the 600 MW geothermal potential that is determined as suitable for electricity energy production,
- Disseminate the implementation of using solar energy in electricity production, and to consider the developments in other renewable energy use potentials depending on the production plans, technological advances and legislation regulations.

In addition to these, establishment of 2 nuclear power plants is included in the goals for 2023.

## TÜBİTAK Energy Efficiency Technology Roadmap List of Targets

TÜBİTAK Energy Efficiency Technology Roadmap List of Targets are as follows;

- Development of technologies that provide 20% energy efficiency with process improvement and waste heat recovery in industry
- Overseeing the implementation of combined heat, power and triple production systems in houses, industry and power plants and developing technologies to raise the total efficiency over 85% in systems in different scales (mini, micro, conventional)
- Developing energy-efficient internal and external lighting technologies with a lighting effectiveness factor of over 150 lm/W, which has maximum local technology and an economic life of at least 50,000 hours
- Developing new generation material and component technologies that will support energy efficiency in buildings and industry. Developing technologies that will support mitigation of energy used in buildings and combined methods

for energy performance management systems in buildings

- Developing the management systems for measuring and monitoring energy and increasing energy efficiency in a way that will maximize the reduction of energy consumption in buildings and industry and making these systems easy to use
- Developing the production technologies of EEF1 efficiency class indigenous electrical motors with at least 93% energy efficiency in 50kW and above capacities and drivers of all capacities

As well as the national studies, international collaborations such as Membership to and Collaboration with European Energy Network (EnR), Project for Increasing Energy Efficiency in Industry, Project for Increasing Efficiency in Buildings were developed and participation in multi-national project activities was realized.

## 4.3.2 Legal Regulations and Applications

After Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electrical Energy No 5346 that entered into effect in 2005 for application of policies and strategies given in previous section in order to use renewable energy, which will affect Greenhouse Gas reduction in a positive way and to increase energy efficiency, a legal platform was formed for energy efficiency and subsidies for electricity production from renewable resources were developed with the Energy Efficiency Law No 5627 that entered into effect in 2007. Detailed information regarding the legislation is presented below.

### Regulations Regarding Renewable Energy Resources

The Ministry of Energy and Natural Resources aims to increase the share of renewable energy resources in electricity energy production to 30% by 2023 and to increase the total installed power of electricity production plants from renewable energy resources to 46,400 by the end of 2019 by carrying out both studies on legal infrastructure and comprehensive studies that will move the sector for increasing the share of renewable energy resources in the energy supply.<sup>3</sup>

Important progress on spreading the use of renewable energy resources for electricity power production, increasing resource diversity, assessment of waste and protection of environment and development of related manufacturing sector are provided with "Law on Utilization of Renewable Energy Resources for the Purpose of Electrical Energy Production" No 5346 that entered into effect in 2005.

<sup>3</sup> Speech Text of Mr. Taner Yıldız, the Ministry of Energy and Natural Resources Presenting the Budget for Year 2015 to the Plan and Budget Commission of Grand National Assembly of Turkey

The Law defines the renewable energy resources, determines the price of electricity to be generated from these resources as between 5-5.5 Euro cents and encourages electricity production from renewable energy by small subsidies like land use etc. This period that started in 2005 was re-shaped with the Law No 6094 that entered into effect on January 8, 2011 and the subsidy rates were increased.

Within the context of Law No 6094, in production based on renewable energy resource, according to facility type; price subsidy of 7.3 USD cents/kWh for hydroelectric power plant and wind energy power plants, 10.5 USD cents/kWh for geothermal energy based production plants and 13.3 USD cents/kWh for biomass based production plants (including landfill gas) and solar power has been provided.

With the Regulation on Unlicensed Electricity Production in Electricity Market published in 2011, real or legal persons who establish a production plant and/or micro cogeneration plant based on renewable energy resources with an installed power of maximum five hundred kilowatts are exempted from the licensing and company establishment liabilities. This decision aiming to increase use of renewable resources in electricity production was increased to 1 MW with the Electricity Market Law No 6446 which entered into effect on 13.03.2013.

Regulation Amending the Regulation on Domestic Manufacturing of the Parts Used in Facilities that Produce Electricity Energy from Renewable Energy Resources entered into effect by being published on Official Gazette No 28755 on September 4, 2013. This Regulation re-regulated the principles and procedures regarding determination of additional price, documentation and inspection for parts and components to be manufactured in our country according to Renewable Energy Resources (YEK) Law No 5346. In case where domestically manufactured equipments are used in plants that produce electricity from renewable energy resources, an additional price subsidy of 0.4 and 3.5 USD cents for each equipment is provided according to the equipment and share of domestically produced components.

The number of electricity power plants which was 300 in 2002 increased to 907 at the end of 2013 and 1,059 as of the end of September 2014. 504 of the existing plants are hydraulic plants, 87 are wind power plants, 14 are geothermal plants, 49 are renewable and waste plants and 73 of them are unlicensed solar power plants. Our renewable energy resources installed power which was 12,305 MW in 2003 has

been doubled as of the end of September 2014 and reached to 27,585 MW.

Our electricity production from renewable resources increased to 69.5 TWh in 2013. The Ministry of Energy and Natural Resources prepared REPA (Wind Energy Potential Atlas of Turkey), GEPA (Solar Energy Potential Atlas of Turkey) and BEPA (Biomass Energy Potential Atlas of Turkey) within the context of potential determination studies for effective and efficient use of renewable energy and utilization in energy production.

Works for establishment of "Monitoring Forecast and Management System for Electrical Power Generated from Wind in Turkey" project and the "Wind Power Monitoring and Forecast Center" (RITM) for integration of more wind power plants to the electricity system and forecasting the electrical power to

#### Renewable Energy Legislation

- Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electrical Energy (5346)
- Electricity Market Law (6446)
- Regulation on Unlicensed Electricity Production in Electricity Market
- Communique on Implementation of Regulation on Unlicensed Electricity Production in Electricity Market
- Regulation on Domestic Manufacturing of the Parts Used in Facilities that Produce Electricity Energy from Renewable Energy Resources
- Electricity Market License Regulation on Documentation and Support of Renewable Energy Resources
- Regulation on Principles and Procedures for Determination, Scoring, Protection and Use of Renewable Energy Resource Areas for Electricity Energy Production
- Regulation on Technical Assessment of License Applications Based on Wind Energy
- Regulation on Technical Assessment of License Applications Based on Solar Energy
- Regulation on Electricity Production Facilities Based on Solar Energy
- Law on Geothermal Resources and Mineral Waters (5686)
- Regulation on Implementation of Law on Geothermal Resources and Mineral Waters and its Annexes
- Regulation on Inspection of SHW Water Structures
- Regulation on principles and procedures related to signing of water rights agreements in order to carry out production activities in electricity market

be generated beforehand in order to utilize our country's wind energy potential at a maximum are completed and improvement studies are in progress. Regulation Amending the Electricity Market Network Regulation, which was published on Official Gazette No 28517 on 03/01/2013 brought the necessity to connect all engaged WPPs to the center.

Within the context of the protocol signed between The Ministry of Science, Industry and Technology, Ministry of Energy and Natural Resources and TUBITAK on August 13, 2012, R&D projects for energy production from renewable resources will be developed in the next 10 years. In energy sector; Energy Sector Research and Development Projects Support Program (ENAR) was developed in order to support, monitor, complete and evaluate the projects that include technology development and innovation-focused research, development and improvement in order to convert the scientific and technological information to be established in a way that will serve energy policies, supply security, local energy technologies and industry to products and systems. Amendments made in order to make the regulation published on ENAR on June 8, 2010 operable were published in Regulation Amending ENAR Regulation on February 21, 2013 and project applications has started.

While electricity production from geothermal resources was regulated through Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electrical Energy No 5346, heat and hot spring applications with geothermal resources are shaped through Law on Geothermal Resources and Mineral Waters No 5686 published on 03.06.2007. Principles and procedures regarding effective exploration, research, development, production, protection of geothermal resources and natural mineral water resources, obtaining rights on these resources and transfer of rights, their economic utilization in harmony with the environment and abandonment are regulated through the mentioned law and secondary legislation.

2% blending rate of biofuel produced from local agriculture products which is applied in the sector since 2006 is exempt from ÖTV (Special Consumption Tax). According to the Decision of the Energy Market Regulation Board that entered into effect by being published in Official Gazette on 27.09.2011, an obligation for the biodiesel (oil ester methyl ester - YAME) ingredient of diesel oil presented to the market as fuel to be at least 1.1% as of January 1, 2014 and at least 2.1% as of January 1, 2015 and at least 3% as of January 1, 2016 was brought. However, this obligation was annulled before the initiation of implementation with a new regulation. Besides

this, a protocol for Meeting the Vegetable Oil and Biofuel Needs was signed between the Ministry of Energy and Natural Resources and the Ministry of Food, Agriculture and Livestock in November 2013.

Again, according to the Energy Market Regulation Board decision that entered into effect by being published on Official Gazette on 27.09.2011, an obligation for the types of gasoline presented as fuel to the market to contain at least 2.1% as of January 1, 2013, at least 3% as of January 1, 2014 of fuel ethanol (bioethanol) produced from local agriculture products was brought. As in biodiesel, in our country, 2% of the bioethanol produced from local raw materials is exempt from Special Consumption Tax.

#### 4.3.2.1. Energy Efficiency

Increasing efficiency in all processes from energy production to transfer, from distribution to utilization, preventing waste and decreasing energy intensiveness in both sectorial and macro level are among the most important agenda items of Turkish energy industry.

Energy efficiency studies in the country were even more activated with the Framework Law on Energy Efficiency No 5627 published in 2007 and several international financing institutions came to Turkey because of this law.

A legal framework for activities regarding increase of efficiency in use of energy resources and the energy itself for effective use of energy, prevention of loss, relieving the burden of energy cost on the economy and protecting the environment was established with the mentioned Energy Efficiency Law No 5627. The Energy Efficiency Strategy, which entered into effect in February 2012 with the Decision of Higher Planning Council, aims to reduce the energy amount consumed per GDP (energy intensity) by at least 20% compared to the value of 2011 (basis value not provided). As a result of the studies carried out, primary energy intensity index was reduced by 1.5% annually between 2000 and 2013 and final energy intensity index was reduced by 1.4% at the same rate.

Energy efficiency studies are carried out by the Ministry of Energy and Natural Resources GDRE and Ministry of Environment and Urbanization General Directorate of Professional Services in relation to buildings. Several other institutions like the Ministry of Science, Industry and Technology, Ministry of Transport, Maritime Affairs and Communication, Small and Medium Enterprises Development Organization (KOSGEB) also carry out studies and projects for energy efficiency.

Studies carried out for energy efficiency until today led to the following important developments:

- A legislation was formed with several regulations, communiques etc. for various sectors.
- Training activities were promoted.
- Framework for building energy performance was determined.
- A grant program was initiated for SMEs and industrial institutions.
- Energy efficiency services sector started to form, energy efficiency applications in building and industry sectors were initiated.

Energy efficiency services are being spread throughout the country within the context of the authority certificate granted to 2 universities, 2 trade associations and 33 Energy Efficiency Consultancy companies (ESCO, in Turkish EVD) by GDRE. Some of the authorized EVDs have conducted about 550 preliminary surveys and surveys in building and industry sector in the last few years and revealed a substantial amount of energy efficiency potential. Some of these are financed by the banks.

Studies for establishing ISO 50001 Energy Management standard in energy efficiency were completed in 2010. Studies for training and certification in order to spread this standard are in progress. Approximately 6,000 people were certificated as building and/or industry energy manager with the trainings organized within the context of Energy Management Program as of September 2014.

Also, within the context of the Energy Efficiency Law implementations, applications for supporting Efficiency Increasing Projects (Called as VAP in Turkish) prepared to increase efficiency in existing systems and industrial enterprises that can reduce their energy intensity at least 10% in average in three years voluntarily started in 2009.

Energy Efficiency Campaign ENVER project was initiated in order to raise awareness in all aspects of the society for efficient use of energy and to keep energy efficiency issue current with various activities with collaboration of public institutions, non-governmental institutions and private institutions.

In 2008, the Regulation on Energy Performance in Buildings entered into effect in order to determine the criteria and application principles of a series of measures to be taken in order to increase the energy performance of new and old buildings and to provide labeling all buildings with energy identity doc-

ument in aspect of energy consumption and greenhouse gas emissions until the end of 2017. Regulation on Energy Performance in Buildings, which was published in 2008 and revised substantially on April 1, 2010 has been an important step to create more efficient building stocks in the country. Until today, 248,772 buildings, 13,068 of which are old and 235,707 of which are new, have obtained energy identity documents and determined the energy class of the buildings. Following the use of BEP-TR national software, using the database of the related software the maximum annual energy demand of the building which includes issues like heating, cooling, ventilation, hot water and lighting, is determined according to the building's function (hotel, hospital, residence, school, mall etc.), climate conditions of its region (temperature, wind effect etc.), architectural design (direction etc.) and its construction according to mandatory standards in effect (TS 825 Heat Insulation Standard etc.) and the maximum CO<sub>2</sub> emissions amount to be allowed in the atmosphere is determined by taking supplying this energy demand from efficient and/or clean energy resources and technologies as a basis, construction of new buildings exceeding these limit values is not allowed. Improvement of allowed energy consumption class and CO<sub>2</sub> emissions class values in yearly basis is aimed by using the statistical information in BEP-TR database.

Regulation on Allocation of Heating and Sanitary Hot Water Costs in Central Heating and Sanitary Hot Water Systems brought a legal regulation that aims to reduce the energy consumption as a result of consumption patterns and change of behavior and applications are initiated. Services are provided to buildings for payment of heating expenses as spent with over 50 authorized company agencies/distributors.

From an R&D aspect, in the recent years, programs are initiated in order to improve domestic production capacity for both energy efficiency and renewable energy subjects;

Within the scope of the decision on Studies for Increasing Energy Efficiency [2013/207] within the framework of domestic manufacturing project decisions in energy sector developed by TÜBİTAK at the 26th meeting of Supreme Council for Science and Technology held on June 11, 2013; it was decided to take the necessary measures for more efficient use of energy in heat insulation in buildings, sectional heating systems, waste heat recovery, street lighting, electrical home appliances, transportation vehicles, electric motors and compressors.

TÜBİTAK has also determined Energy Efficiency Roadmaps in order to determine the concrete R&D and innovation goals in this field and the necessary milestones to achieve these goals. In this context technology roadmaps were established in waste heat recovery, combined heat power and triple production systems and electric motors on supply-oriented technologies side;

and in LED based internal and external lighting, new generation materials and components technologies, smart buildings technologies and sensor systems on demand-oriented technologies side. In this context, it was decided to;

- Develop business model and support packages in coordination of the Ministry of Energy and Natural Resources,
- Carry out regulatory legislation studies,
- Obtain necessary support from the related Ministries and institutions.

### Nuclear Energy

Law on Establishment and Operation of Nuclear Power Plants and Energy Sales was published in Official Gazette No 26707 on December 21, 2007. In years that followed 2007, preparations for legal infrastructure were carried out with the regulations published and a contract was signed with Russian Federation for construction of Akkuyu Nuclear Power Plant in 4,800 MW power and another contract was signed with Japan for establishment of a second nuclear power plant of 4,480 MW power in Sinop. Decision to construct a third nuclear power plant was also made. Commissioning of two nuclear power plants until 2023 and the third nuclear power plant are in assessment process.

### Natural Gas Storage

In order to prevent the problems in gas derivation due to falling pressure in natural gas from especially Iran and Russia in winter time and mitigate price fluctuations, Turkey has to maintain natural gas at an amount at least at 10% of its daily consumption in its storage. This rate is currently under 5% and there is an underground storage facility with a capacity of 1.6 billion m<sup>3</sup>.

While the storage area is aimed to be increased to 10% of consumption in short term and 20% of consumption in long term in 2015 - 2019 Strategy Plan of the Ministry of Energy and Natural Resources, providing promotion of private sector is also among the articles. Therefore uninterrupted use of natural gas by 78 cities throughout Turkey will be possible.

### Greenhouse Gas Reduction Programs and Application Examples

#### Rehabilitation of Public Power Plants

Electricity Generation Company (EUAS) has estimated the efficiency values of public thermic and hydraulic power plants in order to increase efficiency in energy production and rehabilitation studies were initiated as of 2005 in order to increase efficiency and production capacity using new

technologies. Rehabilitation studies were carried out in four hydraulic and 16 thermal power plants in this context. It was aimed to increase performance, reliability and life of power plants and provide compliance with environmental legislations within the context of rehabilitation projects. 13.9 billion kWh production increase will be provided with rehabilitation projects. As a result of the rehabilitations carried out, a production increase of about 7.9 billion kWh was provided at the end of September 2013.

### Supporting Energy Efficiency Projects

Within the context of Supporting Efficiency Increasing Projects (VAP) the projects with a project cost under 1,000,000 TL are supported for 30% of their cost. Support at an amount up to 200,000 TL is provided to industry organizations within the context of Voluntary Agreements Program.

### IZODER- Heat Insulation Loans for Residences

2,201 projects were carried out in 2,759 buildings within the context of the study carried out in collaboration of various banks and IZODER between 2009 and 2014, savings of 311 million m<sup>3</sup> natural gas (or 2.7 billion kWh) electricity and 746,300 tons CO<sub>2</sub> was achieved. Project is important for being a large efficiency implementation project carried out by a non-governmental organization for the first time in Turkey.

Some of the studies carried out except these are listed below:

- Preparation of KOSGEB Roadmap on Environment Project
- Use of Renewable Energy Resources and Increase of Energy Efficiency (YEEV) in Southeastern Anatolian Region Project
- Projects for Energy Efficiency in Industry
  - o Energy Recovery from Waste Heat in Cement Industry
  - o Vitra Karo Sanayi ve Ticaret A.S. Waste Heat Recovery Project
  - o KARDEMIR Energy Efficiency Projects
  - o Sise Cam-Trakya Yenişehir Cam Sanayi A.S. Electricity Production from Waste Heat Project
  - o ICDAS Energy Efficiency Project

### International Energy Efficiency Projects Increasing Energy Efficiency in Industry

Aim of the project which started in January 2011 is to improve energy efficiency in Turkish industry by supporting industrial institutions in establishing an effective energy management by using energy efficiency measures and technologies.

The project supported by KOSGEB, Turkish Standards Institute, Global Environment Funds (GEF), will be carried out in collab-

oration of GDRE, Ministry of Science, Industry and Technology, Technology Development Foundation of Turkey (TTGV), United Nations Development Program (UNDP) and United Nations Industrial Development Organization (UNIDO), it will last five years and it has a total budget of 35,058,400 \$.

### Increasing Energy Efficiency in Buildings

Increasing Energy Efficiency in Buildings Project is carried out by Ministry of Energy and Natural Resources GDRE. Implementing institution of the project, which is supported by GEF is United Nations Development Program (UNDP). Ministry of Environment and Urbanization and Ministry of National Education are other partners of the project. Total budget of the project that started in 2011 is 17,580,000 USD.

The aim of the project is to increase energy performance standards of the buildings, to support and empower implementation of related legislation, develop building energy management standards and to reduce energy consumption and therefore greenhouse gas emissions by showcasing, introducing and disseminating integrated building design approach applications.

### Market Transformation of Energy-Efficient Products Project

The aim of the project which was carried out between 2010 and 2014 with the financial support of UNDP/GEF in coordination of Ministry of Energy and Natural Resources-GDRE is to reduce electricity energy consumption and the greenhouse gas emissions arising out of this consumption in residences in Turkey by increasing sales of highly energy-efficient electrical home appliances and expediting transformation of the old and inefficient products with new ones with high energy efficiency.

Awareness leg of the project, which was implemented in collaboration of United Nations Development Program (UNDP), Ministry of Science, Industry and Technology, White Appliances Manufacturers' Association of Turkey (TURKBESD) and Arçelik A.Ş. reached 9,252,000 people through TV channels and 50,000 personnel who sell home appliances were trained on energy efficiency. 10,000 energy label information flyers were distributed to consumers and energy efficiency awareness level increased from 43.5% to 58.6%, rate of accurate information on energy label increased from 52.5% to 58.2%. Priority of energy efficiency in purchase decisions increased from 3<sup>rd</sup> level to 1<sup>st</sup> level. Energy savings of about 3,700 GWh and CO<sub>2</sub> savings of 2.4 mton was provided within the context of the project.

### Collaboration between Netherlands and Turkey, "Monitoring and Assessment of Energy Efficiency in Turkey and Supporting Infrastructure" Project

Within the context of G2G MET "Project for Improvement of Monitoring and Assessment of Energy Efficiency in Turkey" which started in 2011, realization status of projects determined by industrial enterprises and progress of savings provided were explained in "Textile Industry Workshop" carried out in Bursa on 11/06/2013.

### Near-Zero Zone Project

Within the context of the Near-Zero Zone Project prepared and executed with initiative of US Ministry of Energy, it was aimed to provide efficient use of energy in industry sector of Turkey and establishing a sustainable model in pilot region for improving economic and environmental impacts and İzmir Atatürk Organized Industrial Zone (IAOSB) was selected as the pilot region. Project contributed to transfer of information and experience from USA to our country, improvement of EVD companies in our country, determination of potential and raising awareness.

### Energy Efficiency in Public Buildings Project

The German Climate Technologies Initiative (DKTI) Technical Collaboration Project, which is funded by the Government of Federal Republic of Germany, is carried out in order to contribute to reduce energy intensity in public buildings and therefore to reduce greenhouse gases in Turkey between 2014 and 2018, consultancy services that will be provided within the context of technical collaboration will provide for improvement of legal framework conditions for increasing demand to products and services to be used to increase energy efficiency especially in public buildings. Project will contribute to reduction of energy intensity in buildings, especially the public buildings in Turkey and therefore to reduction of greenhouse gases. Project includes technical collaboration opportunities thanks to consultancy measures executed by GIZ. Project Budget is 6.5 Million €. Project activities are carried out with Ministry of Environment and Urbanization General Directorate of Professional Services and GIZ specialists.

### Project for Increasing Energy Efficiency in Buildings

The period of the project with a budget of 3,333,500 € is planned as 2 years and the general goal of the project is to increase energy efficiency in Turkey in order to obtain economic revenues and contribute positively to climate change and energy supply security. Project aims to provide for better design of buildings to be constructed and to establish improvement criteria by carrying out needs and building typology analyzes of existing buildings. Project is carried out by Ministry of Environment and Urbanization General Directorate of Professional Services..

### Project for Promoting the Use of Energy Efficient Electric Motors among SMEs (2016-2021)

In order to address this important and key issue in energy efficiency, Turkish Ministry of Science, Industry and Technology took action together with UNDP, within the framework of 'Improving Energy Efficiency' programme, which is one of the transformational programmes in Turkey's the National Development Plan.

Hence, the objective of the project supported by GEF and implemented by General Directorate of Efficiency is to achieve 450.000 tons of CO<sub>2</sub> eq mitigated until 2021 by manufacturing approximately 10,000 motors with an energy rating of IE3 and above over the five year period of the project.

### Sakarya Metropolitan Municipality Sustainability Studies

- Project for Developing Climate-friendly Strategies in Lighting
- Sakarya Metropolitan Municipality Urban Bicycle Road Network Project
- Gold Standard Foundation - Sakarya Metropolitan Municipality Sustainable Cities Program Protocol

### Documentation Studies for "Sustainable Green Buildings and Sustainable Settlements"

In Tenth Development Plan, under the topic of Expedition (Acceleration) of Urbanization Process, it is stated that management of continuing urbanization process in a way that will make cities more competitive, habitable and sustainable can contribute greatly to achievement of country's development goals and under Climate Change and Environment topic, it is underlined that the cities can be more environment-friendly and economically effective with new regulations and investments. Also, Energy Efficiency Strategy Document aims to decrease energy demand and carbon emissions of the buildings and to promote sustainable and environmentally friendly buildings that use renewable energy resources. Ministry of Environment and Urbanization carries out studies on this subject and especially tries to integrate this into Urban Transformation Process.

"Regulation on Principles and Procedures for Documentation of Sustainable Green Buildings and Sustainable Settlements" entered into effect by being published in the Official Gazette on December 8, 2014 based on the 2nd and 12th articles of Statutory Decree on Organization and Duties of the Ministry of Environment and Urbanization No 622 dated 29/6/2011.

### Awareness Raising and Capacity Building Projects of the Ministry of Environment and Urbanization:

- Energy-efficient Renewal of Ankara Golbasi Laboratory Buildings:
- Improvement of Trabzon Ahi Evran Hospital

### Energy Efficiency Association Information Projects

Organization carries out Energy Efficient Kid, Energy Efficient Woman, Energy-Efficient Industry and Energy-Efficient Transport projects. Studies for raising awareness of 20,000 women on energy efficiency and energy saving in 20 cities are being carried out within the context of Energy-Efficient Woman Project.

## 4.4. Industry

### 4.4.1 General Policies and Measures

Policies and measures for energy consumption of manufacturing industry, which contributes 16% to the GDP, are explained in 4.1 Energy Section and they are generally in direction of increasing energy efficiency and share of renewable resources in industry. Therefore, this section only contains policies and measures for emissions originating from industrial processes.

When general policies in industry are reviewed within the context of the 10<sup>th</sup> Development Plan published in 2014 and to be applied between 2014- 2018, main goals are stated as realizing transformation in manufacturing industry and transitioning to high added value structure and increasing share of advanced-technology sectors. To this end, main focuses of transformation in manufacturing industry are innovation and company skills, effective contribution of regions to production, inter-sectoral integration, green technology and production, and diversity of foreign market. Goal of efficiency and increase of domestic added value is reported with green production capacity, innovation, company skills and improvement of inter-sectoral integration, and the goal of high and constant growth is reported with diversity of foreign market and improvement of regional production capacities. It is also aimed to raise the total factor productivity (TFP) increase over its long term average.

The following policies, which are considered to be effective on climate change, are declared in direction of these goals:

1. Public procurement will be used as an effective tool in order to foster innovation and green manufacturing capacities of domestic firms. In this context, the capacity for preparation and evaluation of tender specifications will be developed; dissemi-

nation and introduction of best practices in the public sector will be ensured.

2. Country credit and guarantee programs will be used effectively to increase the export of high-technology products and capital goods.
3. Practices such as recycling and recovery in the industry will be given importance.
4. In order to maximize the contribution of renewable energy in the economy, the level of domestic manufacturing will be increased and new technologies will be developed.
5. In the automotive industry, domestic share of value-added will be increased by covering a larger span of the supply chain, including design/R&D, manufacturing and sales/marketing activities in their entirety. Development of new environment friendly technologies will be supported. Collaboration and integration of the sector with other sectors such as electronics, software, electrical machinery, basic metals and defense industry will be improved. Branding will be encouraged by means of concept vehicles designed for the needs of both domestic and global markets.

When the matters stated above are evaluated in aspect of climate change, it is foreseen to provide gains in aspect of low carbon economy by focusing on innovation and advanced technology products and sectors in plan period process, to maximize efficiencies in existing sectors and to provide gains especially in renewable technology field through green technologies.

Increasing competitive power of SMEs and raising their contribution to economic growth is one of the main goals of the 10<sup>th</sup> Development Plan. In this context, it is principal to support fast-growing enterprises or enterprises with growth potential and SMEs that are innovative in aspects of product, service and business model.

In direction of this objective and goal, the following policies are important in aspect of climate change.

- Internationalization of SMEs will be augmented by improving their R&D, innovation and export capacity.
- SMEs will be supported for further organized activities and forming clusters among themselves and with larger enterprises, universities and research centers.

It is aimed to reach the objectives and goals with the prioritized transformation programs created within the context of 10<sup>th</sup> Development Plan. These programs are as follows:

- Program for enhancing productivity in manufacturing
- Energy efficiency improvement program

The article of “Preparing efficiency policies and strategies for improvement of economy in compliance with efficiency principles, increasing and improving efficiency of industrial enterprises and supporting cleaner production projects” was added to organization and duties of the Ministry of Science, Industry and Technology. Directorate General of Productivity is responsible for “Prepare policies and strategies for productivity, improve productivity level of industrial enterprises and support cleaner production projects “. In this framework, within the context of energy efficiency improvement program, General Directorate of Efficiency is assigned to carry out the following components in 10<sup>th</sup> Development Plan:

- Replacing low efficient AC electric motors, which consume more than 70% of the electricity used in industry, with high-efficient ones. Improving the support mechanisms for SMEs on energy efficiency training, studies and consultancy services.

When the technology policies are evaluated from a fight against climate change point of view, the studies carried out on this issue is followed by the Superior Council on Science and Technology that continues with participation of the Prime Minister of Turkish Republic in person. TÜBİTAK subsidies prioritize the projects created in this field. Technology development policies are supported by increase in human and financing resources allocated to this field.

When the industrial sector is reviewed in terms of sustainable development policies, the “Turkish Industrial Strategy Document” prepared in coordination of Former Ministry of Industry and Commerce aims ‘to accelerate the transformation of Turkish industry into an industrial structure that has a greater share in the world exports, where products with high added values and high technology are produced, which includes a qualified workforce, and which is sensitive to the environment and society by increasing the competitiveness and efficiency of Turkish industry’ in the period that covers years 2010 to 2014. It is highlighted that application of environment policies within the framework of sustainable development principle for Turkish industry is an important part of the industry strategy and direction of this process with right transition strategies is very important under the ‘Environment’ topic of “Turkish Industry Strategy Document”. It is stated that it is inevitable that in the near future the competitiveness of the products manufactured in Turkey will be dependent on the utilization of environmentally friendly production processes and Turkish industry has to ensure the efficient use of energy with the rapid growth process. It is also stated that Turkey has prepared its plans and strategies regarding the environment so far and has started applications in many areas; however, the regulations yet to be made in the areas of chemicals, climate change and industri-

al pollution, which are basically of concern to the industrial strategy, will have significant effects on the competitiveness of the industry.

Implementation of the following policies was adopted in order to drive Turkish industry in direction sustainable growth principles:

- Possible impacts of climate change and international conventions and protocols regarding this issue on Turkish industry will be determined and compliance process of Turkish industry with international regulations will be designed accordingly. In this framework, international negotiation processes regarding climate regime after 2012 will be monitored and the suitable position for our country's conditions will be determined.
- Transition to low carbon economy and cleaner production processes in industry will supported and information activities regarding this issue will be prioritized. Accordingly, relocation of industry to production zones that will allow them to produce with regulated infrastructure will be encouraged and also greenhouse gas emissions will be controlled, monitored and reported.
- Country-wide implementation of eco-efficiency programs, which match with cleaner production and which focus on business and environmental excellence at the same time by considering sustainable development, economic development and environmental performance together, which increase competition skills of enterprises by production of quality products and services in direction of efficient use of resources and adoption of production principles that are in compliance with the nature will be provided.
- In relation to all environmental action plans, it is aimed to prioritize environmental impact analyzes and to determine the implementation processes of regulations that will enter into effect in the upcoming period. In this context, starting from the directives defined as high-cost by the EU, execution of impact analysis studies on issues upon which stakeholders will decide is foreseen.

Within the framework of sustainable development principle for Turkish industry, the issues of implementation of environment policies and green production became an important part of Turkish Industrial Strategy Document, preparations of which are about to be completed for implementation in 2015-2018 period. In green production issue, it is aimed that the industrialists reach a production structure that will not harm human health and will use the resources efficiently during production. In this direction, providing conversion to a greener and more competitive industry structure where the resources are used effectively is determined as one of

the 3 strategic goals within the context of the Strategy. The policy of "Green production will be encouraged in industry" is adopted in direction of the mentioned goal and in this context, it is aimed to realize activities for;

- Spreading cleaner production/eco-efficiency applications that will contribute to sustainable growth of industry and increasing its international competitiveness,
- Carrying out studies for obtaining the energy used in industry from renewable energy resources such as sun, wind, biomass etc.,
- Carrying out intensive information studies in order to raise awareness of industrialists on fight against climate change,
- Supporting the activities of SMEs in the fields of environment (especially reducing greenhouse gas emissions) and energy.

#### 4.4.2 Legal Regulations and Applications

An important step for monitoring the greenhouse gas emissions originating from industry sector is the Regulation on Monitoring of Greenhouse Gas Emissions which was prepared by the Ministry of Environment and Urbanization that came into force by being published on Official Gazette No 29003 on May 17, 2004. This regulation aims to regulate the principles and procedures for monitoring, verifying and reporting of greenhouse gas emissions arising out of the activities listed in Annex-1. The regulation will provide for monitoring of greenhouse gas emissions originating from sectors like electricity and steam production, petroleum refining, petrochemistry, cement, iron-steel, aluminum, brick, ceramic, lime, paper and glass production in facility level and regular reporting of these to the Ministry. Facilities within the scope of the regulation submit the greenhouse gas emissions reports they prepare regularly each year for the activities they carry out in the previous year to the Ministry. "Communique on Monitoring and Reporting of Greenhouse Gas Emissions" (Official Gazette No 29068 on July 22, 2014) that covers the principles and procedures for monitoring and reporting the greenhouse gas emissions originating from the activities listed in Annex 1 of the Regulation on Monitoring of Greenhouse Gas Emissions and the related activity data is prepared. Within the context of "Regulation on Monitoring of Greenhouse Gas Emissions", Communique on Verification of the Greenhouse Gas Reports and Authorization of Verification Institutions" (Official Gazette No 29314 on April 2, 2015) entered into effect in order to verify the greenhouse gas emissions reports to be prepared by the facilities and determine the principles and procedures regarding the features of verification institutions that will carry out this verification processes. The verification system established within the scope of the Regulation will provide for verification control of emis-

sion reports prepared in facility basis by on-site inspection of independent institutions before submitting to the Ministry. Production of transparent, accurate, comparable, complete and consistent data and information regarding greenhouse gas emissions in facility basis will be provided through implementation of these regulations and communiques. An important step was taken in negotiations of Environment Stage for EU and basic infrastructure for establishment of climate change policies of our country and implementation of the steps to be taken on fight against climate change was formed with this Regulation.

### Practice Examples for Greenhouse Gas Reduction

When emissions originating from industrial processes are reviewed; it is observed that the biggest share belongs to mineral products sector with 57% and metal production sector follows this with a rate of 29%.

Cement sector, which has an important share in sectoral emissions, is one of the first industrial branches of the country and an important driving power for the economy. Turkey is first in Europe and 5th in the world in cement production in the recent years. Vision of cement sector is to use technology at the highest level in cement production by protecting cultural and historical values and to fulfill its responsibilities for the upcoming generations and for the environment with developed production methods. Main policy of the sector is to increase cement and concrete with high quality consumption by considering issues related to environment in cement production and using all the opportunities provided by technology and to provide for implementation of the "Sustainable Development Principles" for the future of our country and the world.

Sector's share in Turkey's total energy consumption is 6% at average, and its share in energy consumption of the industry is about 18%. According to the data reported by Turkish Cement Manufacturers' Association; in the cement sector which is an energy-intensive sector, about 65% of the costs is formed by energy (40% fuel + 25% electricity energy). When the sector is reviewed in terms of energy consumption, it is observed that the average values are better than the average values in EU Countries.

General technological structure of Turkish Cement Sector is at least 10% better than the technological average of European Union because most of the facilities are recently built and/or an advanced level of modernization was carried out in the recent years. Also, "Energy Efficiency Benchmark" studies carried out in the last 10 years between the Ministry

of Energy and Natural Resources and the cement factories are contributed greatly to this progress.

Cement factories in our country strive to be solution partners in management of industrial and residential wastes as well as cement production, which is their main function. Currently, in 35 of the 49 cement factories active in our country, industrial and residential wastes are converted to value as alternative fuel and alternative raw materials within the context of the permissions obtained from the Ministry of Environment and Urbanization. Turkish cement sector recovers merely about 250 of the 850 different materials accepted as waste by the Ministry of Environment and Urbanization as fuel and alternative raw materials. Turkish cement sector became the solution partner of the industry and environment by converting about 1.15 Mtons of waste to economic value as fuel and raw materials in 2013. Out of these materials, 500 Ktons of waste was converted to value as energy resource and 650 Ktons as raw materials alternative. In this process, the need for mining was reduced since primary fossil fuels like coal, petroleum coke and lignite and natural raw materials like limestone, marn and clay are used less and it was possible to improve the environmental foot print of such activities.

While about 30% (close to 100% in some facilities) of the thermal power in cement factories in 27 member countries of the European Union is generated from wastes, the cement factories in Turkey generate about 3% of the thermal power they need from alternative fuels in 2013. Despite Turkey's average is at 3%, we also have cement factories that use alternative fuels in high rates of 20-25%.

The Iron and Steel sector, which is the second in aspect of process emissions is one of the important sectors of our country and it participates in the studies on climate change in every field. According to the data reported by Turkish Steel Producers Association, Turkey is 2nd in Europe and 8th in the World among steel producer countries with its raw steel production of 34.6 Mtons in 2013. 27 out of 30 institutions active in the sector are facilities with electrical furnaces that melt scrap and 3 of them are integrated facilities based on production from ore. 24 of the 27 furnace facilities use electrical arc furnaces and 3 of them use induction furnaces. Open Hearth Furnace (OHF) production technology, which is a slow process with very high energy consumption, was abandoned completely in 1999. Share of the Iron-Steel sector, which uses energy intensively, in Turkey's total energy consumption is 7% at average, and its share in energy consumption of the industry is about 20%.

Share of energy in input costs in our steel sector is 2nd after raw materials and it has a high rate of about 15-20%. Therefore, our steel sector has drawn a roadmap for itself on devel-

oping projects to increase energy efficiency and continues its studies on improving and renewing its technology constantly. When the studies carried out in the last 10 years in Iron-Steel sector is considered, a reduction of 18% was provided in energy consumption per ton of raw steel. A decrease of 50% in specific energy consumptions was also provided with the studies carried out in world steel sector.

Institutions that are active in Iron-Steel sector continue to establish power plants in order to use energy resources more effectively and to procure cheaper energy. Sector is recently focused on manufacturing products with high added value in order to reduce energy density.

Another project that serves the studies specific to industrial sectors within the context of the objectives and goals stated in Climate Change Action Plan is the "Project for Determination of Resource Efficiency in Industry" prepared by the Ministry of Science, Industry and Technology - Directorate General of Productivity and included in the Investment Program of 2013, and planned to be completed in March 2016. Project is carried out by TÜBİTAK MAM Environment and Cleaner Production Institute and in this context, it is aimed to analyze the potential environmental and economic benefits that can be generated by sustainable use of raw materials, energy and water in sectors and regions level and to establish this potential quantitatively in Turkish manufacturing industry.

One of the outputs of the project will be economic and environmental analysis of the savings potential that will occur as a result of more efficient use of energy. Based on the potential amount of energy that can be saved, amounts of greenhouse gas emissions that may be prevented before their occurrence with realization of this potential will be expressed in carbon dioxide equivalent (CO<sub>2</sub>-eq.) terms.

### 4.4.3 Assessment According to Type of Greenhouse Gas

According to national greenhouse gas inventory of Turkey in 2013, the greenhouse gases originating from industrial processes form 15.7% of the total greenhouse gas emissions and 89% of this is CO<sub>2</sub> and 9% is fluorinated gases

## 4.5. Transportation

### 4.5.1 General Policies and Measures

As mentioned in Chapter 3, greenhouse gas emissions arising from transportation sector for 2013 is 69 Mtoe CO<sub>2</sub>-

eq and its share within the national total emissions is around 15%. The highest source of greenhouse gas emission in the transportation sector is road transport and it has a share of 91%. Greenhouse gas emissions from transportation in Turkey have increased in the ratio of 157% between 1990 and 2013. In our country about 90.5% of intercity passenger transportation and about 87.4% of freight transportation is performed by road (MD\_a, 2013).

In The Tenth Development Plan covering the period of 2014-2018, it is emphasized for the forthcoming period that there has been needs of the switching to corridor approach, supply of integration between transportation modes, and further improvement of transportation connections of less developed regions. It is emphasized that the regions have more efficient, fast and safe transportation, especially freight transportation and logistical infrastructure. Also the importance of strengthening North-South connections is emphasized in a way to increase the interaction between regional centers of the country (MD\_a, 2013).

Turkey Transport and Communication Strategy Document (2011-2023) has been prepared to reveal what targets and activities are needed primarily to carry out in order to offer more qualified, cheaper, faster and safer service in the transportation sector. In the mentioned document, 2023 target of share distribution between transport modes is to raise the rail freight's share above 15% and the passenger transport's share above 10% considering The National Climate Change Strategy. Thus it is targeted reducing down the road's share for freight to the rate of 60% and the road's share for passenger to the rate of 72%. Especially which infrastructure projects would be carried out in road, rail, marine, aviation, logistics and combined transport, urban transportation, pipelines sector and also their places, costs and other technical details in the 2011-2023 period will be determined by the Transportation Master Plan which will be prepared with the active participation of all relevant institutions and organizations in the sector. Target, priorities and projects revealed in the 10th Transportation Council will also be involved in the action plan of this document.

Purposes, targets and action areas specified for the Transportation Sector in National Climate Change Action Plan (NCCAP) were prepared comply with strategies in Turkey Transport and Communication Strategy Document and National Climate Change Strategy Document (NCCSD).

Policies for emission reductions in the transport sector in NCCAP are as follows:

- Increasing the share of railway freight transport in 2009 from 5% to 15% by 2023 and increasing the share of railway passenger transport from 2% to 10% in the same period.
- Reducing the share of the road freight transport in 2009 from

80.63% in ton-km, below 60% by 2023, reducing the share of road passenger transport from 89.59% in passenger-km to 72% in the same period.

- Limiting the rate of increase in emissions from individual car use in urban transport.
- The creation of necessary legislation, institutional structure and guidance documents that are related to urban transport for the implementation of sustainable transport planning approach in cities by the end of 2023.
- Making the regulations and developing the capacity in order to increase the use of alternative fuels and clean vehicles until 2023 (MEU\_a, 2012).

For the transport sector in the medium term in NCCSD;

- Plans will be developed to increase the capacity utilization rate and the share of railway, maritime and aviation in freight and passenger transportation.
- Potential analysis research on the development of combined transport will be done.
- Short sea shipping and lake transport will be supported.
- Arrangements that allow the dissemination of the use of environment friendly transportation such as cycling and pedestrian transport in cities shall be encouraged.
- Public transport system with subway and light rail systems will be expanded especially in metropolises.
- The use of alternative fuel and clean vehicle technologies used in public transport in urban areas will be expanded.
- R&D work will be done to improve geometric and physical standards of road network in order to ensure lower fuel consumption.
- The intelligent transportation system applications will be developed.
- Applications that will improve energy efficiency in transportation will be developed.

In long term;

- The share that is 2% of the railways and maritime in freight and passenger traffic will be increased and air transport will be supported.
- The use of new technology engines that can minimize alternative fuel, CO<sub>2</sub> and NO<sub>x</sub> emissions, and environmental friendly transportation vehicles such as hybrid vehicles will be expanded (MEU, 2010).

In National Intelligent Transportation Systems Strategy Document (2014-2023) and its Supplement Action Plan (2014-2016), the following actions have been identified for reducing fuel consumption and emissions arising from road transport.

- The use of technologies that are environmentally friendly and improve the energy efficiency in traffic components such as variable message signs in urban and intercity roads, traffic lights, sensors and so on,

- The establishment of systems that will distribute the traffic volume to alternative routes in busy corridors and apply measures for it,
- Firstly, determining the corridors experienced congestion in city traffic, the use of AUS system in determining the data on travel demand in these corridors, designing systems that prevent traffic congestion in busy corridors (including incentive applications like usage of the left lane for vehicles carrying two or more passengers). It will be implemented in at least one route in Istanbul, Ankara and Izmir Metropolitan Municipality.

In addition, the following actions have been identified to increase AUS applications in public transportation and to make effective and efficient traffic management with AUS in road network between urban and inter-urban.

- Arrangement of traffic lights and signs to improve the efficiency of traffic flow.
- In the scope of planning the green wave corridor signalizations that will do the optimization according to traffic volume or real-time, the transition to adaptive green wave application will be provided in at least one corridor in the period of action plan. Also the fluidity will be raised by the adaptive intersection control systems that will enable the coordination with other intersections and detect traffic volume from all directions to optimize the cycle time in busy corridors accordingly.
- Making smart the public transportation stops in all metropolitan centers of the district.

The preparatory work for the Strategic Plan including 2014-2018 period has been initiated with the distribution of Circular No. 2012/1 dated 02.08.2012 to Centers affiliated with the ministry and provincial organizations, related and relevant to all institutions and organizations in the framework of "Regulation on the Principles and Procedures for Strategic Planning" that published and came into force in the Official Gazette No. 26179 dated 28.05.2006. Strategy Development Board (SGK), Strategic Planning Committee (SPE) and the Strategic Planning Secretariat (SPS) was founded. The goals in the strategic plan and its relationship with the 10th Development Plan Objectives and Policies are included in the Plan (MEU, 2010).

It is planned that the establishment of a Transport Institute to fulfill educational and R&D activities of transport sector and collaborating with universities in order to train qualified personnel in the field of transport.

R&D work to establish alternative transportation systems will be made in the transport sector. More economical and safe new transportation systems will be provided implemented doing R&D work for the implementation of emerging technologies and new transportation system in railway, highway, maritime infrastructure and superstructure.

## 4.5.2 Legal Regulations and Applications

- Auditing services will be separated from administrative activities such as vehicle registration and driver certification to be installed at the highest level of traffic safety and detached units will be established for these activities.
- In highway, an effective superstructure management system which is based on the concept of preventive maintenance and will ensure to supply repair and maintenance services timely will be installed. Necessary legal and institutional arrangements will be implemented to be carried out maintenance and repair services through the private sector.
- Assessments and reports will be prepared on the compatibility of logistics investments and applications planned or completed in the year with available master plan by making / procuring an annual assessment of urban transportation and the logistics master plan (MD\_a, 2013).
- Regulation on Procedures and Principles Regarding the Improvement of Energy Efficiency in Transportation entered into force in 2008. Regulation sets rules and procedures regarding the establishment of systems for reducing fuel consumption of motor vehicles per unit, raising efficiency standards in vehicles, dissemination of public transportation and increasing traffic flow in order to increase the transportation of energy efficiency. Regulation is implementing by Ministry of Transport, Maritime Affairs and Communication.
- Regulation on Opening, Operating of Vehicle Inspection Stations and Vehicle Inspection is entered into force in 2004. The purpose of the Regulation is making the technical inspection of motorized and non-motorized vehicles navigating on the road in more efficient and healthy way.
- The Regulation on The Disclosure of Consumers About Fuel Economy of New Passenger Car and CO<sub>2</sub> Emission aims to provide enlightenment of consumers about CO<sub>2</sub> emission and fuel economy of new passenger cars offered for sale or rent in the market in order to make consumers informed choices. Therefore, Directorate General for Industry collects and publishes fuel consumptions and emissions of new passenger cars. Within the scope of the Regulation, the market supervision of the cars is done by Directorate General for Safety and Supervision of Industrial Products.
- The arrangement of Special Consumption Tax (SCT) exemption launched in cabotage transportation in 2004 has increased marine transportation by enabling the freight, passenger, fishing, scientific research vessels, commercial yachts and service vehicles take excise duty on fuel. As of 2009 publicly owned passenger and cargo ships which operates on inland waterways are included within the scope of the arrangement.
- General Railway Law Draft foresees the development and improvement of railways versus other transport modes, also aims offering the rail services to users in quality, continuous,

safe and appropriate fee in the framework of the competitive principles, the creation of a strong, stable and transparent structure with the liberalization of the industry and performing independent regulation and supervision. The restructuring of TCDD will complete in the framework of the Law on the Liberalization of Turkey Railway Transport, rail freight and passenger transport will be opened to private rail enterprise. The execution of TCDD network renewal and maintenance repair services by the private sector will be essential. TCDD's financial burden on the public will be taken to a sustainable level.

- It will be provided compliance with the technical and administrative interoperability regulations in order to ensure continuous and compatible rail transport with Europe.
- Corresponding Railway Transport Regulation, Infrastructure Access and Capacity Allocation Regulations, Recording and Registration Regulation of Rail Vehicle, Railway Safety Regulation will be published in parallel with restructuring process specified in The Law No. 6461 about Turkey Railway Transport Regulation (MD\_a, 2013; MD\_a, 2014).
- Regulation on The Reduction of Sulfur Rate in Some Fuel Type entered into force in 2009, is an arrangement that will contribute to reducing emissions from the transportation sector. Implementation is monitored by the Energy Market Regulatory Authority.
- "Regulation on The Reduction of Sulfur Rate in Some Fuel Type" was prepared under the EU 99/32/EC Directive and came into force in 2012. In the frame of this regulation, the use of marine fuels that have sulfur amount by mass of inland water vehicles and connected to the quay or anchored vessels is in excess of the 0.1% (1000 ppm) is prohibited. In addition, all sailing passenger vessels regularly may not use marine fuel that have sulfur content by mass is above 1.5% while plying in Turkey's maritime jurisdiction areas.
- All engines that mounted to a new sightseeing boat or personal watercraft must be in accordance with the Recreational Craft Regulation after the date of 31/12/2011. Provisions of Recreational Craft Regulation were prepared by the harmonization with 2003/44 / EC EU directives and carbon, nitrogen oxides and hydrocarbons ratios in the exhaust emissions of the personal watercraft engines are limited.
- The investments made in aviation have increased the efficiency of sector as in the road transportation. Shortening of flight routes has been studying related to airway transportation. Furthermore the SMART project that aims to modernize the air traffic system targets to provide energy efficiency. Green Airport Project was launched by Directorate General of Civil Aviation and has put into implementation in airports coordinately by General Directorate of State Airports Authority (GDSAA). In the scope of The Green Airport Project, our 36 airports (Istanbul Ataturk, Antalya, Ankara Esenboga, Trabzon, Mugla Dalaman, Mugla Milas-Bodrum, Erzurum, Gaziantep, Isparta Suleyman Demirel, Nevşehir Cap-

padocia, Adiyaman, Amasya Merzifon, Balıkesir Koca Seyit, Balıkesir Center, Bursa Yenisehir, Elazig, Erzincan, Hatay, Kocaeli Cengiz Topel, Konya, Malatya, Mardin, Samsun Çarşamba, Sivas Nuri Demirag, Sanlıurfa GAP, Tekirdag Corlu, Tokat, Istanbul, Batman, Istanbul, Kars, Denizli, Van Ferit Melen, Siirt, Mus and Kahramanmaraş Airports) received Green Certificate of Incorporation. Addition to this, 4 terminals and airport operations including IC İçtaş Zafer International Airport Investment and Management Company, ATM Dalaman Airport Construction and Operating Co., TAV Istanbul Terminal Operations Co. and TAV Esenboga Investment Construction & Operations Co. operated by the private sector in the GDSAA responsibility has received the title of Green Organization. In the scope of this project, Greenhouse Gas Inventory which will be estimated by the aviation enterprises according to TS EN ISO 14064-1 standard is confirmed by TSE according to TS EN ISO 1064-3. Enterprises are certified by the Green Enterprise certification by the Directorate General of Civil Aviation after successful completion of the process and the fulfillment of project requirements. When all enterprises in airports receive Green Company Certificate, that airport will be certified by Green Airport by the Directorate General of Civil Aviation title.

- Master Plan will be prepared about energy transport to do with pipelines and transportation by pipelines of products other than energy transportation.
- Long-term power purchase agreements will be made both in order to strengthen our transit country position and supply Turkey's growing energy needs.
- Spatial Plans and Construction Regulation has entered into force on 14 June 2014. The definition of master plan of transportation is done in Regulation and it is foreseen that master plans of transportation could be done by the municipalities. Regulation brought principles about spatial strategy plan, the environment regulation plan and the development plan, land-use decisions, determination of the transportation network, designing public transport and pedestrian priority transportation system, developing principles in implementation plans for the pedestrian and bicycle path, designing education, health, green spaces and religious facilities within walking distance. Regulations are implemented by municipalities and public institutions.

#### 4.5.2.1 Economical Tools

- One of the most basic methods in Turkey that will promote the use of vehicles which have low greenhouse gas emissions is the vehicle taxation system. Arrangement of the vehicle taxes by foreground the engine capacity provides supporting the lower engine capacity that has less greenhouse gas emissions.
- There is no regulation based on calorific efficiency value and impact on the environment on the taxation of fuel. Adding bio-

fuels to the fuel up to the rate of 5% has been enabled and slice of 2% of biodiesel and ethanol generated from domestic agricultural products is blended with conventional fuel (diesel, gasoline) and exempt from excise tax.

- In order to ensure to be given a sustainable solution to the financing needs, income provided by all modes of transport and taxes collected in a fund, will be used for transport investment in coordination with The Ministry of Transportation, Maritime Affairs and Communications according to a plan and rates in the framework of needs analysis.
- Investments which are not feasible financially but have high social benefits will be provided state support.
- Precautions will be taken and necessary arrangements will be made for the realization of the projects by Public-Private Sector Cooperation and the contribution of the private sector to financing needs.

#### 4.5.2.2 Infrastructure Investments

In the period of the Tenth Development Plan, as a result of featuring on big projects as dual carriageway projects and high-speed train projects, the greatest share in public fixed capital investments including local administration investments and investment in labor, as per sectors is stipulated as 34% (MD\_a, 2014).

##### Highway:

- By the end of 2014, the length of highway network has reached to 2,669 km, while the length of dual carriageways have reached to 22,978 km along with highways, and the length of hot bituminous mixture (HBM) coated road network that is suitable for heavy vehicle traffic has reached to 15,902 km. Within this scope, 15,000 km long dual carriageway network and 14,500 km HBM road network length has exceeded the target. In road transportation, service quality has increased as a result of competitive pressure coming both from the market itself and from other transportation types.
- In highways on the north-south line of Turkey, considering the corridor approach, constructions of primary routes in which Ovit and Cankurtaran tunnels are also take place and corridors which shall improve trade with neighboring countries will continue.
- Within the direction of the target about decreasing the deaths arising from traffic accidents by 50% which takes place in Highway Traffic Security Strategy and Action Plan, shall be extended by using Traffic Electronic Control Systems with Smart Transportation Systems in an integrated way
- For relieving the traffic load of the first and the second Bosphorus Bridges and solving the traffic problem of Istanbul, constructions of approximately 115 km highway between Odayeri-Paşaköy, the connection road and the 3<sup>rd</sup> Bosphorus Bridge are in progress.

### Railway:

- In recent years, the investments on improving and renewing railway infrastructure and the development of the railways by constructing new lines have continued. Electrification in railways, Istanbul-Ankara high speed train project and the Marmaray Project which enables railed tubular passage at Bosphorus are accomplished. Along with infrastructure studies, studies on renewing tractive and hauled stocks are continuing.

### Maritime:

- For the purpose of developing maritime transportation and increasing its share especially in freight transportation, projects on constructions and modernization of harbors, and strengthening harbor-railway connections are continuing. The integration of harbors with other transportation types, logistic centers and villages are significant developments in this area.

### Airway:

- Within the framework of the arrangements, primarily the discounts in taxes and contribution shares in airway transportation, and as new carriers are included in the market, great growth in demand has continued. Total airway passenger traffic realized in 2006 as 61.7 million, has reached to 165.7 million passengers in 2014 with an average annual growth of 13%. Number of active airports have increased from 42 in 2006 to 55 in 2014.

- GAP International Airport and Hatay Airport are completed and put into service. New terminal buildings are put into service at Kayseri, Denizli, Trabzon, Merzifon, Sivas, Balıkesir-Koca Seyit, Batman, Erzincan, Malatya, Kars, Iğdır, Elazığ, Ağrı, Adıyaman, Adana, and Gökçeada airports. Besides, Milas-Bodrum Airport international terminal built by Build-Operate-Transfer method, Sabiha Gökçen Airport national and international terminals, Adnan Menderes Airport international terminal, Esenboğa Airport national and international terminals and Zafer Airport are put into service. The new terminal of Balıkesir Koca Seyit Airport at Gulf of Edremit in Balıkesir is completed and put into service. The new terminal building for international flights is opened.

- Construction of the 3rd Airport in Istanbul has started. In airways sector, Istanbul shall be supported to be an international transfer and maintenance-repair center.

- Within the framework of investment needs for long term air cargo traffic projections on the basis of airports shall be determined within the scope of "Air Transportation General Survey Project".

- Considering the results of Air Transportation General Survey, air cargo terminal capacity shall be expanded by building new air cargo terminals at the airports.

- For the period of 2007-2013, EU monetary cooperation

process has entered in a new period with IPA-Instrument for Pre-Accession Assistance. The Ministry of Transport, Maritime Affairs and Communication is implementing the Transportation Operational Program as the Program Authority responsible from the management of IPA funds provided to Transportation Sector. This program is prepared to finance transportation infrastructure projects through IPA funds within the scope of "Regional Development" which is the III. Subcomponent of five subcomponents of IPA funds and is approved by the European Commission on December 7, 2007. Transportation Operational Program has three basic priorities: 1) Improving railway infrastructure, 2) Improving harbor infrastructure and 3) Technical Support. Process of supporting the projects that are prepared within the directions of these priorities from IPA funds is in progress.

- Dual carriageway practices in highways which is one of the important investments of 2000's, have affected traffic security and freight shipment sector positively, and also had a contribution in decreasing the rate of greenhouse gas emissions (MD\_a, 2013; MD\_a, 2014).

### Inter City Transportation:

- Time schedules of bus, plane and ferry services between two distances can be seen by updating "National Transportation Portal" by the Ministry of Transport, Maritime Affairs and Communication (MD\_a, 2013; MD\_a, 2014; IMM, 2014; AMM, 2014 )

- As an alternative to railed systems, Metrobus, which is a much more cost efficient Bus Rapid Transit – BRT implementation, is put into service in Istanbul, in 2006. Another important application in bus systems in public transportation is renewal of bus fleets by purchasing vehicles running with natural gas. Purchasing is made in Ankara and Istanbul in this aspect. These are practices having significant positive impacts on air quality in cities and supporting greenhouse gas reduction strategy.

- On sustainable transportation, "Konya Bicycle Festival" and Bursa Nilüfer Municipality "Green Nilüfer Week" celebrations and "Once a Month The Street is Ours Campaign" which is started by the cooperation of nongovernmental organizations-universities and supported also by Istanbul Metropolitan Municipality are important projects

- "Bicycle Roads and Pedestrian Ways" is generally the most effective system which may significantly reduce intercity vehicle traffic and be a solution for short distance replacements without vehicle. As a result of the necessity for creating a good infrastructure for popularizing this system and making it more attractive; "Study on Survey, Planning, Designing Bicycle Roads and Walk Ways throughout Istanbul" is performed by the Directorate of Transportation Planning. Under the title of "Work on having Survey, Planning, Designing Bicycle Roads and Walk Ways throughout Istanbul and having Regional Transportation and Traffic Surveys made", a "Bicycle and Pedestrian Trans-

portation System” is established within the 630 km. long project area within the boundaries of Istanbul Metropolitan Municipality determined by Law number 5216. Within this system, for providing links between the counties and continuity of routes, inter links are added to 630 km bicycle road and the total bicycle road length is increased to 1004 km. Having the year of 2023 as the target year, routes within the scope of “Bicycle and Pedestrian Transportation system” is divided in 4 groups related to the application as the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and the 4<sup>th</sup> primary bicycle roads, and among these, for the 1st and the 2nd primary routes, concept projects are already prepared (IMM, 2014).

- Practices and investments on Bicycle and pedestrian transportation is limited. Bicycle plan is made in Konya City and practices have started, however, a comprehensive and safe bicycle network is not constituted yet. In Bursa Nilüfer Municipality, investments for bicycle roads and bicycle parking lots at light rail system (Bursaray) stations are being made. Also in Gaziantep, investments on bicycle roads has been started, besides, a system known as “public bicycles” application is established at the university campus.

#### 4.5.2.3 Research and Development

In transportation sector, especially in alternative fuel technologies, important R&D studies which public, private sector and universities are included, are being performed. R&D studies on fuel cells and hybrid vehicles are still being continued. Studies and investments of private sector, particularly on electrical vehicles have increased in recent years. Some of the studies which are put into practice are:

- Prepared within the scope of Turkey’s 2023 vision, studies on developing a national electric vehicle and mass production of environment friendly vehicle are being initiated.
- Researches and practices on high energy efficient and environment friendly vehicle technologies are supported by the Society of Automotive Industry.
- Although practices on manufacturing rail system vehicles in Turkey are limited, studies conducted by Istanbul Ulaşım A.Ş. are rather important. Rail system studies are being performed also by municipalities such as Bursa and Gaziantep.
- Seferihisar county of Izmir owns the first “Slow City” certificate in Turkey within the framework of urbanization policy supporting sustainable transportation and taking the most environment friendly types of transportation as walking and bicycle as the basis instead of high speed automobile driving, and within this scope, developed the applications on motorcycle running with solar energy. Studies on extending the application continue.

#### 4.5.3 Assessment According to Greenhouse Gas Type

The major part of the greenhouse gas emissions arising from the transportation sector is CO<sub>2</sub> emissions. Policy and precautions on decreasing CO<sub>2</sub> emissions are given in the sections above. There are many legal regulations and technology development projects on decreasing nitrogen oxides (NO<sub>x</sub>), non-methane organic pollutants (NMVOC), carbon monoxide (CO) and sulphur dioxide (SO<sub>2</sub>) emissions arising from fuel combustion in transportation sector.

#### 4.6. Agriculture

In Turkey, greenhouse gas emissions arising from agricultural activities were constituting 16% of the total emissions in 1990 which was the year of the first calculations were made and the rates were 7% in 2009 and 7.3% for the year of 2012 and is showing an increasing tendency in recent years. (Turk-Stat\_f, 2014). Agricultural production, livestock raising, fertilization, rice cultivation, incineration of agricultural wastes and soils constitute agricultural based greenhouse gas emissions. In these sub-sectors, N<sub>2</sub>O, CH<sub>4</sub> gases release from soils, CH<sub>4</sub> gas releases from animal digestion and wastes, CH<sub>4</sub> and N<sub>2</sub>O gases release from fertilization and manure management, CH<sub>4</sub> gas releases from rice cultivation and wetland areas and CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O gases release from incineration of agricultural wastes in the field. Agricultural activities constitute the greatest share in N<sub>2</sub>O emissions of greenhouse gases. Among these sectors, the highest contribution to total agricultural emissions is enteric fermentation based on animal digestion. Due to decrease in the number of animals in Turkey, a decrease is seen in methane emission after 1990; however, an increase is recorded in greenhouse gas emission due to development in agriculture sector after 2009. Majority of this increase is sourced from the development trend in this sector as a result of the stock farming supporting policies.

#### 4.6.1 General Policies and Measures

In the Tenth Development Plan (2014-2018), a development adopting the concept of “green growth” against climate change is designed. In the plan, it is decided to develop practices on the necessity of related International organizations and regional cooperation to prevent fluctuations in food prices caused by the negative pressure of climate change on agriculture sector, to ensure efficient use of food, water and natural resources. In the plan, continuing fight against climate change and harmonization studies by considering the country facts and within the direction of “common but differentiated responsibilities” and “relative capabilities” principles are accepted.

In the Tenth Development Plan, issues on providing coordination between related public organizations in irrigation, transportation and land consolidation activities, increasing irrigation rate by activating in-farm development services, renewing water transmitting and distribution facilities and accelerating transition to pressured irrigation system and extending modern irrigation methods in in-farm irrigation have taken place (MD\_a, 2013).

Preserving qualified agricultural lands primarily the naturally protected areas having a special important, fighting against erosion, environmental and taking the preventive measures by observing social effects of agricultural activities on soil resources are planned. For obtaining current and healthy land information, studies on creating a National Soil Database by benefiting from remote sensing and geographical information systems and efficient soil use, primarily by agriculture by making land use planning have been started. Besides, National Rural Development Strategy is prepared and put into effect to solve harmonization problems which International obligations, membership process to EU and accelerating change in agricultural structure caused on rural section and to create a framework on rural development project and activities.

In the Ministry of Food, Agriculture and Livestock 2010-2014 Strategic Plan, importance of protecting ecologic balance, sustainable use of natural resources and taking efficient precautions against global warming are emphasized. In this period, fourteen laws including Agricultural Law are made, agriculture master plans, regional master plans, rural Development strategy, agricultural strategy, rural Development Plan and IPARD Program are prepared, Agriculture Basins Production and Supporting Model is created, regulations on preserving agricultural lands are put into practice, land consolidation studies are accelerated, and agricultural supports are quadrupled (MFAL\_a, 2010).

In 2013-2017 Strategic Plan of the Ministry of Food, Agriculture and Livestock, it is pointed out that global climate change is threatening security of supply of the countries and agricultural production strategies, and in parallel with this change and developments, necessity of featuring policies protecting efficient agricultural production, sustainability, development and ecologic balance primarily in food safety is expressed (MFAL\_a, 2013).

In Rural Development Plan (2010-2013), agricultural use of renewable energy resources are indicated and subjects on providing environment friendly aquaculture is included in the plan to remove problems as environment pollution and climate change. For extending integrated basin rehabilitation practices, decision on conducting the natural resource reha-

bilitation studies being conducted on basin base according to the United Nations Framework Convention on Climate Change, Biological Diversity Agreement and The United Nations Convention to Combat Desertification which our country is a part of is included in the plan (MFAL\_b, 2010).

In the Organic Agricultural Strategy Document (2006-2020) of the Ministry of Food, Agriculture and Livestock, increasing the competition power and efficiency of organic agricultural sector to establish a sustainable agricultural sector in Turkey considering environmental dimension is defined as the basic goal. In Organic Agricultural Strategic Plan (2012-2016), Turkey has accepted an approach aiming to protect and develop soil and water resources and biological diversity for next generations and perceiving agriculture as a strategic sector. For the purpose of developing sustainable agriculture techniques and facilitating the consumers' reaching to healthy food, by Organic Agricultural Law number 5262 and Regulations on Principles and Practices of Organic Agriculture prepared on the basis of this Law National legislation is brought in conformity with the European Union Legislation, duties and authorities are determined by circulars, and Organic Agriculture Information system (OTBIS) is established.

For greenhouse gas emission control by National Climate Change Strategy (2010-2020), limiting emissions by using modern techniques in subjects as conscious fertilizer use, irrigation, soil cultivation, agricultural spraying in agricultural sector, supporting organic agriculture and drought-tolerant plant types and certificated seed production, encouraging in-field modern pressured irrigation systems (drip/sprinkler irrigation systems) and land consolidation are submitted as studies to be performed in short term. In middle term, it is listed as crisis management based on agricultural drought estimation, developing soil and land classification standards and observing applications, protecting and developing meadows and pasture areas, fertilization based on soil analysis, developing techniques for increasing carbon capture in soil, selecting adequate feeding methods in stock farming to reduce methane emissions, manure management and good drainage in rice cultivation, taking precautions for reusing treated wastewaters in agriculture. In long term, decision on establishing a central geographical information system for all land use classes in our country is taken for preparing National Greenhouse Gas Inventory Report in compliance with IPCC guide.

Within the framework of compliance with climate change, in agricultural sector, improvement of water quality impaired as a result of negative effects of climate change, fighting against animal diseases and plant pests take place in short term, soil cultivation, drainage, irrigation techniques to avoid increase in salinity in irrigated fields, mulching, training farmers, observing plant production areas and supporting plant production esti-

mation studies take place in medium term, and studies on pricing water according to the volume basis, improvement of irrigation network, transition to modern systems and encouraging projects on this subject take place in long term (MEU, 2010).

#### 4.6.2 Legal Regulations and Applications

##### Agricultural Law

Agricultural Law includes determining policies necessary for developing and supporting agricultural sector and rural area, making the arrangements, specifying scope and subjects, forming and conducting programs, finance and administrative structuring, application principles and procedures related to primary research and development programs. In the Law, purposes of agricultural policies are based on subjects as production, development, protecting and developing natural and biological resources, productivity, food security and strengthening security and organization and the Ministry of Food, Agriculture and Livestock is authorized and held responsible.

In the Law, the subject of agricultural basins take place as an explicit provision for concentration of agricultural production in the fields in compliance with their ecology, supporting, organizing, specializing and conducting in an integrated way. Among supports to be given for this purpose, there are agriculture insurance payments, rural development supports and environment-purpose agricultural land protection program supports. Protection of Environment-Purpose Agricultural Lands Program supports for practices including preventing climate change and reducing greenhouse gas emission subjects are being used.

##### Law on Soil Conservation and Land Use and Changes

Law on Soil Conservation and Land Use is made for determining principles and procedures providing protection and development of soil by preventing soil loss and quality loss, and which shall provide planned land use in compliance with environment priority sustainable development principle.

With the Law on Amending the Law on Soil Conservation and Land Use the smallest agricultural parcel size according to provinces and counties is defined for determining minimum agricultural land and sufficient income agricultural land sizes and preventing divisions. New arrangements made shall provide strengthening effective use by decreasing number of agricultural machinery and the usage period. This application shall be a measure reducing greenhouse gas emission arising from machinery used in agriculture. Avoiding parcel

division shall specifically provide change in irrigation methods, reducing in water loss and increasing in irrigation efficiency.

##### Pasture Law

Pasture Law has bestowed to the Ministry of Food, Agriculture and Livestock the authority and responsibility of arrangement to be made for determining research, planning, breeding projects, grazing period, usage system, protection and control measures to provide maintenance, breeding, protection, control and proper use of pastures, summer pastures and winter quarters.

Methane gas emission in stock farming is directly related to feeding. In development of pastures, determination and using plant types which may reduce methane emission arising as a result of enteric fermentation is a kind of opportunity for greenhouse gas emission arising from stock farming. As it has granted this authority, Pasture Law has an important function in controlling Greenhouse Gases.

##### Animal Breeding Law

Animal Breeding Law aims improvement studies to increase productivity of animals by all kinds of animal production and activities, protection of gene resources, animal production being economic and increasing competitive power, activities related to these issues and animal breeding by keeping pedigree records, raising breeding in healthy and hygienic conditions and passing to producers and passing to producers free from diseases, and protection. One of the options for decreasing methane gas outlet is raising animal breeds with high feed conversion rates (Alford, Cacho, Griffith and Hegarty, 2006). Similarly, raising animals with high feed conversion rate is included among measures for decreasing N<sub>2</sub>O gas emission. Sanctions of Law has a feature of supporting improvement studies which shall provide advantage in methane emission control in stock farming.

##### Decree of the Council of Ministers on Supporting Stock Farming

Stock farming support payments are started with Decree of the Council of Ministers on Supporting Stock Farming, and by the Communiqué on the Code of Practice on Supporting Stock Farming, direct support practices per animal for cattle, buffalo raising, calf supporting, sheep and goat brood stock support, angora goat raising and angora goat producer support are started for organized breeders, agricultural cooperatives and milk producer's union.

##### Law on Veterinarian Services, Crop Health, Food and Feed

Law on Veterinarian Services, Crop Health, Food and Feed number 5996 published in the Official Gazette dated 13.06.2010

with number 27610 and put into effect, is made to protect and provide food and feed safety, public health, plant and animal health and animal improvement and welfare, by considering protection of consumer interests and environment. One of the options for decreasing methane gas emission is good ration feature. Using high quality feed with high energy in ration, adding mitigant feature substances as tannin and oil to ration may reduce CH<sub>4</sub> emission. The Law stating the conditions required for food and feed security has an important effect in reduction of Greenhouse Gas emissions arising from stock farming.

### Organic Agriculture Law

Purpose of Organic Agriculture Law is determining principles and procedures on taking necessary precautions to provide development of organic product and inputs production for offering the consumers reliable, high quality products. The Law assuring control and control of certification process, and this process is one of the strongest tools in controlling fertilizer use in agricultural production. In this context, it provides significant contribution in decreasing N<sub>2</sub>O emission.

### Law on Olive Rehabilitation and Wild Olive Grafting

Law on Olive Rehabilitation and Wild Olive Grafting includes issues on establishing olive groves to be constituted by raising, growing, collecting and propagation of grafted olives on state lands, allocation to natural or legal entities for determining, grafting, protecting and managing wild olive groves and supporting them. Within this framework, protecting existence of olive which may be evaluated within agricultural sink areas takes place within the measures reducing the effects of Greenhouse Gas.

### Seed Law

Purpose of Seed Law is increasing productivity and quality in plant production, providing quality assurance in seeds, making arrangements in seed production and trade and performing arrangements necessary for restructuring and developing seed sector. It is known that coarse seeds with high nitrogen productivity reduce N<sub>2</sub>O emission in stock farming. Seed improvement of feed plants having high Nitrogen fixation shall provide advantage in reducing Greenhouse Gases.

### Law on Accepting the Statutory Decree by Changing, on Production, Consuming and Inspection of Food

By the Law on Accepting the Statutory Decree by Changing, on Production, Consuming and Inspection of Food, it

is aimed to provide food security, technical and hygienic production, process, protection, storage, marketing of all kinds of food substances and materials and substances contacting food, and proper nutrition of public, determining properties on safety of all kinds of raw, semi-produced and produced food substances used in producing food products and additives for food process and materials and substances contacting food to protect producer and consumer benefits and public health.

### Agricultural Reform Law on Land Arranging in Irrigation Areas

Agricultural Reform Law on Land Arrangement in Irrigation Areas aims to develop applications taking efficiently managing of irrigation areas and areas with high agricultural potential areas as the basis. It includes all measures as soil distribution and change, consolidation, in-land development services, managing irrigation investments. The Law specifically includes proper arguments to provide contribution to developing policies considering conformity of irrigation areas to climate change.

### Biosafety Law

Purpose of Biosafety Law is avoiding risks arising from genetically modified organisms and products obtained by using modern biotechnology, establishing and implementing Biosafety system for protecting human, animal and plant health and the biological diversity of the environment, and providing sustainability and determining the principles and procedures related to control, arrangement and tracking of these activities within the framework of scientific and technologic developments. The Law is a basis for the biological resources which may be used in reduction of the Greenhouse Gases.

### Agriculture Basin Regulations

Agricultural Basins Regulations are arranging principles and procedures related to conducting, supporting, organizing, specializing and preparing agricultural inventory in the determined agricultural basins of the agricultural activities. By these applications, it enables adaptation to changing climate conditions in efficient use, protection and planning of soil and water resources.

### Chemical Fertilizer Control Regulations

Chemical Fertilizer Control Regulations include technical arrangements in production, import and consumption of chemical fertilizer and are prepared for providing market control in specific standards, in compliance with rules and taking under record. Regulations enable preventive control of exceeding specific amounts of Greenhouse Gases to be released in case chemical fertilizers are applied by analysis.

### Extending Analysis- Based Fertilizer Use

This practice arranged by the Decree of the Council of Ministers on Making Support Payment for Fertilizer and Soil Analysis is prepared for making fertilizer and soil analysis at the laboratories authorized by the Ministry and making fertilizer suggestion according to analysis results for being able to give agricultural supports. Adequate-sufficient fertilizer suggestion according to soil analysis performed at the authorized laboratories, undertakes important duties in reduction of Greenhouse Gases. Specifically, emissions of agricultural origin N<sub>2</sub>O gases may be reduced by this practice.

### Fertilizer Usage Control

Agricultural Credit Cooperatives give information and guide their partners either by their technique staff or by technique staff of the participant, Gbretař on determining the fertilizer types, manner, amount and time of application, etc. Agricultural engineers are given in-service training and are specialized in fertilizer and fertilization, and calibration of tools and machinery to be used in fertilization and by this way, producers are prevented from using fertilizers unconsciously and wrong. These practices have a nature of support for decreasing N<sub>2</sub>O emission by avoiding excess fertilizer use.

### Circular on Authorizing Soil-Plant Analysis Laboratories and Controls

Principles and procedures are established for authorizing soil-plant analysis laboratories of real and legal entities and public and universities to make soil analysis and approve application forms and their controls for farmers included in Farmer Register System who want to get support payment by having soil analysis made, and make rules for issues on authorization criteria, technical specifications, mode of study, management, responsibilities and controls of the laboratories conducting analysis studies. Within the framework of these rules, there are 284 Authorized Soil -Plant Analysis Laboratories in total under Soil Analysis Support. Inspection and Control of Laboratories are performed in a dynamic system and as of 05.05.2014, besides above mentioned laboratories, there are records of 77 laboratories which their authorities are suspended and 8 laboratories which their authorities are cancelled .

### Regulations on Good Agricultural Practices

Purpose of Regulations on Good Agricultural Practices is performing an agricultural production which does not give any harm to environment, human and animal health, protecting natural resources, and arranging principles and procedures of good agricultural practices to provide traceabil-

ity and sustainability in agriculture and for submitting reliable products. Effective practices are performed in terms of food security and proper-sufficient fertilizer use.

### Environmentally Based Agricultural Land Protection Program (ÇATAK)

In areas where intensive agricultural activities are performed, erosion, soil and water pollution exists, has irrigation water problem, and natural balance is disturbed; taking necessary cultural precautions for increasing soil and water quality, sustainability of renewable natural resources, avoiding erosion and decreasing negative effects of agriculture, improving soil structure by taking "Minimum Soil Tillage Agriculture" practices in this project which raising awareness of producers on agriculture-environment is aimed, increasing agricultural income of the producers by reducing input costs are prioritized. In areas which project practices are planned to be performed, it is aimed to protect soil and water structure and natural vegetation, by extending organic agriculture and good agricultural practices; producers to be able to evaluate the effects of agricultural activities they perform on environment, and being able to protect the environment by considering natural plant and animal structure. As of 2013, practices are performed in 30 cities in total, 35,084,038 TL in total is paid to 9,195 producers in 33,172 hectare area .

### Farmer Registry System

With the Farmer Registry System Regulations updating and developing Registry system and conducting agricultural supports in a controllable and traceable way are enabled for establishing healthy agricultural policies. It is the body of systems where personnel information of farmers engaged in agricultural activities, and assets (land, animal, input, etc.) they use during the activities, product design and average yields are recorded, agricultural supports are applied, tracked and controlled, and which is used for establishing agricultural policies. Besides, there are other Agricultural Information Systems constituted of Farmer Informing Service, "Trkvet", Organic Agricultural Information System, Underover Registry System, Beekeeping Registry System, and Good Agricultural Practices Registry System. Agricultural Information Systems provide all inventories necessary for tracking and controlling agricultural-origin greenhouse gas emissions.

### Supporting Private Irrigation Machinery and Equipment Purchasing within the Scope of Supporting Program of Rural Development Investments

Supporting activities are being carried out in 81 provinces within the scope of Program of Supporting Rural Development Investments to avoid excessive use of production inputs

as irrigation water, energy and fertilizer by extending use of modern irrigation machinery and equipments developed for agricultural activities by producers, helping to protect quality and quantity of our soil and water resources, contributing in improvement of quality and productivity in production and reducing manpower need. According to the amount of goods purchasing basis to the donation announced every year for real and legal entity applicants provided to be separately, it is made in the rate of the determined donation support (50% - 75%). Within the scope of the supports, as of the end of 2013, productivity in agricultural production is increased and negative effects which extreme irrigations on our soil and water resources shall cause are prevented in approximately 750 thousand decare area by providing the utilization of modern irrigation methods.

### Modern Irrigation Systems Incentive

There has been a significant progress in irrigation system supplies for the producers to have in-farm modern pressure irrigation system by enabling the producers to use low interest (over discounted interest rate) investment and working capital loan to meet financial needs of the producers in affordable conditions, develop agricultural production and increase productivity and quality. Approximately 800 Agricultural Engineers working at the Agricultural Credit Cooperatives have taken applied training and prepared numerous projects. Within this framework, by provided supports of 24,000,000 TL for 2,586 projects in 2012, and 28,000,000 TL against 3101 projects in 2013, irrigation systems are established by the Agricultural Credit Cooperatives.

### Specialized organized industrial zones based on Agriculture

Specialized Organized Industry Zones based on Agriculture may be established where industrial facilities for plant and animal origin production constituting agriculture based industrial input to provide integration of agriculture and industry sector and for the process of these take place and provided that they shall follow the biosafety measures proposed according to the relevant. Recently, there are five Specialized Organized Industry Zones based on Agriculture under construction and eight which have acquired legal entity status.

### Projects on Sustainable Land Management and Climate-Friend Agricultural Applications

With this project, adaptation and spreading of low carbon emission technologies are aimed within the framework of land degradation, climate change, bio-diversity protection, efficient use of agriculture and forest lands. The project conducted at Konya Endorheic Basin is constituted of work packages of improvement of environmental structure for various benefits obtained from rehabilitation of disturbed ar-

reas and climate friend agricultural practices and sustainable land management, and the stage of application of the project is in progress (MFWA\_b, 2014).

### Protecting Animal Breeds

Number of breeds and lines taken under protection is 41 as of 2013, protection and identification studies are being performed. 7 cattle in the hands of 593 breeders in 23 provinces have been taken under protection. 2 animal gene banks are established, studies on DNA, cell, tissue, embryo and sperm freezing and storing and identification in DNA level are being conducted.

### Family Farms

As the year of 2014 is accepted as the 'Family Farming Year' by the United Nations, necessity for reviewing family farming in terms of technical aspects and the basic indicators has arisen. Family Farming is leading our country agriculture and it is possible to continue as it is in the predictable future. Taking the subject in the agenda has started the related agricultural organizations. Climate change is determined to be one of the basic problems increasing flood, drought and disease risks also for family farming (TKDK, 2014). Food safety support, sensitivity in use of water and soil resources, tendency of protecting the land in long term in terms of environmental aspects and sustainable use of natural resources are expressed as the strengths of family farmers who are the continuous suppliers of high quality varied products (FAO, 2014).

### Studies and Applications on Using Renewable Energy Resources in Agriculture

Providing energy need in rural regions and agricultural businesses by renewable energy technologies is a factor which may create advantage in terms of a sustainable environment. In agricultural-purpose practices, generally small wind turbines with horizontal axis are used. Wind turbines making direct power generation and specifically small size wind turbines are used at agricultural businesses in all agricultural activities where use of electricity as heating, cooling, drying, lighting, operating milking units is the point.

Within the scope of the Program of Supporting Development Investments applied in our country, pressure irrigation systems have rapidly increased and significant amounts of water saving is provided throughout the country. Solar energy is being used as an energy source for agricultural irrigation systems. Initial investment costs of agricultural irrigation systems with solar energy are higher than the diesel systems. Operation and maintenance costs of agricultural irrigation systems are very low and fuel cost is zero. Within the framework of the existing legislations, for low dynamic height values as 10 m, 20 m and 30 m, solar energy irrigation systems are rather economic and offer environmentalist solutions. Investments made on renew-

able energy resources which are very important in terms of sustainable environment, for the purpose of using in agriculture are within the scope of support (Şenol, 2012).

By Law on Geothermal Resources and Natural Mineral Waters and Governing Regulations of the Law on Geothermal Resources and Natural Mineral Waters use of geothermal resources for all sectors is enabled. Current status of greenhouses in 10 provinces in Turkey performing geothermal green housing are analyzed in terms of economic, social and environmental aspects at greenhouses using geothermal resource or not, and reasons for starting geothermal green housing and the problems encountered in production process are determined (Hasdemir, Gül and Yasan Ataseven, 2014).

### 4.6.3 Assessment According to Type of Greenhouse Gas

Policies conducted in agriculture are shaped according to the criteria of strengthening management techniques, evaluation of product remains and animal wastes, improving new technologies and increasing their use, and supporting behavior changes on scientific and technological developments and innovations (Türkeş M. , 2003), and basic practices in reduction of CH<sub>4</sub> and N<sub>2</sub>O, CO and NO<sub>x</sub> emissions sourced from agricultural activities are being improved. Arrangements made with Pasture Law, Animal Breeding Law, Law on Veterinarian Services, Crop Health, Food and Feed, Seed Law, Specialized Organized Industry Zones based on Agriculture are creating directly effective areas in reduction of methane gas in stock farming sector. As life of methane is shorter than carbon dioxide, decrease in methane shows its effect on climate change faster than the decrease in carbon dioxide. Accordingly, importance of policies and projects targeted in reduction of methane emission increases more (Demir and Cevger, 2007). Within the scope of Good Agricultural Practices and Organic Agriculture, supports given to the practices in these sectors within the scope of ÇATAK program constitute measures reducing methane gas emissions. Projects which promote livestock raising, agricultural business, organic agriculture and combined projects including biogas production are practices for reducing methane emission.

By Law on Soil Conservation and Land Use and Changes, collapsing of agriculture parcels are avoided and by this way, agricultural sourced carbon dioxide emission decreases by providing strengthening of effective use by decreasing number of agricultural machinery and the usage period. In all

practices based on proper-sufficient use, reduction is provided in greenhouse gas emissions arising from agricultural production inputs as irrigation water, energy and fertilizer.

In areas which land consolidation is made, as a result of changes in road lengths and routes, farmers' daily road distances are shortened in average of 26.68 km (minimum 6.44 km and maximum 70.24 km), this shortening reduces average carbon dioxide emission value by 28.93 kg (minimum 6.98 kg and maximum 76.16 kg). As a result, at least 1.90 kg, and 20.77 kg at the most and average 7.89 kg carbon dioxide equivalent reduction is provided per kilometer (Polat and Manavbaşı, 2012).

Increasing carbon capture by reduced soil processing, extending plant alternations, increasing level of benefiting of plants from nitrogenous fertilizers and using nitrification reducing chemical or natural inhibitors are listed as net Greenhouse Gas emission reducing measures from soil (Kayıkçıoğlu and Okur, 2012).

Reaching to higher yield in unit area by optimizing efficiency of nitrogen fertilizer and using protective soil processing techniques are among the agricultural origin N<sub>2</sub>O and CO<sub>2</sub> emissions reduction methods. In this respect, Organic Agricultural Law, Chemical Fertilizer Control Regulations, Regulations on Extending Fertilizer Use Based on Analysis, Regulations on Fertilizer Usage Control and Good Agricultural Practices are providing amount of nitrogenous fertilizers to be used to soil to be proper-sufficient. Accordingly, it shows reduction effect on N<sub>2</sub>O and CO<sub>2</sub> emissions in both fertilizer production and soil emission. It is thought that by Seed Law, seed improvement for growing feed plants with high nitrogen fixation power directly reduces emission of N<sub>2</sub>O gases.

Supporting olive cultivation with Law on Olive Grove Rehabilitation and Wild Olive Grafting and applying deterrent penalties for cutting down olive trees increase CO<sub>2</sub> sink basin. With Sustainable Land Management and Climate-Friendly Agricultural Practices Project, it is possible to provide CO<sub>2</sub> capture and protect bio-diversity.

## 4.7. Forestry

### 4.7.1 General Policies and Measures

As of the First Five-Year Development Plan including the period of 1963-1967, by protection of forests and providing their sustainability, rehabilitation of degraded forest lands, increasing their productivity and afforestation, gaining new forest lands have become continuous targets. Also in the Tenth Development Plan (2014-2018), in relation with forests; developing

combats with forest fires, diseases and pests, accelerating studies on afforestation and rehabilitation of degraded forest lands, determination, protection, sustainable use, development and monitoring of biological diversity are listed as the main targets (MD\_a, 2013).

There is also a National Forestry Program of Turkey prepared by the Former Ministry of Environment and Forestry and including the years of 2004-2023. In the program, sustainable forest management is specified as the main goal of Turkey's forestry. In the National Forestry Program, there are no direct policies or strategies on climate change combat and adaptation. However, in the program, protection of forests, improvement of forests and benefiting from forest resources are shown as the main goals indirectly in relation with climate changes. Besides, carbon sequestration in forests is handled as an ecosystem service and under the title of strategy of benefiting from the protective and environmental functions of forests, targets for realizing studies for raising awareness in public on enlarging forest lands to be allocated for forest functions, including carbon sequestration, and on the importance of forest functions are given (MEF, 2004).

Also in the strategic plan GDF has prepared for the period of 2013-2017, strategic goals which part of them may be indirectly evaluated within the scope of climate change combating are determined and these are given below (GDF\_b, 2012).

- Protection of forests, areas considered as forests and biological diversity in these areas against all kinds of biotic and abiotic harmful effects,
- Improving existing forests, increasing their productivity and expanding their areas,
- Meeting developing and changing expectations of society from the goods and services produced by forests at the highest level, benefiting from forests in a versatile and sustainable manner,
- Providing corporate development to provide sustainable forest management, offering faster and higher quality service and achieving to defined strategic objectives
- Within the direction of the sustainable forest management principles, to make ecosystem based and multi-purpose forestry plans.

With the development plans and National Forestry Program in Turkey, in order to put forth the goals determined in GDF strategic plan, some action plans are prepared and applied by GDF as of the years of 2000. These are listed below.

- Action Plan on Rehabilitation of Degraded Oak Areas

(2005-2014)

- Action Plan on Rehabilitation of Cedar Forests (2005-2014)
- Action Plan on Conversion of Coppice Forests to High Forests (2006-2015)
- Action Plan on Rehabilitation of Juniper Forests (2006-2015)
- Action Plan on Rehabilitation of Oak Forests (2006-2015)
- Afforestation and Erosion Control Mobilization Action Plan (2008-2012)
- Rehabilitation of Burnt Forest Areas and Establishment of Fire Resistant Forests Project (YARDOP) (2008- in progress)
- A Forest to Every Village Action Plan (2007-2011)
- Young Stands Improvement Mobilization Action Plan (2012-2016)
- Industrial Plantation Studies Action Plan (2013-2023)

Not only by GDF, but also by the General Directorate of Combat Desertification and Erosion (GDCDE), action plans are prepared in relation with improvement of lands which their biological diversity is disturbed and preventing floods and overflows. These may be listed as;

- National Action Program to Combat Desertification (2005)
- Combating with Erosion Action Plan (2013-2017)
- Upper Catchment Flood Control Action Plan (2013-2017)
- Dam Catchments Green Belt Afforestation Action Plan (2013-2017)
- Combating Flood Action Plan (2013-2017)
- Combat Desertification National Strategy (2014-2023)
- National Basin Management Strategy (2013-2023)
- Mine Site Rehabilitation Action Plan (2014-2018).

In addition to these action plans, National Biological Diversity Strategy and Action Plan (2008-2017) prepared by the General Directorate of Nature Conservation and National Parks (GD-NCNP) is still in effect and studies are in progress for the revision of the subject Action Plan.

Also in the above listed action plans there is no direct goal on climate change. As the action plans are applied, carbon pools shall be indirectly increased as forests' protection, productivity increase and enlarging forest areas shall be provided. However, one of the most important defects of the results of these action plans is specifically not being measurable, reportable and verifiable in terms of carbon sequestration.

In issues of forestry sector to greenhouse gas emission reduction and climate change mitigation and adaptation, there are more concrete purposes and goals in National Climate Change Strategy Certificate (IDES) (2010-2020), Climate Change National Action Plan (NCCAP) (2011-2023) and Climate Change Adaptation Strategy and Action Plan (2011-2023).

Among these, as a short term strategy in NCCSD, evaluation of the effects of climate change on forests and development of adaptation strategies by putting forth the situation related to deforestation and forest degradation are determined. As a mid-term strategy, in 2008-2012 period, it is aimed to perform studies on afforestation on 2.3 million hectare area and rehabilitation of degraded forests. In the subject period, this strategy is accomplished and studied on 2.4 million hectare area. Also in 2013 and 2014, studies on afforestation and rehabilitation of degraded forests have continued and 510 bin hectare more areas are rehabilitated and afforested (GD-F\_a, 2015). Besides, another middle term strategy is making afforestation in semi-arid areas with drought-tolerant tree species. As long term strategies, establishing a monitoring model based on satellite data to estimate all land uses and land use changes for national greenhouse gas inventory is projected. Additionally, in long term, developments of urban green areas and urban forestry are planned (MEU\_c, 2010).

In NCCAP, 4 purposes are determined related to forestry. These purposes are increasing carbon amount captured in forest lands, reducing deforestation and effect of pests and diseases, limiting negative effects of land uses as forest, pasture, agriculture and settlement and changes on climate change and strengthening legal and corporate structure for climate change in land use and forestry subjects. Above these purposes, there are goals as increasing carbon amount captured in forest lands by 15% and reducing deforestation and forest degradation by 20% until 2020 in comparison with 2007 (MEU\_a, 2012).

In Turkey, the Ministry of Forestry and Water Affairs is responsible from LULUCF sector of study group for decreasing of Greenhouse Gases emissions under Coordination Board on Climate Change and Air Management established to manage studies on climate change mitigation and adaptation.

The Ministry of Forestry and Water Affairs have constitute Carbon Pools and Climate Change Specialized Group within the body of GDF in 2013 to prepare forest carbon inventory, provide adaptation of forestry to climate change and generate climate change policies. By sub-study groups under specialized group, studies are performed on National Greenhouse Gases inventory and climate change National communication calculating carbon storage in forests by AFOLU methodology and more healthily, determining adaptation of forest trees and forestry activities to climate change and the defects in National legislation and the valuation of ecosystem services.

## 4.7.2 Legal Regulations and Applications

Forestry in Turkey has a deep rooted past and protection, improvement, development and enlarging forests are among basic Forestry policies. For these purposes, the first law related to forests (Law Number 3116) is put into effect in 1937. Later in 1945, a law related to nationalizing private forests is made. In 1956, Forest Law (Law Number 6831) which is still in force although it has been amended from time to time, is accepted. Besides, there are provisions also in the Constitution on protection and development of forests and protection of forest villagers. Activities related to forestry are conducted by the Ministry of Forestry and Water Affairs.

Turkey has been attaching notice on nature conservation for a long time. For instance, the first national park is announced in 1958. Today, 6.3 million hectare on lands and 1.6 million hectare in water, a total of 7.9 million hectares area is under protection. The Ministry of Forestry and Water Affairs and the Ministry of Environment and Urbanization are responsible from protected areas. In relation with protected areas National Parks Law number 2873 is put into effect in 1983. This Law arranges principles on selecting and determining protected areas as national park, nature park, nature monument and nature conservation area, protection of their properties and characters without destroying, their development and management. Besides, in relation with special environment protection areas and natural heritage sites, Law on Protection of Cultural and Natural Property (Law Number 2863) issued in 1983 is still in effect. In 2011, General Directorate of Preservation of Natural Heritage connected to the Ministry of Environment and Urbanization is established. This general directorate has duties as determining the principles and procedures on registering, approving, amending and announcing natural properties and natural protected areas and private environment protection regions and determining, registering, managing and having managed the boundaries of these areas. Within this scope, studies on evaluating all natural protection areas shall be performed scientifically by the general directorate in the years between 2014 and 2016.

Although protection and enlarging of forests in Turkey take place in the Constitution and the Forest Law, by laws as Mining Law, Tourism Law and Renewable Energy Law allocations of forest lands for usage besides Forestry can be made. These applications cause forests in the allocated areas to be destroyed partially or completely and narrowing carbon pools (MEU, 2011).

There are no direct provisions on climate change combating or adaptation in the National legislation related to Forestry and Nature Conservation summarized above. However, by studies performed on increasing forest lands, improvement of degraded forest lands and enlarging protected areas, carbon amount accumulated in the forests are indirectly increasing. Hence, according to Turkey National Greenhouse Gas Inventory prepared for 2013, annually accumulated carbon amount in Turkey forests has increased from 7.7 million ton/year C to 13.9 million ton/year C in the period of 1990-2013 (TurkStat, 2015).

### Application Samples on Greenhouse Gas Reduction

Various projects are being financed by international organizations, GDF and various non-governmental organizations and GDF takes place as the conducting organization. These projects are briefly presented below.

- Monitoring Forest Ecosystem Program (ICP Forest)
- Adapting the framework for forestry policy to meet the needs of climate change in the MENA region (2010-2015)
- Integrated Approach to Management of Forests in Turkey, with Demonstration in High Conservation Value Forests in the Mediterranean Region (2013-2018)
- Project on development of the production of goods and services of Mediterranean forest ecosystems in the context of global changes (FFEM Project) (2013-2018)
- Project on Adaptation of Mediterranean Forests to Climate Change (2013-2016)

### 4.7.3 Assessment According to Type of Greenhouse Gas

The amount of CO<sub>2</sub> taken from the atmosphere and bound in connection with the protection, enlarging and development studies of forests are increasing every year. Despite this, as a result of fires on forest lands. CH<sub>4</sub>, N<sub>2</sub>O, NO<sub>x</sub> and CO gas emissions occur. However, emissions of these gases remain at low levels by studies conducted by GDF for combating fires.

## 4.8. Waste

### 4.8.1 General Policies and Measures

Waste sector has been the second sector as having the greatest share in energy sector in greenhouse gas emissions in Turkey from 1995 to 2009. However, according to the 2013 calculations, it is ranked in the fourth place following industrial processes, this is a result of waste reduction in in-

dustry as a nature of IPPC directive and using the best existing techniques as well as the development of the concept of clean production by time; at the same time, as a result of rapidly growing industrial production in parallel with the increasing population it has caused an increase in the sector to get ahead of the waste sector.

According to 2013 National emission inventory, waste sector constitutes 5.7% of the total greenhouse gas emissions. Waste sector includes greenhouse gas emissions, emissions formed by disposal of urban solid wastes (regular/irregular waste storage), emissions generated by waste incineration, emissions sourced from composting wastes and sludge formation and disposal from urban wastewater treatment plants.

One of the sub sectors generating greenhouse gas emission in Turkey is wastewater treatment (because of nitrogen in wastewater and generated N<sub>2</sub>O gas). According to TURKSTAT's Municipal Wastewater Statistics, while population that is served by sewerage systems has a share of 52% in Turkey's population in 1994, the share has reached to 78% in 2012. Pursuant to the Wastewater Treatment Action Plan for 2008-2012 prepared by Ministry Of Environment And Urbanization, the rate of population served by wastewater treatment plants was 58% in Turkey's population in 2012 while the rate was just 10% in 1994.

While compost production in Turkey in 1991 had a capacity value of 245,000 ton for 2 active facilities, in 2006, 29,000 tons of production is realized in 4 facilities, and in 2010, this value has been 38,000 tons in 5 active facilities. Support mechanisms are needed for the increase of compost production which was equivalent to only 7% of production capacity in 2010 and has decreased by 20% compared to 47,000 tons value of the year of 2008.

Another sub sector constituting greenhouse gas emission is waste incineration; with Istaç, the first incineration plant of Turkey having 9,000 tons capacity in 1995, and with Ilaydaş, the second incineration plant, annual waste incineration has increased to annual 44,000 tons in 1997. In 2010, in Turkey, total 40,000 tons of waste are incinerated and heat energy is recycled.

General policies on waste sector in Turkey take place in the 10th Development Plan prepared in 2013. Targets given in the plan on reduction of greenhouse gas emissions generated from waste sector are given below;

[Target 982] "Solid waste management shall be enabled, waste reduction, decomposition in the source, collection, transportation, recycling and disposal stages shall be developed as a whole in technical and financial ways; priority shall be given to consciousness raising and development of corporate capacity. Using recycled materials in production shall be encouraged."

(Target 1034) "In compliance with sustainable cities approach, applications as reducing waste and emission in cities, energy, water and resource productivity, recycling, avoiding noise and visual pollution, environment friendly material use, environment sensitivity and life quality shall be increased."

In 2008 Waste Management Action Plan (AYEP) (2008-2012) is prepared by the former Ministry of Environment and Forestry. In the subject plan, in addition to the main policy of the Local Administrative Unions (Local Waste Management Unions) planned to be established in the 9th Development Plan, targets given for the reduction of greenhouse gas emissions;

- Constituting Regional and National Waste plan and providing sustainability,
- Encouraging the use of technologies minimizing waste formation during production,
- Harmonizing wastes with EU criteria of international trade and providing its application,

Are being applied by the Ministry of Environment and Urbanization and the Ministry of Science, Industry and Technology. Majority of the Waste Management Unions established in compliance with the above targets are put into practice, domestic solid wastes of local administrations are being stored at the selected common areas by regular storing. The National Recycling Strategy and Action Plan has been prepared under the coordination of the Ministry of Science, Industry and Technology as of 2015 and it is applied and monitored by the Ministry of Environment and Urbanization.

Preparing NCCAP which is one of the main targets of the 9th Development Plan for decreasing formation of greenhouse gas emissions in waste sector is accomplished in 2011. One of the most important outputs of the plan in the recent years is net decrease in the domestic solid amount stored irregularly by the waste unions established.

One of the strategies of NCCAP developed on decreasing greenhouse gas emissions of wastes (wastewater) is as "For performing a healthy water management in industry sector in Turkey, primarily, providing water saving in the beginning of the process, recycling of wastewater and putting primary policies into practice in industrial subsectors consuming excessive water (water reduction in paper industry) are necessary. Within this framework, Revising Turkey Industry Strategy Document (2014-2020) projecting decreasing energy and fuel consumption more and focused on providing treatment of industry sourced wastewater within the scope of environment legislation is aimed in terms of water efficiency practices in industry, by considering the effects of climate change ". The strategy document addresses the is-

sue under the action with title of "National Eco-efficiency Programme to be carried out". Also in NCCSD target of reusing treated wastewater in urban green areas takes place. One of the National strategic actions in NCCAP is determined as "Encouraging treatment of wastewaters to use in agriculture and industry sector with economic instruments".

Some of the actions on waste sector in NCCAP are given below;

- Taking the year of 2005 as the basis, amount of biodegradable waste to be accepted to regular storing facilities to be reduced in weight to 75% until 2015, to 50% until 2018, and to 35% until 2025
- Continuing to establish integrated disposal facilities until 2023 throughout the country and to remove 100% of municipality wastes at these facilities
- Closing 100% of irregular storage facilities until 2023

As a result of these actions, publishing Control Regulations of the Biodegradable Wastes in the first quarter of 2015 is expected. The first integrated Waste Disposal Facilities is Izmit Izaydaş and the second is Istanbul-Ecologic Energy Facility. Irregular Storage Facilities are being closed in various cities by the funds of local government and/or EU.

#### 4.8.2 Legal Regulations and Applications

There are important Regulations put into effect within the scope of waste sector legislation adaptation on greenhouse gas emission reduction sourced from waste sector in Turkey specifically in the Environment Stage EU Negotiations opened in 2009.

Main regulations in effect on reduction of greenhouse gas emission sourced from waste sector are:

- Regulations on Solid Wastes' Control (1991),
- Regulations on Hazardous Wastes' Control (2005),
- Regulations on Urban Wastewater Treatment (2006),
- Regulations on General Principles of Waste Management (2008),
- Regulations on Urban Wastewater Treatment Regulations and Communiqué on Sensitive and Less Sensitive Area Water Areas (2014)
- Regulations on Waste Incineration (2010),
- Regulations on Usage of Domestic and Urban Treatment Sludge in Soil (2010)
- Regulations on Packaging Wastes Control (2011),
- Communiqué on Fuel, Additional Fuel and Alternative Raw Material Derived from Wastes (2014)
- Compost Communiqué (2015)

## Regular Storage of Wastes

The related control authorities in Turkey related to waste management is Provincial Directorate of Environment and Urbanization, and conducting institutions and organizations are municipalities or municipality economic companies. According to Solid Waste Master Plan which the first part is completed in 2006 and the second part in prepared in 2009 according to the Waste Management Action Plan, local administration unions (solid waste unions) have acquired legal tender and are continuing effectively to waste management activities.

According to the results of Municipal Waste Statistics Survey 2012, 664 municipalities collected and stored solid wastes at 80 regular waste collection storages in 2012. It is calculated that waste disposal and recycling facilities owned by or working for municipalities is serving to a population of 40,795,550.

Significant progress is made in regular storage of wastes and as of 2012, there are 80 regular storage facilities taken into service rendering service to a 63 million population through 2,894 municipalities. Required investment need for improvement and closure of irregular storage areas is estimated to be around 1400 in the Solid Waste Master Plan is estimated to be 350,000.000 Euro. Irregular storage areas in some cities are closed and the collected garbage is burned by flare system.

On disposal of wastes and decreasing methane emissions formed in storage areas, the Ministry of Environment and Urbanization coordinates various R&D and application projects. The main projects are as the following;

- Project on Determining and Reducing Methane Emission Arising from Regular or Irregular Storing Areas (Netherlands- Turkey Common Project -MATRA)
- Management of Irregular Storage Areas in Turkey (Netherlands- Turkey Common Project-MATRA (2010-2011)
- Project on Biogas Production from Animal Wastes (Germany- Turkey Common Project- GTZ)(2010-2012)
- Domestic / Urban Treatment Sludge Management Project (TUBITAK KAMAG) (2010-2013)

Besides, solid waste and wastewater treatment plant projects of various cities in Turkey are also being supported within the scope of EU IPA Program ([www.ipa.gov.tr](http://www.ipa.gov.tr)).

## Treatment of Wastewaters

"Wastewater Treatment Action Plan (2008-2012)" is prepared by the former Ministry of Environment and Forestry. In the plans made, it is aimed to reach the rate of population served by wastewater treatment plant to total municipality population to 73% in 2010 and 80% in 2012. Planning wastewater treatment plants according to water basins is started to achieve these goals, and within this framework, Basin Protection Action Plans and Private Provision Determination studies are made at 25 water basins and sub basin (Atatürk Dam, Eğirdir Lake, Kartalkaya Dam, Gökçe Dam and Alibey Dam) on the basis of wastewater treatment targets. In these plans, water potential and water pollution status of the basins are analyzed as agricultural, domestic and industry sourced pollutants, pressures on current protection areas are specified and investment and renewal needs for wastewater treatment plants in the basin are determined for future.

Project of Supporting Infrastructures of Villages (KÖYDES), is a project started in 2005 for providing sufficient and healthy drinking water to villages and neighbors which do not have drinking water or road or have insufficient drinking water, raising standards of village roads, increasing life quality of villages by the development of small scaled irrigation and wastewater infrastructures, and providing economic and social improvement of villages. By KÖYDES Project, amount of water consumption per capita has significantly increased following sufficient drinking water supply to our villages and building pressure water network. Due to wastewaters generated as a result of this situation starting to be a severe risk for environment and public health, for the purpose of disposing this type wastewaters in compliance with technique, provided that it shall be limited with cesspool, wastewater infrastructure projects are included in KÖYDES Project by the Decree Dated 31/03/2011 with Number 2011/5 on Making an Amendment in the Decision on Principles and Procedures on Distribution, Usage, Monitoring and Inspecting of KÖYDES Project Allocation on the basis of Provinces dated 08/02/2011 with number 2011/2 of the Higher Planning Council (YPK) and the Ministry Circular number 2011/37 is published. By the YPK Decree number 2012/3, primarily at the settlements where village wastewaters threaten the drinking water basin and environment and public health, recovering wastewater infrastructure needs of villages which their water drinking network infrastructures are completed by proper treatment and/or disposal systems is specified as the main goal. As a concrete result of this Action Plan, rate of population whose wastewater is treated to the total population has reached to 58% according to 2012 TurkStat data.



### Incineration of Wastes and Obtaining Energy from Wastes

There are various scaled projects and practices which have started in 2000 and are accelerated in relation with the evaluation of storage gas released as a result of regular and irregular storage of wastes in Turkey. There are production plants producing biogas energy from landfill gas established in metropolis as Ankara, Istanbul, Bursa, Konya, Gaziantep and Sakarya, and in other Metropolis and Provinces, establishing integrated wastes plants are planned or the project is at construction stage. Biogas energy production plants established in Turkey are shown in Table 4.3.

Due to the provisions of Regulations on Wastes Incineration, real or legal entities wishing to obtain heat energy from domestic, medical and/or dangerous wastes should receive license from the Ministry of Environment and Urbanization. Plants in Turkey on waste incineration are shown in Table 4.4. Besides these plants, cement and lime production plants have license on waste incineration and are included in greenhouse gas emission account over their own sectors.

In relation with clean production (eco-efficiency) practices which is of the most important tools of compliance in industry; former Ministry of Environment and Forestry has performed "Project on Determining the Framework Conditions

and R&D Needs for Expanding Clean Production Practices in Turkey" in 2009 for establishing an infrastructure for a roadmap for expanding clean (sustainable) production in Turkey. Besides, due to Special Consumption Tax General Communiqué with Serial No 29, the process is encouraged by an arrangement brought on 31.12.2013, by applying 2% tax incentive for blending gas oil with biodiesel obtained from domestic agricultural products, and adding biodiesel obtained from used frying vegetable oils collected in Turkey and expired vegetable oil.

### 4.8.3 Assessment According to Type of Greenhouse Gas

According to National Greenhouse Gas Inventory of Turkey for 2013, 93% of Greenhouse Gases arising from waste sector is constituted of CH<sub>4</sub> and 7% is constituted of N<sub>2</sub>O gas. In the inventory, there are storage of wastes, composting of wastes and calculations arising from wastewater treatment. Data on incineration of wastes is not included in calculation, as energy input is in question as a result of waste incineration it is included in emission inventory under the title of (power generation).

Plant	Planned Installed Power (MW)	Current Capacity (MW)	Year of Establishment
Istanbul Odayeri	28	7	2008
Ankara Mamak	22.6	22.6	2007
Adana Yüreğir Sofulu	16	4.2	2010
Sincan Çadırtepe Biomass Energy Plant	14	--	2011
Bursa Hamitler	9.98	8	2011
Istanbul Kömürcüoda	7	3.45	2008
Gaziantep MM (metropolitan municipality)	5,65	1.13	2011
Kayseri MM	4.2	--	2012
Istanbul Hasdal	4	--	2013
Samsun MM	3.6	--	2015
Konya MM	2.43	--	2013
Kocaeli Körfez	2.26	--	2012
Sakarya Pamukova Int. Plant	1.4	--	2012

Source: Energy Market Regulatory Authority  
**Table 4.3** Biogas power plants in Turkey

## 4.9. International Air and Maritime Transport

Eight sister port agreements are concluded between our country ports and other country ports. While sister port agreements include issues on cooperation between the ports, marine agreements undersign many general and international practices between countries in terms of navigation. 57 marine agreements are signed and studies for signing marine agreement with 30 countries are in progress. 45 of the signed agreements are in practice. Between the years 2013 and 2014, 6 marine agreements are signed. Approval process of 12 agreements are continuing (MTMAC-a, 2014).

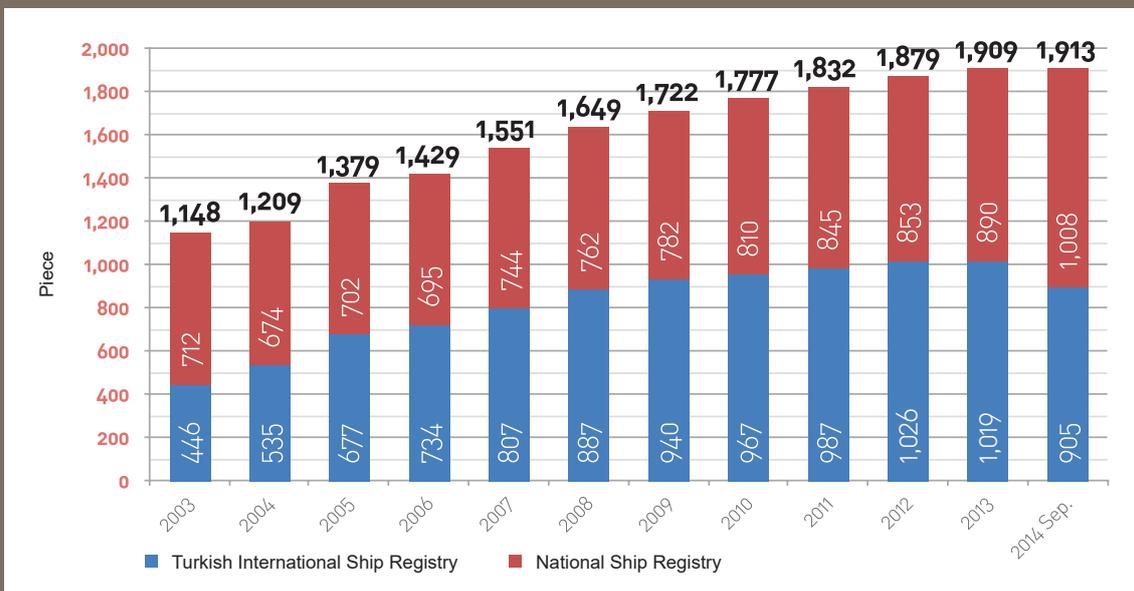
Secretariat of the technical study group established for the development of maritime lines within the scope of the Organization of the Black Sea Economic Cooperation (BSEC) is undertaken by the Ministry of Transport, Maritime Affairs and Communication for two years since May 2013. Technical study group duty of the Ministry in the stage of establishing marine highways in the Black Sea Region and creating the Master Plan on the Development of the Motorways of the Sea in the BSEC Region, still continues. Related to the subject, website at [www.bsecmos.org](http://www.bsecmos.org) is constructed and uninterrupted communication is enabled between the administrations of the member countries (MTMAC-a, 2014).

Plant	Incineration Capacity (ton/year)	Year of Establishment
Izaydaş, Kocaeli	35,000	1997
Petkim, Izmir	17,500	2006
Tüpraş, Kocaeli*	7,750	1998
Istaç, Istanbul	8,760	1995
Erdemir, Ereğli	6,084	--

\* It is not operating according to TUSIAD's Notice Dated 19/06/2015.  
Source: [izinlisans.cevre.gov.tr](http://izinlisans.cevre.gov.tr)

**Table 4.4** Waste incineration plants in Turkey

Studies on increasing marine trade between D-8 countries are conducted at D-8 Shipping Study Group. The Ministry of Transport, Maritime Affairs and Communication shall be the coordinator of the Study Group for 2 years (MTMAC-a, 2014). Number of Ro-Ro lines connected to overseas in the last 4 year period has reached to 16. In 2010 4 lines, in 2011 6 lines, in 2012 3 lines and in 2013 3 lines are opened. As Tuzla-Köstence line is closed for now for lack of demand, 15 of the subject 16 lines are active (MTMAC-a, 2014). Merchant maritime fleet registered to international and national vessels registry have shown an increase of 16% and 12% respectively as of 2012 compared to 2008 on the basis of quantity. Development of Turkish flagged fleet



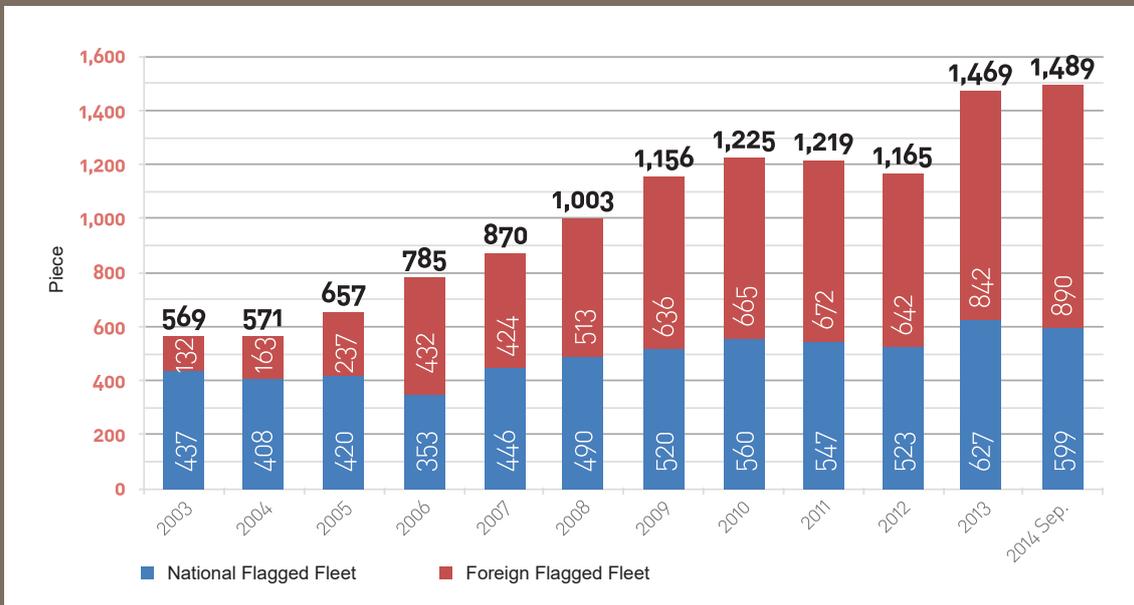
Source: MTMAC\_a, 2014

**Figure 4.3** Turkish flagged fleet quantity development (150GT and Over)

Merchant maritime fleet in between the years 2003-2014 are given in Figure 4.3.

Number of national flagged and foreign flagged vessels in the Merchant maritime fleet owned by Turks (1000 GRT and over) has shown increases of 7% and 74% respectively as of 2012 compared to 2008. Number of vessels in Merchant maritime fleet owned by Turks in between the years 2003-2014 are given in Figure 4.4.

The Ministry of Transport, Maritime Affairs and Communication is performing efficiently the duties at the International civil aviation organizations of our country as EUROCONTROL Transitional Council Presidency, ECAC, International Civil Aviation Organization (ICAO) North Atlantic Regional Aviation Safety Group, JAA TO and D-8 Vice Presidency. International organizations participated in aviation field are summarized in Table 4.5.



Source: MTMAC-b, 2014

Figure 4.4 Turkish owned merchant marine fleet number of vessels (1000 GT and over)

Organization	Duty
D8 Civil Aviation Commission	Vice Presidency
ECAC (European Civil Aviation Conference)	Vice Presidency
EUROCONTROL Transitional Council Coordination Committee	Presidency
EUROCONTROL SRC Safety Regulation Commission	Vice Presidency
JAA-TO (Joint Aviation Authorities-Training Organization)	Board Membership, Vice Presidency
ICAO European North Atlantic Regional Aviation Safety Group	Vice Presidency

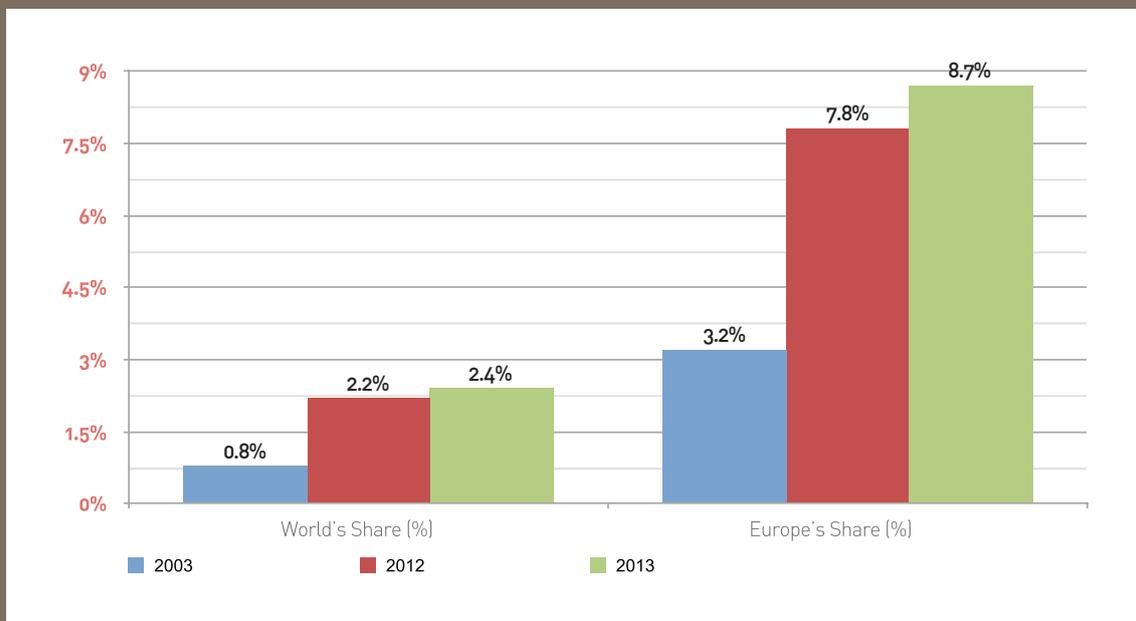
Source: MTMAC-b, 2014

Table 4.5 International organizations in Aviation Field which we're assigned

For being among 36 member countries at ICAO Council, the executive decision making body of ICAO which we are a founding member of and in which we have not been represented since 1950, our country has been a candidate for the elections of 2016. Within the framework of aiming to sign agreements with 191 countries which are the members of the International Civil Aviation Organization, Turkey has raised the number of countries having Air Transport Agreement with to 162, and accordingly, become a country which is able to make direct

connections to 236 points by airlines. Share of Turkey in the World and Europe airway travels (Figure 4.5) has gradually increased and in 2013, reached to the passenger shares of 2.4% in the World and 8.7% in Europe (MTMAC-b, 2014).

In 2013, Istanbul Atatürk Airport being in the first place in the World with a connectivity increase in air transportation according to the number of passengers, is the 18th in the World and the 5th in Europe (MTMAC-b, 2014).



Source: MTMAC\_a, 2014

Figure 4.5 Turkey's share in the World and European airway travels (%)

### International Awards

Adnan Menderes Airport is selected as "the Most Environment-Friendly Airport of Europe" by raising from monitoring level to decreasing level in ACI (Airports Council International) Europe Carbon Accreditation program (MTMAC-b, 2014).

Adnan Menderes Airport has deserved Emerging Markets Airport Awards 2011; "Eco-Innovation Award" (ACI Europa) in 2010, and "the 1st Airport in Green Airport branch" (DOHA Havacılık-2009-QATAR) in 2009 (MTMAC-b, 2014).

Antalya Airport succeeding to enter among 8 airports with the lowest carbon emission of the World in 2012, is awarded

with "Airport Carbon Accreditation Optimization" certificate. In 2013, Antalya Airport, achieving "optimization" level in "Carbon Accreditation" program for the second time, has been among 9 organizations achieving to this level. The Airport is certificated by ACI Europe in Lisbon on June 17, 2011 for carbon emission reduction in 2011 (MTMAC-b, 2014).

Muğla Dalaman Airport has deserved "Environmental Sensitivity Award" with its architecture in 2006 in London. Besides; the International Terminal has been the 13th among "the Best Terminals of the World" in 2006, the year it was in service (MTMAC-b, 2014).

**Table 4.6** Policies and Measures regarding greenhouse gas emission mitigation in Energy Sector

Policy/ Measure	Purpose and / or Affected Activity	Affected GHG	Policy/Measure Type	Status	Executive Institution/ Organization	Estimated GHG Mitigation Effect (thousand ton CO <sub>2</sub> -eq.)			
						2010	2015	2020	2025
Legal Regulations for Energy Efficiency	aws and regulations on increasing energy sources and efficiency of energy use (between the years of 2007-2012) 2.2% improvement is provided in the primary energy density)	CO <sub>2</sub>	Legal Regulation, (Economic, Financing, Informing, Voluntary Agreement)	Legal Regulation, (Economic, Financing, Informing, Voluntary Agreement)	The Ministry of Energy and Natural Resources	-	-	-	-
Support Program for Energy Efficiency Projects	Financing partially EE projects in industry All procedures for the applications for the years 2009 and 2010 are completed and support payment are made for 22 Energy Efficiency projects in total providing the determined saving amount. For 11 projects which agreement is made in 2012 for support payment, follow-up studies are in progress.	CO <sub>2</sub>	Financing	Financing	The Ministry of Energy and Natural Resources GDRE, Private Sector	-	-	-	-
Voluntary Agreements Program	Commitments for Decreasing rates of at least 10% Energy Density in Industrial Businesses which Voluntary Agreement is made for the Periods of 2010-2012 and 2011-2013 –Commitments are claimed from GDRE. Voluntary Energy Efficiency agreement including the period between the years 2011-2013 is concluded and energy saving of approximately 45,000 TEP/ year is committed.	CO <sub>2</sub>	Financing, Voluntary Agreement	Financing, Voluntary Agreement	The Ministry of Energy and Natural Resources GDRE; Private Sector	-	-	-	-
Capacity Development Project on Energy Efficiency in SME's in Turkey	Financing capacity development, sample survey and EE investments at KOSGEB with French Development Agency for EE practices	CO <sub>2</sub>	Education, Financing, Voluntary Agreement	Education, Financing, Voluntary Agreement	KOSGEB	-	-	-	-
Cogeneration and Trigeration Practices in Buildings	Providing energy saving at buildings by cogeneration and trigeration practices; support is given for cogeneration investments working with 80% efficiency and over.	CO <sub>2</sub>	Research , Economic	Research , Economic	Undersecretariat of Treasury	54 (yilda)	-	-	-
Rehabilitation of Public Power Plants	To increase efficiency in energy production at public thermal plants and hydraulic power plants being operated for long years.	CO <sub>2</sub>	Improvement	Improvement	The Ministry of Energy and Natural Resources	-	-	-	-
Eco-credit investment Loan Application	Offering finance solutions to end users who aims to make their buildings energy-efficient. Accomplishing 1,016,392.30 m <sup>2</sup> of heat insulation in 503 projects within the scope of this cooperation.	CO <sub>2</sub>	Financing	Financing	Associations and Banks	52 (yilda)	-	-	-

Policy/ Measure	Purpose and / or Affected Activity	Affected GHG	Policy/Measure Type	Status	Executive Institution/ Organization	Estimated GHG Mitigation Effect (thousand ton CO <sub>2</sub> -eq.)			
						2010	2015	2020	2025
Projects conducted with bilateral / multilateral agreements	Realizing EE practices in household electrical appliances, capacity increase, incentives. Approximately 3,700 GWh energy saving and 2.4 mton CO <sub>2</sub> saving are provided within the scope of the project.	CO <sub>2</sub>	Education, Financing	Completed	The Ministry of Energy and Natural Resources; The Ministry of Science, Industry and Technology	-	-	2,4 mton CO <sub>2</sub>	-
Legal regulations on producing electricity from renewable energy sources	Supporting RE production by high purchasing guarantees; encouraging usage of RE in power generation by legal regulations on supporting REL (Renewable Energy Law) facilities which shall be in operation until 2012 by various kinds of exemptions	CO <sub>2</sub>	Legal Regulation ((Economic, Financing)	In Force	The Ministry of Energy and Natural Resources	-	-	-	-
Legal regulations on bio-fuel	Special Consumption Tax exemption to bioethanol and biodiesel additive in fuel in various rates; regulations on replacement /addition of diesel and benzene with bio-fuel and increasing use of bio-fuel in transportation	CO <sub>2</sub>	Legal Regulation (Economic, Financing)	In Force	The Ministry of Energy and Natural Resources	-	-	-	-
Regulations on Supporting Program of Research-Development Projects of Energy Sector (ENAR)	Procedures and principles on supporting scientific and technological R&D projects in energy sector	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	Legal Regulation (Financing, Research)	In Force	The Ministry of Energy and Natural Resources	-	-	-	-
Legal Regulations on Energy Labeling	Determining rules and performance standards related to energy labeling for informing consumers to ensure saving in energy consumption for Household Refrigerators, Deepfreezes, Refrigerator Deepfreezes and their components	CO <sub>2</sub>	Legal Regulation (Informing,)	In Force	The Ministry of Science, Industry and Technology	-	-	-	-
Automatic sampling device for crude oil tanks and converting crude oil tanks not having floating roof to floating roof	Emission reduction	CO <sub>2</sub>	Legal Regulation	In Force	The Ministry of Environment and Urbanization	-	-	-	-
Greenhouse Gas Monitoring	Firing natural gas in Closed System gasifier	CO <sub>2</sub>	Legal Regulation		BOTAS; The Ministry of Environment and Urbanization	-	-	-	-

**Table 4.7** Policies and Measures regarding greenhouse gas emission mitigation in Industry Sector

Policy/ Measure	Purpose and / or Affected Activity	Affected GHG	Policy/Measure Type	Status	Executive Institution/ Organization	Estimated GHG Mitigation Effect (thousand ton CO <sub>2</sub> -eq.)			
						2010	2015	2020	2025
10 <sup>th</sup> Development Plan Program	Replacing low efficient AC electric motors which consume more than 70% of the electricity used in industry with high efficient ones	CO <sub>2</sub>	Consciousness-raising	In Progress	The Ministry of Science, Industry and Technology	-	-	-	-
10 <sup>th</sup> Development Plan Program	Improvement of mechanism on supporting education, study and consultancy services on SME's Energy Efficiency	CO <sub>2</sub>	Support	Accepted	The Ministry of Science, Industry and Technology	-	-	-	-
Project on Determining Potential of Resource Productivity in Industry	In industry, analyzing potential environmental and economic benefits which may be obtained by effective and sustainable use of raw material, energy and water at sectors and regions level and revealing this potential quantitatively	CO <sub>2</sub>	Analysis	In Progress	The Ministry of Science, Industry and Technology	-	-	-	-
Promoting Energy-Efficient Motors in Small and Medium Sized Enterprises	Strengthening the legal framework for the transformation of inefficient electric motors (IE1 and IE2) in use in manufacturing industry to efficient motors (IE3 and IE4), developing financial support mechanisms, consciousness raising, activities for development of test laboratories and applications in industry	CO <sub>2</sub>	Consciousness-raising,	Planning Stage	The Ministry of Science, Industry and Technology	-	-	-	-

**Table 4.8** Policies and Measures regarding greenhouse gas emission mitigation in Transportation Sector

Policy/ Measure	Purpose and / or Affected Activity	Affected GHG	Policy/Measure Type	Status	Executive Institution/ Organization	Estimated GHG Mitigation Effect (thousand ton CO <sub>2</sub> -eq.)			
						2010	2015	2020	2025
Green Airport Project	Minimizing or removing, if possible, systematically damages which organizations operating at the airports give or may give to environment and human health is aimed. At the end of the Project, 36 Airports have obtained Green Organization Certificate	-	Incentive/ Renewal Deduction	Completed	General Directorate of State Airports Authority	-	-	-	-
Increasing Corporate and Administrative Capacity of Directorate General of Civil Aviation EU Twinning Project	Emission Follow-up and Reduction System Setup	CO <sub>2</sub> CH <sub>4</sub> N <sub>2</sub> O	Capacity Increase	In Progress	Directorate General of Civil Aviation	-	-	-	-

**Table 4.9** Policies and Measures regarding greenhouse gas emission mitigation in Agricultural Sector

Policy/ Measure	Purpose and / or Affected Activity	Affected GHG	Policy/Measure Type	Status	Executive Institution/ Organization	Estimated GHG Mitigation Effect (thousand ton CO <sub>2</sub> -eq.)			
						2010	2015	2020	2025
Law on Making Amendments in Law on Soil Conservation and Land Use dated 15.05.2014 with number 6537	Strengthening effective use by decreasing number of agricultural machinery and the usage period	CO <sub>2</sub> , NO <sub>x</sub>	Plan/Application	In Force	The Ministry of Food, Agriculture and Livestock	-	-	-	-
Pasture Law dated 28.02.1998 with number 4342	Providing maintenance, improvement, protection, control and proper use of pastures and winter quarters pasture	CH <sub>4</sub>	Plan/Application	In Force	The Ministry of Food, Agriculture and Livestock	-	-	-	-
Animal Breeding Law dated 10.03.2001 with number 4631	Raising animal breeds with high feed conversion rates for decreasing methane gas outlet	CH <sub>4</sub> , N <sub>2</sub> O, CO <sub>2</sub>	Plan/Application	In Force	The Ministry of Food, Agriculture and Livestock	-	-	-	-
Organic Agricultural Law dated 03.12.2004 with number 5262	Taking mineral fertilizer use under control	N <sub>2</sub> O	Plan/Application	In Force	The Ministry of Food, Agriculture and Livestock	-	-	-	-
Fertilizer and Soil Analysis Supporting Payment published in the Official Gazette dated 14.05.2009 and with number 27200 and entered into force	Using less mineral fertilizer by adequate-sufficient fertilizer suggestion according to soil analysis.	N <sub>2</sub> O, CO <sub>2</sub>	Plan/Application	In Force	The Ministry of Food, Agriculture and Livestock	-	-	-	-

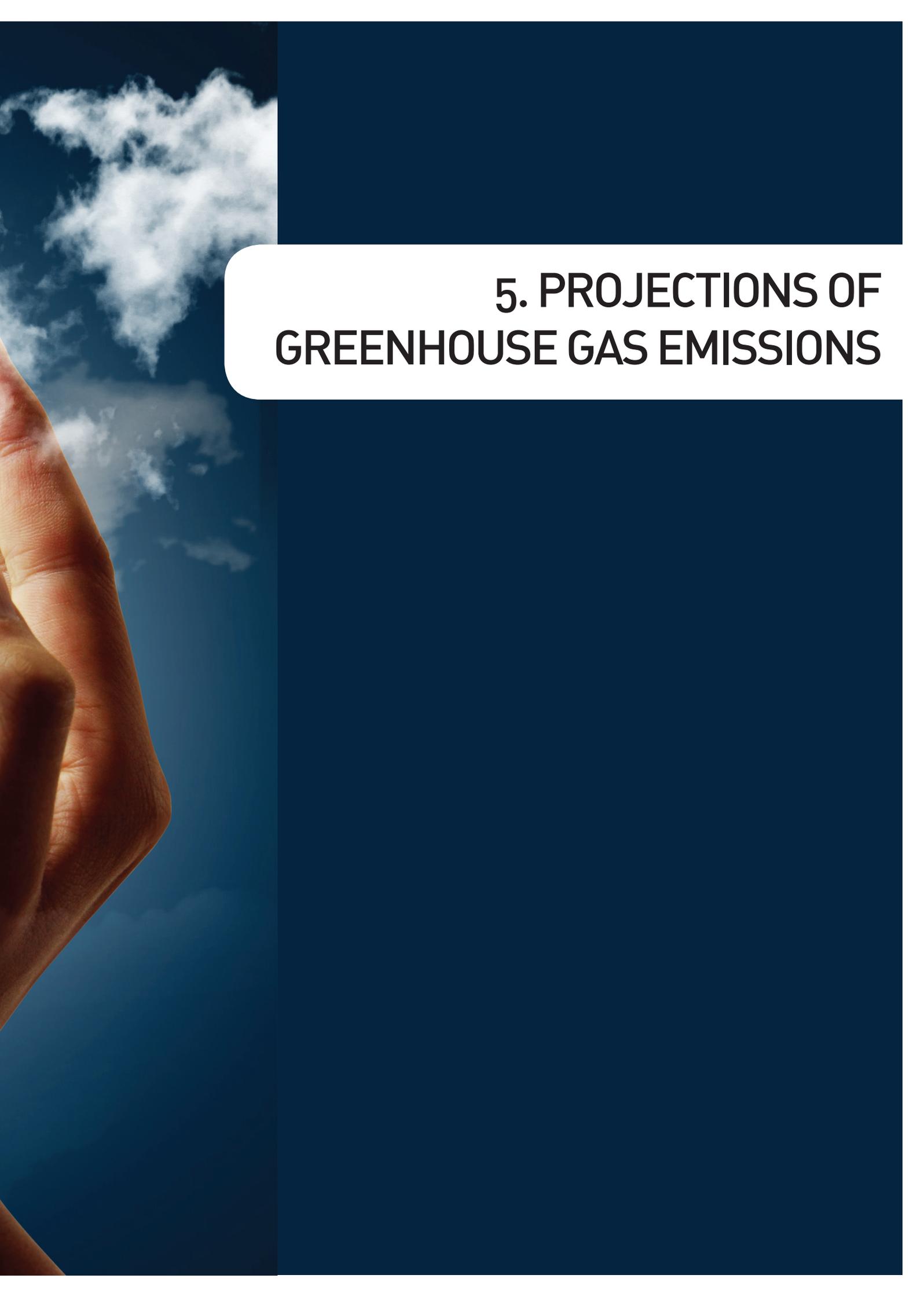
**Table 4.10** Policies and Measures regarding greenhouse gas emission mitigation in Forestry Sector

Policy/ Measure	Purpose and / or Affected Activity	Affected GHG	Policy/Measure Type	Status	Executive Institution/ Organization	Estimated GHG Mitigation Effect (thousand ton CO <sub>2</sub> -eq.)			
						2010	2015	2020	2025
Forestation and erosion Control Mobilization Action Plan (2008-2012)	Increasing forest lands and rehabilitation of infertile forest lands	CO <sub>2</sub>	Plan/Application	Completed	The Ministry of Forestry and Water Affairs (GDF)	1,000	3,000	4,000	5,000
Action Plans on Rehabilitation of Degraded Oak, Cedar, Coppice, Juniper Forests	Rehabilitation of infertile forest lands	CO <sub>2</sub>	Plan/Application	In Force	The Ministry of Forestry and Water Affairs (GDF)	-	-	-	-
Fire Resisive Forest Creating (YARDOP) Project	Reducing forest fires	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, NO <sub>x</sub> , CO	Project/ Application	In Force	The Ministry of Forestry and Water Affairs (GDF)	-	-	-	-
Young Stands Raising Mobilization Action Plan (2012-2016)	Reducing forest fires	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, NO <sub>x</sub> , CO	Project / Application	In Force	The Ministry of Forestry and Water Affairs (GDF)	-	-	-	-
Catchments Green Belt Forestation Action Plan (2013-2017)	Increasing forest lands	CO <sub>2</sub>	Plan/Application	In Force	The Ministry of Forestry and Water Affairs (GDF, ODE, DSI)	54 (y/lda)	-	-	-
Mine Sites Rehabilitation Action Plan (2014-2018)	Increasing forest lands	CO <sub>2</sub>	Plan/Application	In Force	The Ministry of Forestry and Water Affairs (GDF, ODE, GDNCNP)	-	-	-	-

**Table 4.11** Policies and Measures regarding greenhouse gas emission mitigation in Waste Sector

Policy/ Measure	Purpose and / or Affected Activity	Affected GHG	Policy/Measure Type	Status	Executive Institution/ Organization	Estimated GHG Mitigation Effect (thousand ton CO <sub>2</sub> -eq.)			
						2010	2015	2020	2025
Waste Management Action Plan	Determining necessary actions to improve current status of waste management and applying them	CH <sub>4</sub> , N <sub>2</sub> O, CO <sub>2</sub> and others	Plan-Strategy	Completed	The Ministry of Environment and Urbanization	-	-	-	-
Solid Waste Master Plan	Establishing waste management associations for increasing regular storage of solid wastes	CH <sub>4</sub>	Plan	In Force	The Ministry of Environment and Urbanization	-	-	-	-
Regulations on General Principles of Waste Management	Determining general principles and practices for disposal of wastes generating as a result of various domestic and industrial activities	CH <sub>4</sub> , N <sub>2</sub> O, CO <sub>2</sub> and others	Legal Regulation	Completed	The Ministry of Environment and Urbanization	-	-	-	-
Regulations on Packaging Wastes Control	Reducing amount of packaging waste, avoiding their damage to environment, Recycling and reusing arrangements	CH <sub>4</sub> , N <sub>2</sub> O, CO <sub>2</sub> and others	Legal Regulation	In Force	The Ministry of Environment and Urbanization	-	-	-	-
Regulations on storing wastes regularly	Arranging technical and other conditions on storing wastes regularly	CH <sub>4</sub>	Legal Regulation	In Force	The Ministry of Environment and Urbanization	-	-	-	-
Regulations on wastes' incineration	Avoiding and limiting negative effects of Wastes' incineration on environment	CH <sub>4</sub> , CO <sub>2</sub>	Plan	In Force	The Ministry of Environment and Urbanization	-	-	-	-
Wastewater Treatment Action Plan	Increasing treatment rate of domestic wastewaters, practicing targets and related actions	N <sub>2</sub> O	Plan-Strategy	In Force	The Ministry of Environment and Urbanization	-	-	-	-
National Recycling Strategy	Applying recycling in all sectors, defining support mechanisms and actions	CH <sub>4</sub> , N <sub>2</sub> O, CO <sub>2</sub> and others	Plan-Strategy	In Force	The Ministry of Environment and Urbanization	-	-	-	-
Communiqué on Fuel, Additional Fuel and Alternative Raw Material Derived from Wastes	Limiting removal of wastes by regular storage, obtaining product from waste	CH <sub>4</sub> , CO <sub>2</sub>	Legal Regulation	In Force	The Ministry of Environment and Urbanization	-	-	-	-
Compost Communiqué	Limiting removal of biodegradable wastes by regular storage	CH <sub>4</sub> , CO <sub>2</sub>	Legal Regulation	Draft	The Ministry of Environment and Urbanization	-	-	-	-



A hand is visible on the left side of the frame, pointing towards the right. The background is a deep blue sky with scattered white clouds. A white rounded rectangular box is positioned in the upper right quadrant, containing the section header text.

## **5. PROJECTIONS OF GREENHOUSE GAS EMISSIONS**

## 5. PROJECTIONS OF GREENHOUSE GAS EMISSIONS

### 5.1. Introduction

On September 30<sup>th</sup> 2015, the Republic of Turkey submitted its Intended Nationally Determined Contribution (INDC) to UNFCCC towards achieving the ultimate objective of the Convention, which is set out in its Article 2 and clarifying information, in accordance with decisions 1/CP.19 and 1/CP.20. In this section, the projections of greenhouse gas emissions by 2030 are based on two scenarios: Business-As-Usual Scenario and Mitigation Scenario. The projections have been prepared based on the works done under the project called "Preparation of Turkey's Sixth National Communication on Climate Change", which was carried out by Ministry of Environment and Urbanization and Technological Research Council of Turkey, Marmara Research Center. TIMES-MACRO model has been used for energy related modeling and industrial processes and product use, while for non-energy emissions different national models and studies have been used.

### 5.2. Key Assumptions

The assumptions used to estimate the projections of greenhouse gas emissions are presented in Table 5.1. Turkey achieved 230% increase in GDP between 1990 and 2012. While Turkey's annual GDP growth stood at 2.10% in 2012, it is projected to reach 4% by 2030. Its population has increased to 75.6 million by more than 30% from 1990 to 2012. Turkey's energy demand increases by 6-7% each year. According to the projections by Ministry of Energy and Natural Resources, electricity demand in 2030 will reach 580 TWh under the business-as-usual scenario.

Emissions factors used to estimate greenhouse gas emissions are based on 2014 National Inventory Report and 2006 IPCC Guidelines published by TurkStat and collected data

provided by various national institutions. Global warming potential on a 100 year timescale used for the calculation of CO<sub>2</sub> equivalent emissions is in accordance with the IPCC's Fourth Assessment Report.

### 5.3. Business-As-Usual Scenario

This scenario projects greenhouse gas emissions up to 2030 based on the case of the mitigation measures which have been legalized, applied or planned since 2012 will not be implemented between 2012 and 2030. Greenhouse gas emissions for 1990-2012 and projected emissions up to 2030 are listed in Table 5.2 based on the type of greenhouse gas. CO<sub>2</sub> emissions are projected to increase about 187% by 2030 compared to 2012. CO<sub>2</sub> emissions, which were 79% of the total emissions in 2012, are projected to be 84% and 87% to total emissions in 2020 and 2030 respectively (excluding LULUCF) due to a gradual increase in energy consumption.

The ratio of CH<sub>4</sub> and N<sub>2</sub>O emissions to total emissions is 15% and 5% in 2012. The ratio of CH<sub>4</sub> emissions to total emissions is 11% and 9% in 2020 and 2030 respectively, while the ratio of N<sub>2</sub>O emissions to total emissions is 4% and 3% 2020 and 2030 respectively. On the other hand, the ratio of fluorinated gases emissions to total emissions is not expected to change much by 2030.

In business-as-usual scenario, emissions from energy consumption are projected to increase about 27.3 Mton CO<sub>2</sub>-eq. per year for 2012-2020 and about 40.5 Mton CO<sub>2</sub>-eq. per year for 2020-2030. Greenhouse gas emissions for 1990-2012 and projected emissions up to 2030 for business-as-usual scenario are listed at Table 5.3 based on the type of greenhouse gas.

Parameter	2012	2015	2020	2025	2030
Population (in thousand)	75,627	78,151	82,076	85,569	88,427
Population growth (annual)	1.38%	1.07%	0.93%	0.75%	0.60%
GDP growth (annual)	2.10%	3.50%	4.15%	4.25%	4.12%

Table 5.1 Key assumptions used in the projections

Greenhouse Gases	GHG Emissions and Sinks (kton CO <sub>2</sub> -eq.)						Business-As Usual Scenario (kton CO <sub>2</sub> -eq.)	
	1990	1995	2000	2005	2010	2012	2020	2030

## GHG emissions without LULUCF

CO <sub>2</sub>	153,826.9	184,296.7	239,028.4	285,926.9	326,105.1	368,338.8	602,051.1	1,057,058.1
CH <sub>4</sub>	46,764.8	48,474.3	51,022.9	52,216.9	60,441.2	67,606.8	76,549.2	107,651.5
N <sub>2</sub> O	16,969.9	16,238.3	19,004.2	19,663.6	19,477.9	21,044.2	25,719.9	33,050.0
HFCs	NO	NO	900.3	2,616.9	4,882.3	6,305.0	7,504.2	13,444.5
PFCs	603.4	516.4	515.1	487.8	NE	NE	NE	NE
SF <sub>6</sub>	NE	NE	308.0	819.2	835.5	926.4	1,269.7	2,274.7
TOPLAM	218,165.0	249,525.7	310,779.0	361,731.3	411,742.0	464,221.2	713,094.1	1,213,478.7

## GHG emissions including LULUCF

CO <sub>2</sub>	123,651.2	154,125.5	202,850.2	241,999.5	278,645.6	317,488.2	561,857.9	1,018,360.0
CH <sub>4</sub>	46,764.8	48,474.3	51,022.9	52,216.9	60,441.2	67,606.8	76,549.2	107,651.5
N <sub>2</sub> O	16,969.9	16,238.3	19,004.2	19,663.6	19,477.9	21,044.2	25,719.9	33,050.0
HFCs	NO	NO	900.3	2,616.9	4,882.3	6,305.0	7,504.2	13,444.5
PFCs	603.4	516.4	515.1	487.8	NE	NE	NE	NE
SF <sub>6</sub>	NE	NE	308.0	819.2	835.5	926.4	1,269.7	2,274.7
TOPLAM	187,989.4	219,354.5	274,600.7	317,803.8	364,282.5	413,370.6	672,900.8	1,174,780.6

Table 5.2 Emissions of CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFCs, PFCs, SF<sub>6</sub> based on Business-As-Usual Scenario

Sector	GHG Emissions and Sinks (kton CO <sub>2</sub> -eq.)						Business-As Usual Scenario (kton CO <sub>2</sub> -eq.)	
	1990	1995	2000	2005	2010	2012	2020	2030
Energy <sup>1</sup>	131,565.7	158,808.6	213,775.6	251,828.7	284,789.8	320,763.5	538,886.8	943,547.0
Industrial Processes	31,078.1	33,691.6	36,247.5	46,866.5	59,977.0	69,567.2	94,750.2	169,753.8
Agriculture	41,598.5	40,168.6	40,095.3	38,459.9	39,797.7	46,337.8	51,557.0	59,277.9
LULUCF	-30,175.6	-30,171.1	-36,178.2	-43,927.4	-47,459.5	-50,850.5	-40,193.3	-38,698.1
Waste	13,922.6	16,856.8	20,660.5	24,576.2	27,177.5	27,552.7	27,900.0	40,900.0
TOTAL	187,989.4	219,354.5	274,600.7	317,803.8	364,282.5	413,370.6	672,900.8	1,174,780.6

<sup>1</sup> Emissions of Transportation Sector are included in Energy Sector.

Table 5.3 Emissions by sector based on Business-As-Usual Scenario

## 5.4. Mitigation Scenario

In mitigation scenario, emissions for 2012-2030 were developed based on mitigation measures from various policy papers and strategic documents. The plans and policies to be implemented are listed below for each sector.

### Electricity Generation Sector

The plans and policies in electricity generation sector are listed below;

- Increasing capacity of production of electricity from solar power to 10 GW until 2030,
- Increasing capacity of production of electricity from wind power to 16 GW until 2030,
- Tapping the full hydroelectric potential,
- Commissioning of a nuclear power plant until 2030,
- Reducing electricity transmission and distribution losses to 15% at 2030,
- Rehabilitation of public electricity generation power plants,
- Establishment of micro-generation, co-generation systems and production on site at electricity production.

### Industry Sector

The plans and policies in industry sector are listed below;

- Reducing emission intensity with the implementation of National Strategy and Action Plan on Energy Efficiency,
- Increasing energy efficiency in industrial installations and providing financial support to energy efficiency projects,
- Making studies to increase use of waste as an alternative fuel at the appropriate sectors.

### Transportation Sector

The plans and policies in transportation sector are listed below;

- Ensuring balanced utilization of transport modes in freight and passenger transport by reducing the share of road transport and increasing the share of maritime and rail transport,
- Enhancing combined transport,
- Implementing sustainable transport approaches in urban areas,
- Promoting alternative fuels and clean vehicles,
- Reducing fuel consumption and emissions of road transport with National Intelligent Transport Systems Strategy Document (2014-2023) and its Action Plan (2014-2016),
- Realizing high speed railway projects,
- Increasing urban railway systems,

- Achieving fuel savings by tunnel projects,
- Scraping of old vehicles from traffic,
- Implementing green port and green airport projects to ensure energy efficiency,
- Implementing special consumption tax exemptions for maritime transport.

### Residential-Commercial Sector

The plans and policies in residential-commercial sector are listed below;

- Constructing new residential buildings and service buildings as energy efficient in accordance with the Energy Performance of Buildings Regulations,
- Creating Energy Performance Certificates for new and existing buildings so as to control energy consumption and greenhouse gas emissions and to reduce energy consumption per square meter,
- Reducing the consumption of primary energy sources of new and existing buildings by means of design, technological equipment, building materials, development of channels that promote the use of renewable energy sources (loans, tax reduction, etc.),
- Dissemination of Green Building, passive energy, zero-energy house design in order to minimize the energy demand and to ensure local production of energy.

### Agriculture Sector

The plans and policies in residential-commercial sector are listed below;

- Fuel savings by land consolidation in agricultural areas,
- Controlling the use of fertilizers and implementing modern agricultural practices,
- Supporting the minimum tillage methods.

### Waste Sector

The plans and policies in waste sector are listed below;

- Disposing wastes to managed landfill sites,
- Reuse, recycle and use of other processes to recover secondary raw materials, to utilize as energy source or to remove wastes,
- Recovering energy from waste by using processes such as material recycling of wastes, bio-drying, bio-methanization, composting, advanced thermal processes or incineration,
- Recovery of methane gas from landfill gas from managed and unmanaged landfill sites,
- Utilization of industrial wastes as an alternative raw material or alternative fuel in other industrial sectors, through industrial symbiosis approach,

- Conducting relevant studies to utilize wastes generated from breeding farms and poultry farms,
- Rehabilitation of unmanaged waste sites and ensuring wastes to be deposited at managed landfill sites.

### Removals

The plans and policies for removals are listed below;

- Increasing sink areas and preventing land degradation,
- Implementing Action Plan on Forestry Rehabilitation and National Afforestation Campaign.

Under the mitigation scenario based on these plans and policies, GHG emissions are given at the Table 5.4. It is projected that increase in CO<sub>2</sub> emissions will be about 133% from 2012 to 2030. The ratio of CO<sub>2</sub> emissions to total GHG emissions will be 84% and 86% in 2020 and 2030 respectively. Compa-

red to business-as-usual scenario, emissions of CO<sub>2</sub> and NH<sub>4</sub> are projected to decrease 19% and 15% respectively by 2030 (excluding LULUCF).

The ratio of CH<sub>4</sub>, N<sub>2</sub>O and fluorinated gases emissions to total GHG emissions are slightly different compared to business-as-usual scenario.

When evaluating emission projections by sector, it shows that the greatest mitigation will happen in the waste sector up to 23.2% by 2030. Policies such as rehabilitation of unmanaged waste sites and recovery of methane gas from landfill gas will play a major role in mitigation. The energy sector will be in the second place of the greatest mitigation up to 21.8% by 2030. Renewables and plans/policies about nuclear power will be effective in mitigation in the energy sector. Also, implemen-

Greenhouse Gases	GHG Emissions and Sinks (kton CO <sub>2</sub> -eq.)						Mitigation Scenario (kton CO <sub>2</sub> -eq.)	
	1990	1995	2000	2005	2010	2012	2020	2030

#### GHG emissions without LULUCF

CO <sub>2</sub>	153,826.9	184,296.7	239,028.4	285,926.9	326,105.1	368,338.8	564,093.3	860,048.8
CH <sub>4</sub>	46,764.8	48,474.3	51,022.9	52,216.9	60,441.2	67,606.8	71,214.7	91,824.9
N <sub>2</sub> O	16,969.9	16,238.3	19,004.2	19,663.6	19,477.9	21,044.2	25,170.9	31,104.6
HFCs	NO	NO	900.3	2,616.9	4,882.3	6,305.0	7,504.2	13,444.5
PFCs	603.4	516.4	515.1	487.8	NE	NE	NE	NE
SF <sub>6</sub>	NE	NE	308.0	819.2	835.5	926.4	1,269.7	2,274.7
<b>TOTAL</b>	<b>218,165.0</b>	<b>249,525.7</b>	<b>310,779.0</b>	<b>361,731.3</b>	<b>411,742.0</b>	<b>464,221.2</b>	<b>669,252.8</b>	<b>998,697.6</b>

#### GHG emissions including LULUCF

CO <sub>2</sub>	123,651.2	154,125.5	202,850.2	241,999.5	278,645.6	317,488.2	494,057.4	790,338.4
CH <sub>4</sub>	46,764.8	48,474.3	51,022.9	52,216.9	60,441.2	67,606.8	71,214.7	91,824.9
N <sub>2</sub> O	16,969.9	16,238.3	19,004.2	19,663.6	19,477.9	21,044.2	25,170.9	31,104.6
HFCs	NO	NO	900.3	2,616.9	4,882.3	6,305.0	7,504.2	13,444.5
PFCs	603.4	516.4	515.1	487.8	NE	NE	NE	NE
SF <sub>6</sub>	NE	NE	308.0	819.2	835.5	926.4	1,269.7	2,274.7
<b>TOTAL</b>	<b>187,989.4</b>	<b>219,354.5</b>	<b>274,600.7</b>	<b>317,803.8</b>	<b>364,282.5</b>	<b>413,370.6</b>	<b>599,216.9</b>	<b>928,987.2</b>

**Table 5.4** Emissions of CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFCs, PFCs, SF<sub>6</sub> based on Mitigation Scenario

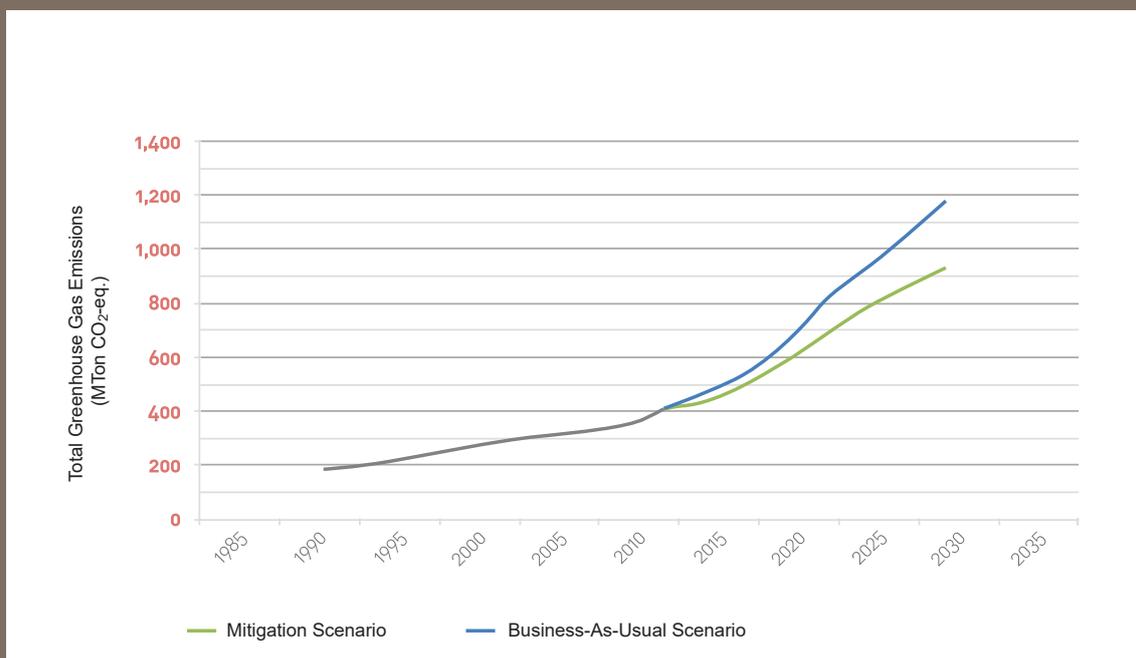
tation of urban transformation projects in residential-commercial sector and adoption of transformation programs in industry sector will help the mitigation of greenhouse gases in these sectors. On the other hand, for the LULUCF, Turkey aims to increase its forestland to cover 30% of the country (23.400.000 ha) by 2023 which will rise removal of greenhouse gases by 80% in 2030. Greenhouse gas emissions for 1990-2012 and projected emissions up to 2030 for mitigation scenario are listed at Table 5.5 based on the type of greenhouse gas.

Up to 21% reduction in GHG emissions is anticipated by following these policies and plans from the business as usual level by 2030 (Figure 5.1). Recalling the decisions 26/CP.7, 1/CP.16, 2/CP.17, 1/CP.18 and 21/CP.20, in order to achieve this mitigation target, Turkey will use domestic sources and receive international financial, technological, technical and capacity building support, including finance from the Green Climate Fund.

Sector	GHG Emissions and Sinks (kton CO <sub>2</sub> -eq.)						Mitigation Scenario (kton CO <sub>2</sub> -eq.)	
	1990	1995	2000	2005	2010	2012	2020	2030
Energy <sup>1</sup>	131,565.7	158,808.6	213,775.6	251,828.7	284,789.8	320,763.5	499,355.5	738,265.9
Industrial Processes	31,078.1	33,691.6	36,247.5	46,866.5	59,977.0	69,567.2	94,750.2	169,753.8
Agriculture	41,598.5	40,168.6	40,095.3	38,459.9	39,797.7	46,337.8	51,557.0	59,277.9
LULUCF	-30,175.6	-30,171.1	-36,178.2	-43,927.4	-47,459.5	-50,850.5	-70,035.9	-69,710.4
Waste	13,922.6	16,856.8	20,660.5	24,576.2	27,177.5	27,552.7	23,610.0	31,400.0
<b>TOTAL</b>	<b>187,989.4</b>	<b>219,354.5</b>	<b>274,600.7</b>	<b>317,803.8</b>	<b>364,282.5</b>	<b>413,370.6</b>	<b>599,216.9</b>	<b>928,987.2</b>

<sup>1</sup> Emissions of Transportation Sector are included in Energy Sector.

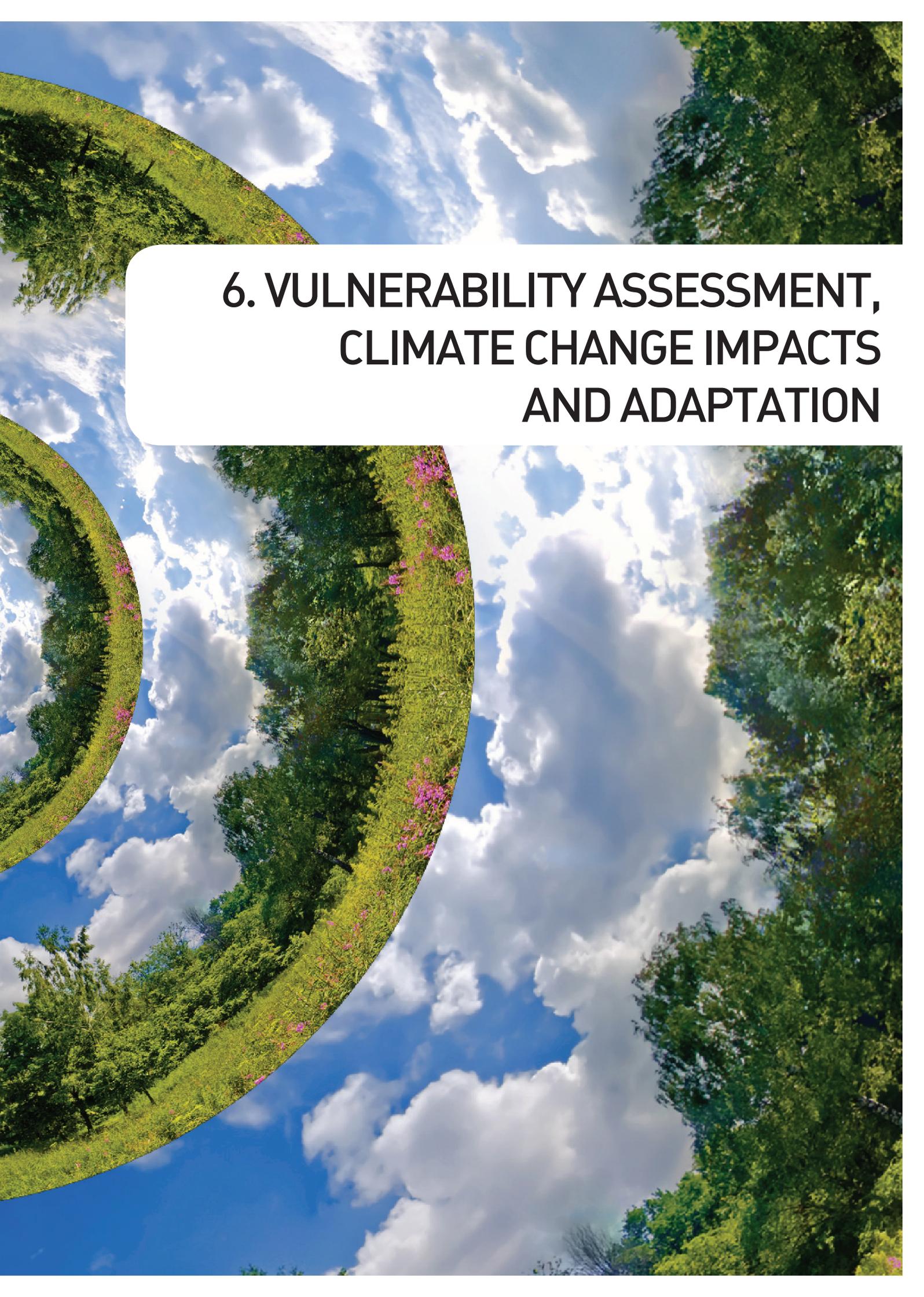
**Table 5.5** Emissions by sector based on Mitigation Scenario



**Figure 5.1** Total Greenhouse Gas Emissions







## **6. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION**

## 6. VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION

### 6.1. Situation Analysis

#### 6.1.1 Temperature Trend Analysis

In the study conducted by Şensoy et. al. (2013), data of the years between 1960 and 2010 of 109 stations of SMS in Turkey are used to determine various climate index tendencies. Among these, those related to temperature are as the following:

- Number of summer days is increasing throughout Turkey. Specifically, tendency of the stations in North is more. Kendall's tau based tendency forecast specifies that average increase tendency is 39 day/100 year and that most of the tendencies are important at 95% level.
- Number of tropic nights is increasing except Euphrates basin. It has a significantly reducing tendency after building Elaziğ Keban Dam. Specifically, coastal stations have great tendency. The estimated average increase tendency is 37 day/100 year and most of them are meaningful at 95% level.
- Number of hot days is increasing throughout Turkey. The estimated average increase tendency is 14 day/100 year. Most of the tendencies are meaningful at 95% level.
- Number of hot nights is increasing besides at Euphrates basin. The greatest increases are at Mediterranean coasts. The estimated average increase tendency is 15 day/100 year. Most of the tendencies are meaningful at 95% level.
- Number of cool days at most of the stations are reducing. Only 10 stations show an increasing tendency. The estimated average decreasing tendency is 6 day/100 year. Most of the tendencies are statistically meaningful at 95% level.
- In most of the stations, number of cool nights is decreasing. Only 20 stations show an increasing tendency. The estimated average decreasing tendency is 15 day/100 year. Most of the tendencies are statistically meaningful at 95% level.
- While number of frost days show an increase tendency in 55 stations, significantly in Edirne, Balıkesir, Eskişehir, Region of Lakes, Çorum, Erzurum and Diyarbakır, 53 stations show decreasing tendency. The estimated average decreasing tendency is 14 day/100 year. Most of the tendencies are statistically meaningful at 95% level.

In the study conducted by Toros (2012), generally in Turkey, increase tendency is observed in 165 stations in the daily maximum and minimum temperature values of the period of 1961-2008, reducing tendency is observed in the daily maximum and minimum temperature differences.

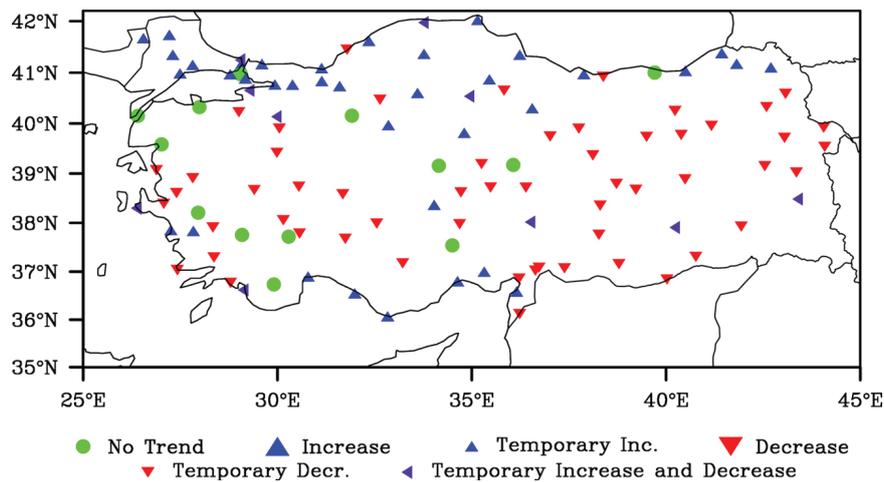
#### 6.1.2 Precipitation Trend Analysis

In the study conducted by Sensoy et. al. (2013), data of 109 stations of SMS for the period of 1960-2010 are used and various climate index tendencies are determined. Among these, those related to precipitation are as the following:

- It is found that annual total precipitation tendencies in the North of the country have increasing tendency, Southeastern Anatolia, Mediterranean and Aegean Regions has decreasing tendency.
- Number of days with heavy precipitation has an increasing tendency in most of the stations except Aegean and Southeastern Anatolia Regions. The estimated average increase tendency is 17 day/100 year. While a strong increase tendency is observed in the number of days with heavy precipitation in the Eastern Black Sea, a strong decreasing tendency is observed in the Southeastern Anatolia Region.
- Number of days with extreme precipitation has increasing tendency in most of the stations except Aegean and Southeastern Anatolia Regions. The estimated average increase tendency is 119 mm/100.
- One day maximum precipitations have an increase tendency in most of the stations except Aegean and Southeastern Anatolia Regions. The estimated increase tendency is 17 mm/100 year.

In the study conducted by Efe et. al. (2015), trend analysis for the annual total precipitation of the period of 1950-2013i generally in Turkey is given in the Figure 6.1. As seen in the Figure 6.1, there is an increasing tendency in precipitations at all coastal line, primarily in the Black Sea and Marmara regions. Almost at all terrestrial regions, annual total precipitations having a decreasing tendency may be a predictor for a move to drought. At 13 stations, tendency is not observed in annual total precipitations.



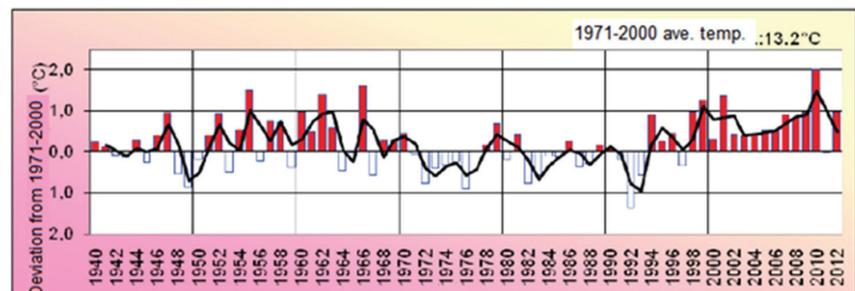


Source: Efe, Toros, and Deniz, 2015

Figure 6.1 Trend analysis for annual total precipitation

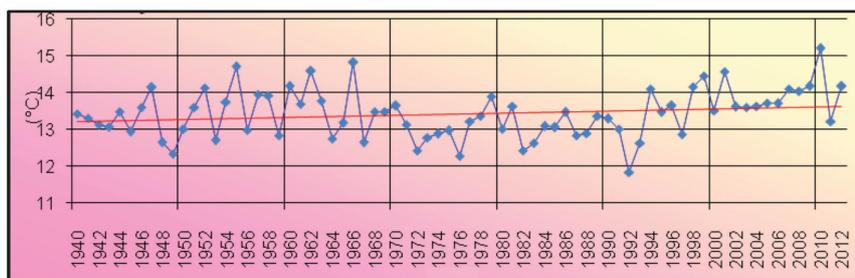
### 6.1.3 Climate Scenarios

In SMS studies, meteorological data of the period of 1940-2012 are used (SMS\_c, 2014). Findings obtained from SMS studies are compatible with IPCC report. SMS taking the 1971-2000 period as a reference period has found the average temperature value of whole Turkey for this period as 13.2°C. The temperature shows more increase specifically as of 1990's. In the reviewed period, 2010 has been observed as the warmest year. Since 1994, except 1997 and 2011, continuously positive anomaly values are observed. It is emphasized that the decrease in the years 1997 and 2011 may be a result of volcanic explosions (Figure 6.2 and Figure 6.3).



Bars Show anomaly values and the black curve shows the curve representing the best data by the smallest squares method.  
Source: SMS\_c, 2014

Figure 6.2 Turkey's average temperature anomaly values

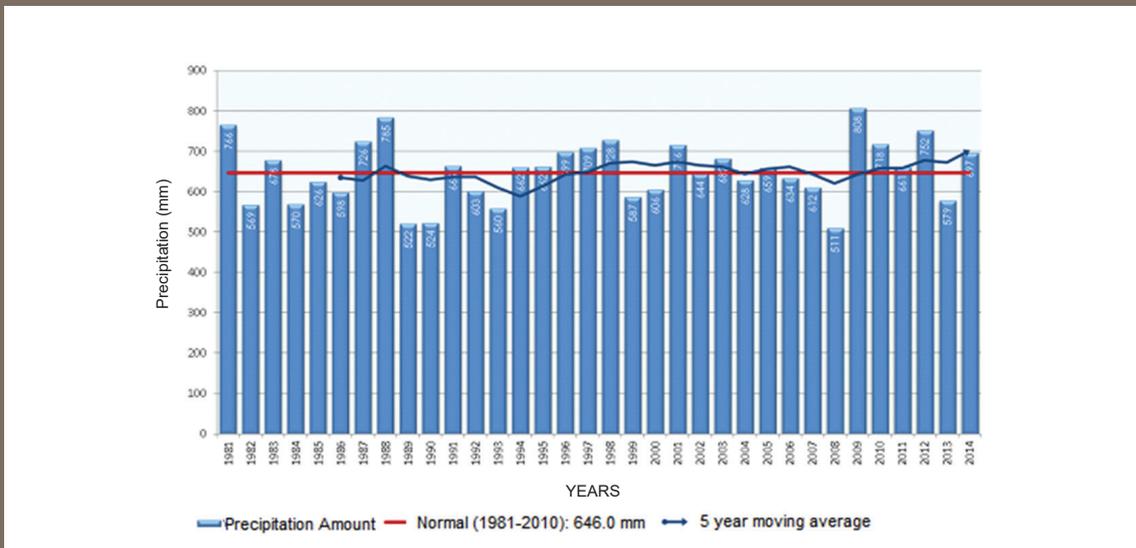


Blue curve shows time serial and the red line shows the trend of the serial.  
Source: SMS\_c, 2014

Figure 6.3 Turkey's annual average temperature change

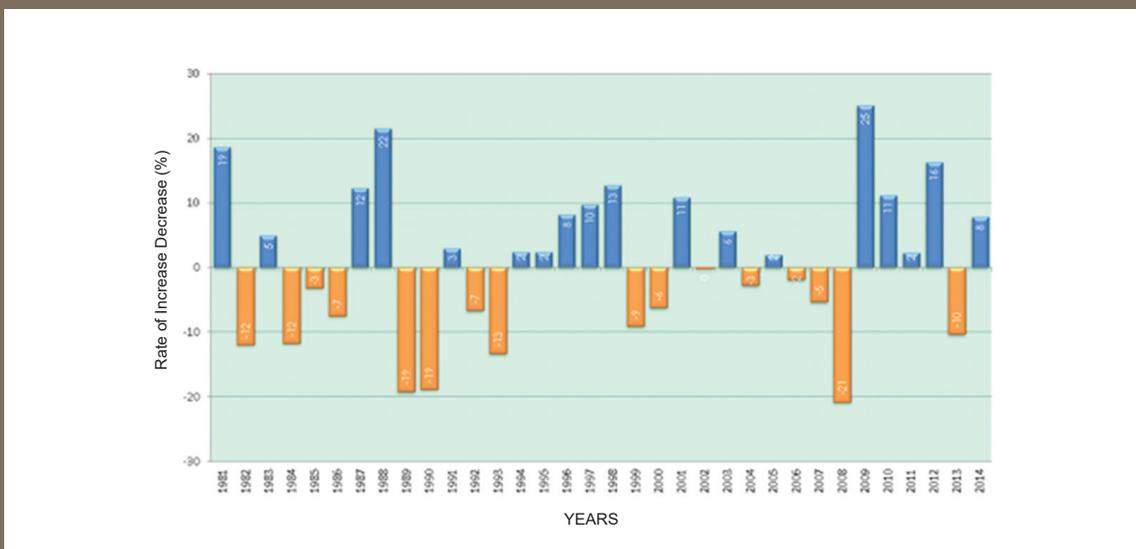
In the report prepared by SMS, precipitation data of the years of 1970-2012 are analyzed. It is emphasized that there is no significant increase or decrease in the average precipitation values throughout Turkey for study period (SMS\_c, 2014). For the study period and stations, average precipitation is 646 mm generally in Turkey. In the reviewed period, it is stated that the year with the highest precipitation is 2009 (804 mm) and the arid year is 2008 (506 mm) and while a

dry period is lived in the years 2006-2008, the period of 2009-2012 was a more rainy period (Figure 6.4). In Figure 6.4 blue filled columns show precipitation amount, red horizontal line shows long years of Turkey's average, blue columns show 5 year floating average values. When precipitation anomalies are reviewed in Turkey generally, precipitation values of some years are below average total precipitation value and in some years, it is above the average (Figure 6.5).



Source: SMS\_b, 2015

Figure 6.4 Precipitation change in Turkey according to years



Source: SMS\_b, 2015

Figure 6.5 Increase (blue column) or decrease (orange column) rates in total precipitations for years in Turkey

### 6.1.3.1 Climate Projections of Turkey

SMS is generating regional climate projection for Turkey up to 2100 by dynamic downscaling method in a way to be compatible with scenarios used in IPCC 5. Assessment Report, 1. Working Group Report. In the regional climate projections SMS has created by downscaling method by taking global models within the scope of Coupled Model Inter-comparison Project Phase 5, CMIP5 prepared by the World Climate Research Program (WCRP) member 20 climate modeling group, and new generation concentration scenarios (Representative Concentration Pathways, RCP) used in IPCC 5. Assessment Report. In the projection, medium radiative forcing (4.5W/m<sup>2</sup>) RCP4.5 and high radiative stress (8.5W/m<sup>2</sup>) RCP8.5 scenarios are used for the period of 2100-2150 and climate projection model developed by Hadley Research Center connected to England Meteorology Office climate

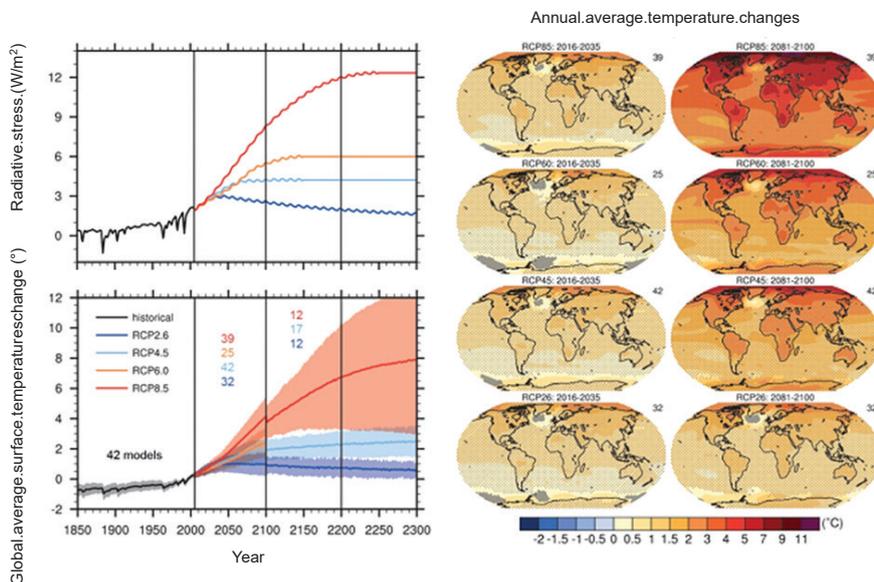
projection model HadGEM2-ES global model results are created by downscaling with the Regional Climate Model system, RegCM4. Detail information on model resolution, study area, sensitivity analysis, projection period and the scenario used in relation with global (HadGEM2-ES) and regional model (RegCM4) used are given in Table 6.1.

SMS has performed climate projections by benefiting from IPCC 5. Assessment Report in global projections and from its own products in projections related to Turkey. When taking the period of 1986-2005 as the basis, global average surface temperature change in the years 2016-2035 is expected to be between 0.3°C and 0.7°C. According to radiative forcing acceptance in Figure 6.6, 42 different model results estimate the change in the temperature until 2250 to be up to 7°C (IPCC, 2013).

Phases	GCM	RCM	Solubility (km)	Domain Size	Sensitivity Analysis (1971-2000)	Projection Period	Scenario
PHASE-I Generating Projections	HadGEM2-ES GFDL-ESM2M MPI-ESM-MR	RegCM.3.4	20x20	130x180	<ul style="list-style-type: none"> <li>• CRU</li> <li>• UDEL</li> <li>• UDEL-C</li> <li>• GSMs RAW DATA</li> </ul>	1971-2000 RF 2013-2040 2041-2070 2071-2099	RCP4.5 RCP8.5
PHASE-II Transmitting to Users	A practical internet interface is being developed to reach to all users from all sections. It shall be possible to reach this interface from every place having internet connection.						

Source: SMS\_c, 2014

**Table.1** Main features of model studies



According to various radiative stress acceptance (upper left), according to various model results, global surface temperature change projections (lower left). Global average annual surface temperature projections by taking the years between 1986-2005 as the preference according to radiative stress and various model results (right). Left section of right figure according to surface temperature generated by 42 models between the years of 2081-2100

Source: IPCC.2013

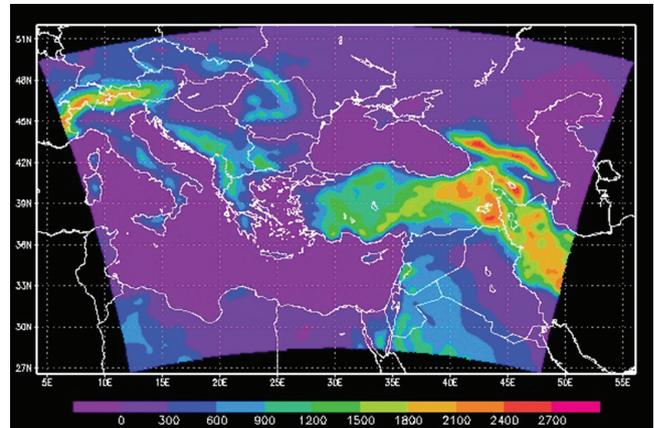
**Figure 6.6** Years of 1986-2005, global average surface temperature and radiative stress changes (left), average annual surface temperature projections according to RCP scenarios, for years of 2016-2035 and 2081-2100 (right)

A project titled “The Effect of Climate Change on Water Resources Project” is started in 2013 by the Ministry of Forestry and Water Affairs, General Directorate of Water Management (GDWM). The project shall be completed in July 2016. Within the scope of the project, at least three places under CMIP5 shall be estimated by using regional climate model of system model simulation on Turkey at 10 km high resolution. As an emission scenario RCP 4.5 and RCP 8.5 are used. It comes against between the reference period 1971-2000; and the following years 2015-2099. The project aims performing hydrologic analysis within the direction of the future climate expectations on 25 river basins and examining effect studies on sectoral basis. As of 2015, downscaling studies for HadGEM2-ES and MPI- ESM-MR are completed and pre-assessments on 14 river basins are performed. Besides, 17 climate indices identified by WMO are examined in approximately 30 year periods specifically for Turkey and basins. In order to make a comparison between the models, within the scope of “The Effect of Climate Change on Water Resources Project” conducted by GDWM, among results generated according to RCP4.5 and RCP8.5 scenarios, only MPI global model results are stated. Results of 5 indices selected among Climate indices are offered for both place system model.

### 6.1.3.2 Reference Period and Area Selection for Climate Projections

In SMS studies, the period of 1971-2000 is selected as the reference period. The area which the models shall be operated is the region between 27.00°-51.00° North latitudes and 5.00°-55.00° east longitudes which shall represent Turkey the best and by considering the technical equipment (Figure 6.7) (SMS\_c, 2014).

4 different representative concentration routes are determined for new concentration scenarios to be used in IPCC 5. Assessment Report. Before these, The Special Report on Emissions Scenarios, SRES published in 2000 is prepared by IPCC. From these scenarios, by assuming a heterogeneous world, for increasing global population and regional economic growth A2 and for very rapid economic growth and new and more effective technologies in the world A1F1 shows similarities to RCP8.5. Assumption that emissions or radiative forcing shall make peak until 2100 and then, these values shall make a fall constitutes the basis of the scenarios.



Source: SMS\_c, 2014

Figure 6.7 Study area at RCM (RegCM4.3.4)

### 6.1.3.3 Regional Climate Model Used (RegCM-4.3.4)

In the study, RegCM-4.3.4 Regional Climate Model developed by American National Atmosphere Research Center (NCAR) and supported by International Abdusselam Theoric Physics Center (ICTP).

### 6.1.3.4 Regional Climate Projections for Turkey

Regional climate projections formed by downscaling in RegCM4 of HadGEM from global models used within the scope of CMIP5 project are created by SMS. In the study, 1971-2000 is taken as the reference period and the period of 2016-2099 is taken for projection.

SMS has primarily made parameterization tests and then, 4 different periods are selected and the model is operated. 4 periods that SMS has used in climate projections are between the years of 1971-2000, 2016-2040, 2041-2070 and 2071-2099. The model has 20 km x 20 km resolution and is constituted of 23.400 (180x130) grid in study area. As the regional model has taken the start and limit conditions from global model, 12 grids from the sides are not considered in the results. The model is operated one year before the examined period and the related first year is not considered as it is a transition year. When results of the regional climate model obtained in reference period is compared with the results of the global models in the same period, a great harmony is seen specifically in summer

and winter temperatures. In annual average temperatures, it is seen that regional model results are lower than global model results and observations. Although precipitation values of the regional climate model in the reference period matches other model results and observation data in winter season, model results and observations in spring and autumn seems different. In Table 6.2, comparison of average temperature and total precipitation results of the reference period 1971-2000 with different observation data sets seasonally. For the reference period of 1971-2000, when average temperature results obtained from HadGEM2-ES global model data by downscaling method are compared

Season	Temperature (°C)				Precipitation (mm/day)				
	RCM	CRU	UDEL	RAW	RCM	CRU	UDEL	UDEL-C	RAW
WINTER	0.436	0.561	0.258	1.762	2.159	2.126	2.064	2.452	2.764
SPRING	8.294	9.712	9.503	9.867	2.622	1.974	1.881	2.101	2.874
SUMMER	20.792	20.859	20.834	20.763	0.947	0.686	0.653	0.733	0.952
AUTUMN	10.412	12.480	12.177	12.349	1.830	1.333	1.347	1.497	1.858
AVERAGE	9.987	10.906	10.694	11.190	1.886	1.531	1.487	1.697	2.107

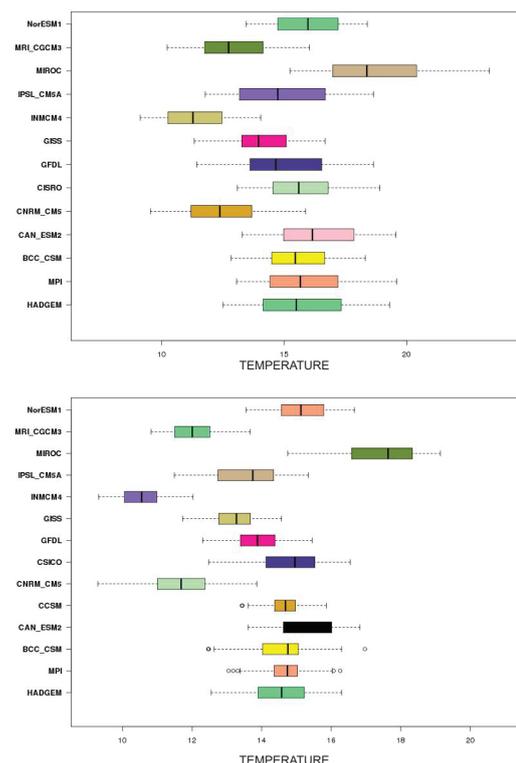
**Table 6.2** Comparing seasonal average temperatures and precipitation with observation data for the reference period of 1971-2000

with observation data specifically model results of winter and summer season are compatible with other observation data. In spring seasons, temperature values of the model are 1.5°C lower than observation data. When Turkey average is considered, model results are 0.71-0.92°C lower regarding observation data of the UEA Climatic Research Unit's Global Climate data set (CRU) and Willmott, Matsuura, and Collaborators at University of Delaware data set (UDEL). Likewise, when daily precipitation results are compared with other observation data, specifically in winter season, it is seen that model results match up with other observation data. In spring and autumn seasons, precipitation values of model are greater than observation data. Considering Turkey average, model results estimates 23% more precipitation in average in regards with other observation data [Demir, Atay, Eskioğlu, Tüvan, Demircan and Akçakaya, 2013].

According to HadGEM, Geophysical Fluid Dynamics Laboratory GFDL and Max Planck Institute for Meteorology MPI global model data results SMS uses, average temperatures obtained as a result of regional climate projection are in harmony with global models. According to RCP4.5 and RCP8.5 scenarios of global models, comparison of average temper-

ature values shown for Turkey are given in Figure 6.8. The lowest increase in the temperature in SMS evaluations according to RCP4.5 scenario, model of Institute for Numerical Mathematics, Moscow, Russia is obtained by using INMCM4 model results. The highest increase in the temperature according to RCP8.5 scenario is obtained by using the MIROC (Model for Interdisciplinary Research on Climate) model results.

General characteristics of global and regional models used in SMS studies are given in Table 6.3. SMS creates 20 km. resolution results by using 112.5 km resolution results of global model HadGEM on RegCM model.



Source: SMS\_c, 2014

**Figure 6.8** Comparison of average temperature values global models show for Turkey according to RCP4.5 (left) and RCP8.5 (right) scenario

GCM	Sol. (km)	Source Institute	RCP	Period	Reference Period	RCM	Sol. (km)	Final Status
HadGEM	112.5	Hadley Center	4.5 8.5	2016 - 2099	1971-2000	RegCM	20	Completed
MPI	210	Max Planck	4.5 8.5	2016 - 2099	1971-2000	RegCM	20	Completed
GFDL	220	Noaa-GFD lab.	4.5 8.5	2016 - 2099	1971-2000	RegCM	20	Completed

**Table 6.3** General features of GCM and RCM used in SMS Studies

In climate simulation studies, specifically in recent years, they are focused on Turkey and surrounding. Önoğlu and Semazzi (2009) have performed climate projection for the period of 2071-2100 by using regional climate change simulation for Eastern Mediterranean 1961-1990 reference period and SRES A2 scenario (Önoğlu and Semazzi, 2009). In climate projection, when Turkey is considered completely, the highest temperature increase for summer season is estimated as 4.3°C. In the precipitation results of the model, it is estimated that there shall be significant changes as increase in winter season in the Black Sea Region and decrease in the Mediterranean Region. Besides, in the model simulation study conducted again by Önoğlu, a significant increase is determined in summer temperatures in Turkey in the last twenty years (Önoğlu, Bozkurt, Turunçoğlu, Sen and Dalfes, 2013).

One of the regional climate scenarios having made by SMS is prepared by downscaling GCM ECHAM5 model simulation outputs of SRES-A2 and SRES-B1 emission scenarios (a scenario based on rather more interactive world assumption and more nature friendly) obtained from Max Planck Institute for Meteorology in Germany by using RegCM3 regional climate model. By this method, climate projections for the periods of 1961-2000 and 2000-2099 are obtained. Various products (temperature, precipitation, flow, etc.) of these simulations are offered to the users under "Data Distribution System".

Downscaled climate change projections obtained in the study on temperature performed by the climate research group of Eurasia Institute of Earth Sciences working in the body of ITU are prepared for different scenarios. When results of ECHAM5 model outputs based on A2 scenario are examined, for the period of 2011-2040 an increase in surface temperature is estimated for all Turkey and this increase is expected to be higher in the years of 2099. Although model simulation projects that surface temperature increases in Turkey shall not be equal, they put forth that more increase shall be observed in the inner parts of the Eastern Turkey in winter tem-

peratures and that more increase shall be observed in summer temperatures in the South and southeast parts.

Sensitivity simulations are performed by Bozkurt and Şen (2011) to understand the effects of the seas surrounding Turkey on climate and is stated that surface water of the seas triggers increase in summer and autumn temperatures, probably formation of floods and extreme precipitation events.

Many studies based on climate simulations are performed for the purpose of effective use of water resources of the Middle East countries for the future. In a study performed, the size of precipitations for the western coasts of Turkey being in the rate of 5-25% in the first half of the 21st Century has protected its consistency in all model results (Hemming, Buontempo, Burke, Collins and Kaye, 2010). In the simulation performed by Kitoh et. al. (2008) on estimated annual water flow; due to precipitation deficit in the basin in Euphrates River, a significant decrease is estimated in the end of the 21st Century and that this decrease is in the rate of 30%-70% (Kitoh, Yatagai and Alpert, 2008).

When the part related to precipitation of the results based on A2 scenario of ECHAM5 model outputs of Eurasia Institute of Earth Sciences climate research group is examined, it is stated that in the first 30 year period (2011-2040), in most of the regions of Turkey winter and spring precipitations show an increase of up to 30%. It may be said that ECHAM5 simulation remarks two regions (hot regions) where important changes shall be experienced in precipitations related to increasing emissions of ECHAM5 simulation. These regions are Mediterranean and Southeastern Anatolia Regions where there shall be significant decreases in precipitations and the Black Sea Region where there shall be significant increases in precipitations. Changes which shall occur in other regions are relatively less.

The purpose of the project titled "The Effect of Climate Change on Water Resources Project" started in 2013 by the Ministry of Forestry and Water Affairs, GDWM is determining the effect of climate change scenarios on surface and underground waters on the basis of basin and determining adaptation activities. For this purpose, preparing climate change projections in all basins shall be provided. Application area of the project is 25 river basins

and the period of the projection is the years between 2015-2100. For this reason, three place system model are selected under CMIP5 and model simulations are held subject to dynamic downscaling by regional climate model RegCM. For this purpose, primarily, climate simulations are performed on Med-CORDEX area at 50 km resolution and later, by using these results, current and future climate expectations on Turkey is estimated at 10 km high resolution. For Representative Concentration Routes RCP4.5 and RCP8.5, simulations are performed by 2 place system model for Turkey (HadGEM2-ES and MPI-ESM-MR). Studies are continuing for the 3rd place system model.

### 6.1.3.5 Temperature and Precipitation Projections according to RCP4.5 Scenario

According to temperature (Figure 6.9) and precipitation (Figure 6.10) projections generated by SMS for Turkey by using RCP4.5 scenario HadGEM2-ES global data considering reference period including the years between 1971-2000; Period of 2016-2040:

It is projected that;

- Increase in temperatures shall generally be limited by 2°C,
- In summer season, temperature shall increase by 2-3°C in Marmara and the Western Black Sea Regions,
- An increase in precipitations shall be expected in winter months in Aegean coasts, the Eastern Black Sea and Eastern Anatolia,

- Approximately 20% decreases shall be seen in spring precipitations in a significant part of Turkey besides Aegean coasts and east of Eastern Anatolia.

Period of 2041-2070:

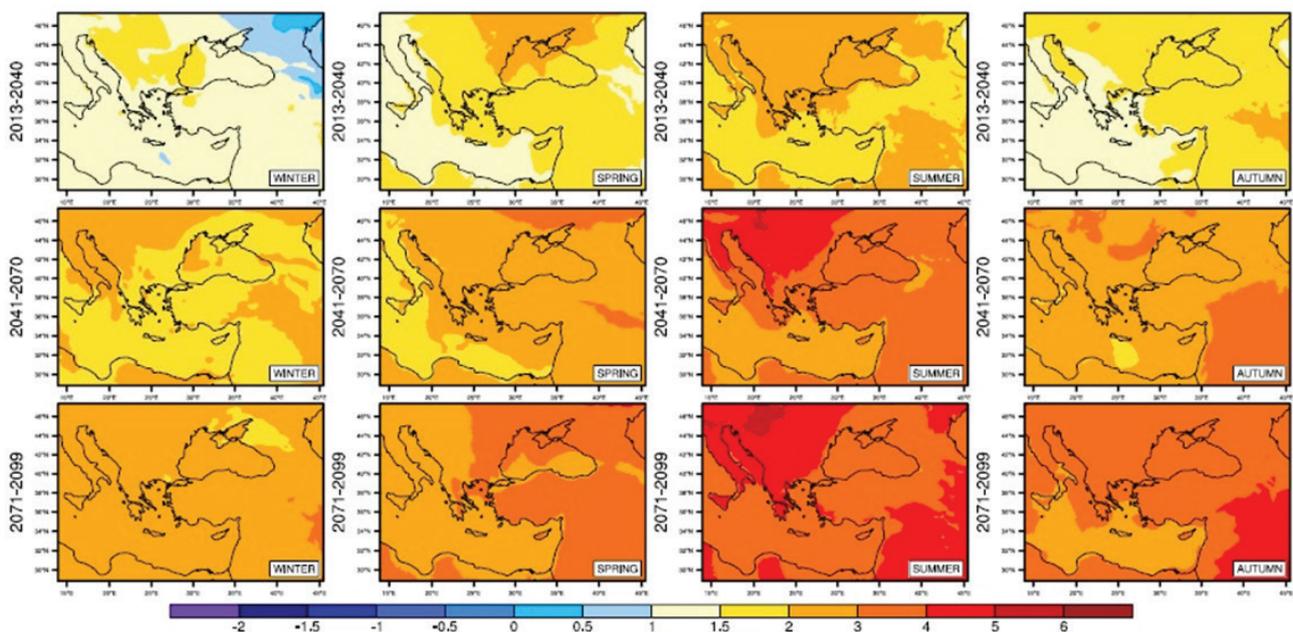
It is projected that;

- temperature increase in spring and autumn shall be approximately 2-3°C,
- There shall be up to 4°C increase in summer months.
- It is projected that in precipitations, there shall be approximately 20% decreases in winter precipitations in the Eastern and Southeastern Anatolia and Central and Eastern Mediterranean Regions,
- In summer months, there shall be approximately 30% decreases in the Eastern Anatolia where precipitations are important,
- In autumn precipitations, there shall be decreases besides Aegean coasts and a small part of the Central Anatolia.

Period of 2071-2099:

- Increases in temperatures are expected to be 2°C in winter,
- And 3°C in spring and autumn.
- In summer temperatures, temperature increases exceeding 4°C are expected in Aegean coasts and the Southeastern Anatolia are projected.
- In precipitations in spring approximately 20% decreases are expected except in Coastal Aegean, Central Black Sea and Northern Eastern Anatolia Regions,
- In winter precipitations, approximately 10% increases specifically in coastal line is expected,
- Except in Aegean, Marmara and the Black Sea coasts, up to 40% decreases are projected in summer precipitations,
- And decreases almost all over Turkey in autumn precipitations are projected (SMS\_c, 2014).

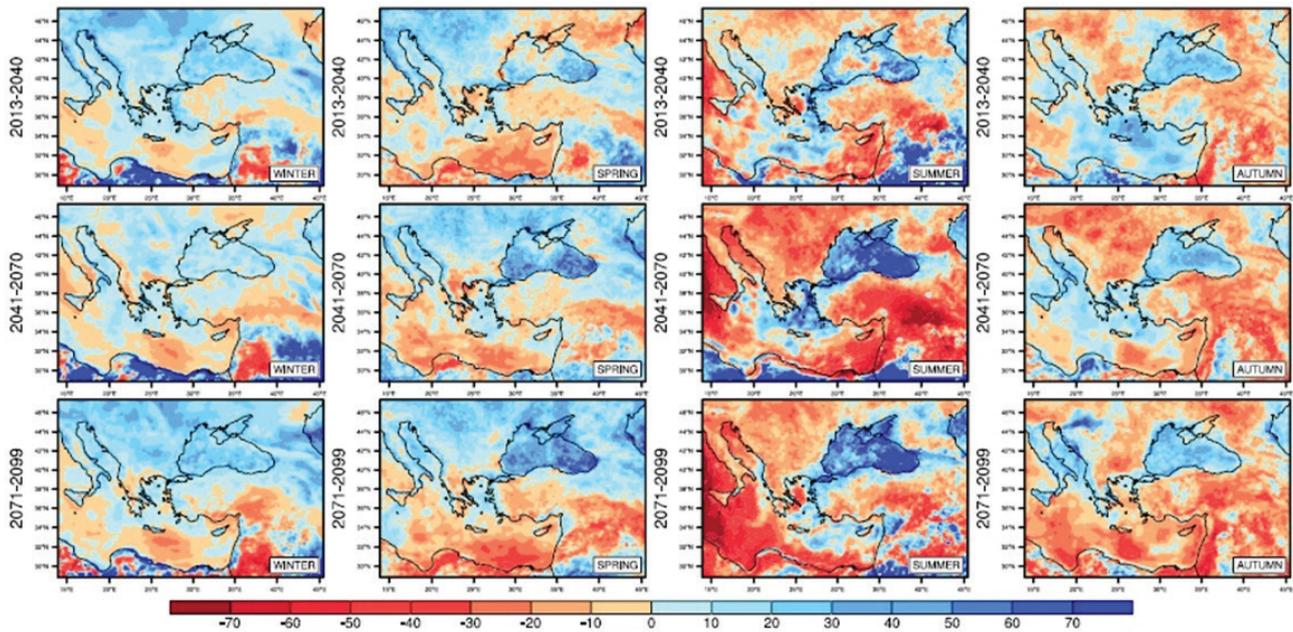
#### HadGEM2-ES RCP4.5 TEMPERATURE PROJECTIONS (20km)



Source: SMS\_c, 2014

Figure 6.9 SMS temperature projections according to RCP4.5

## HadGEM2-ES RCP4.5 PRECIPITATION PROJECTIONS (20km)



Source: SMS\_c, 2014

**Figure 6.10** SMS precipitation projections according to RCP4.5

The results of the project named “The Effect of Climate Change on Water Resources Project” started by the Ministry of Forestry and Water Affairs GDWM in 2013 are as the following:

According to temperature and precipitation projections generated for Turkey by using RCP4.5 scenario MPI-ESM-MR global data considering reference period including the years between 1971-2000;

Period of 2015-2040:

- It is estimated that average temperature anomaly values throughout Turkey shall be between 1-2°C range,
- In spring and summer months, the greatest increase in temperature anomalies may be seen in the West of Turkey,
- increase in the Black Sea Region in winter months shall change between 100-150 mm generally in Turkey,
- Among the regions where lack of precipitation shall be felt the most shall be the Mediterranean and the Aegean Regions.

Period of 2041-2070:

- While temperature increases are expected to be approximately 2-3°C in spring months at the most,
- Eastern Anatolia Region shall be among the regions where increase in anomalies shall be felt the most,
- increase in summer temperatures shall be over 3°C in the Eastern Anatolia and Southeastern Anatolia Region,

- and decreases up to 300 mm are expected in annual total precipitation quantities throughout Turkey,
- It is observed that the Aegean and Mediterranean Regions shall be among the regions which shall confront the most with drought.

- Decreases between 100-150 mm to be experienced in total precipitation anomalies in the Black Sea and Marmara Regions are projected by the model system.

Period of 2071-2099:

- It is expected that temperature increases shall be experienced in all seasons,
- In winter months temperature anomalies shall be approximately 2°C throughout the country,
- Temperature increase shall be 4-5°C in summer months,
- And temperature increase in the east and southeast of Turkey shall reach to 4-5°C.
- It is determined that annual total precipitations shall increase by 100-400 mm in the Black Sea and Marmara Region,
- And spring precipitation anomalies shall increase up to 150 mm in the Eastern Anatolia and Western Black Sea Regions.
- Decreases up to 400 mm are expected in winter months, annual precipitation anomalies are expected in the Mediterranean Region, Aegean Region, the Central Anatolia and the Southeastern Anatolia

### 6.1.3.6 Temperature and Precipitation Projections according to RCP8.5 Scenario

According to temperature (Figure 6.11) and precipitation (Figure 6.12) projections generated by SMS for Turkey by using RCP8.5 scenario HadGEM2-ES global data, taking period including the years between 1971 and 2000 as a reference; Period of 2016-2040:

- Increase in temperatures are projected to be approximately 3°C specifically in spring and summer seasons,
- Decreases are projected in precipitations in autumn throughout Turkey and in spring in the west of Mersin-Ordu route,
- In summer months, increases up to 40% are projected in all coastal regions except the Western Mediterranean.

Period of 2041-2070:

- In temperature increase, 2-3°C increases in winter months, 3-4°C increases in autumn and spring months and up to 5°C increases in summer months are projected.
- In precipitations, increases are expected in winter at regions besides the Coastal Mediterranean, Southeastern Anatolia and the South of Eastern Anatolia.
- In spring, approximately 20% decreases are expected across the country except the Coastal Aegean and Northern - Eastern Anatolia.
- It is projected that there shall be approximately 50% decreases in summer months across the country, specifically

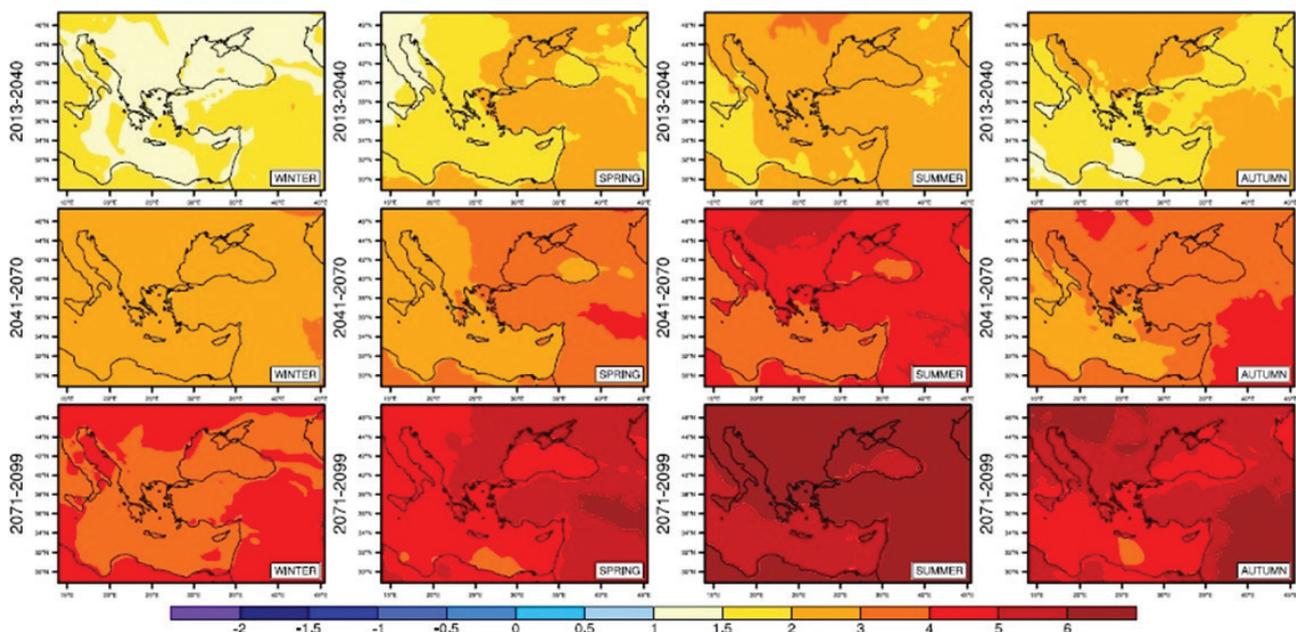
in the Eastern Anatolia, except the Aegean, Marmara, Western and the Eastern Black Sea,

- And that there shall be decreases in autumn precipitations throughout Turkey.

Period of 2071-2099:

- Increases exceeding 6°C are expected in temperature, specifically in summer.
- Increases of 6°C are expected in spring and autumn months, specifically in the Southeastern Anatolia.
- Temperature increases of 3-4°C in the West and 4-5°C in the East of Mersin-Trabzon line in winter months are projected.
- In precipitations in winter, decreases in the Central and the Eastern Black Sea and Southeastern Anatolia Regions and increase in other regions, specifically in the Central and the Eastern Black Sea coasts are projected.
- In spring months, approximately 20% decreases are expected in regions other than Coastal Aegean, western part of the Central Black Sea and the Eastern Black Sea,
- In autumn precipitations, decreases up to 40%, even 50% from place to place, are projected throughout Turkey besides the Marmara coasts.
- In summer months, while increases are expected in the Marmara and Western Black Sea Regions, decrease in precipitations are projected in the Mediterranean and Eastern Anatolia specifically (SMS\_c, 2014).

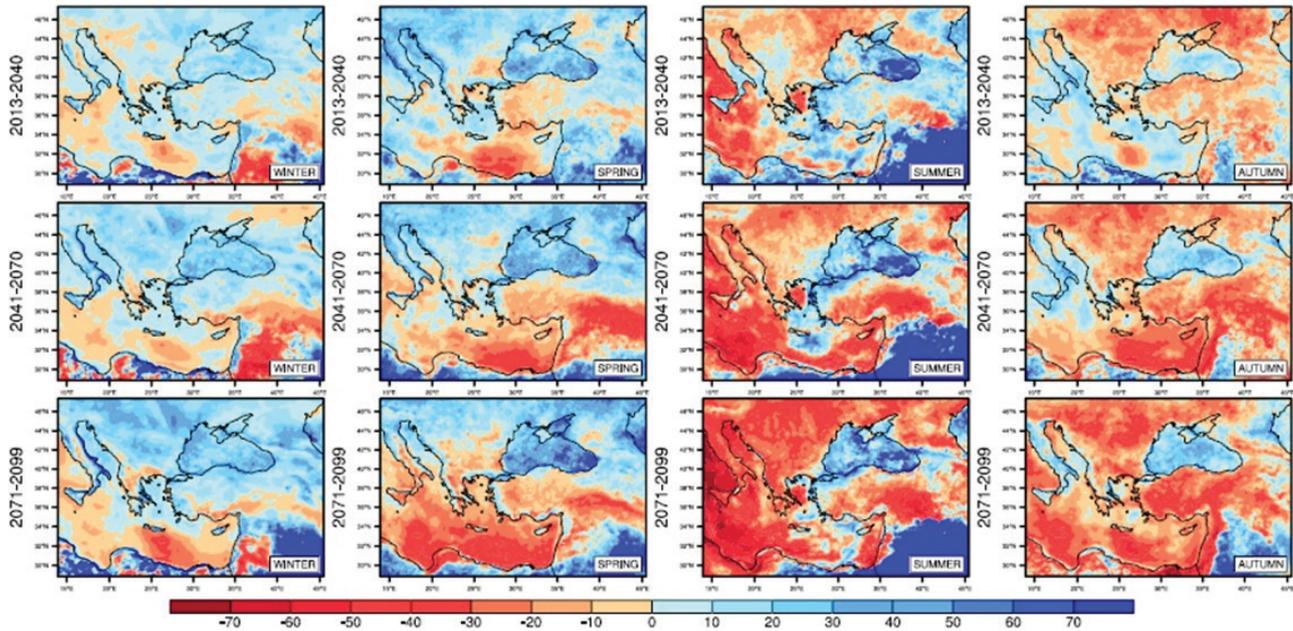
#### HadGEM2-ES RCP8.5 TEMPERATURE PROJECTIONS (20km)



Source: SMS\_c, 2014

Figure 6.11 SMS Temperature Projections according to RCP8.5

## HadGEM2-ES RCP8.5 PRECIPITATION PROJECTIONS (20km)



Source: SMS\_c, 2014

**Figure 6.12** SMS Precipitation Projections according to RCP8.5

When temperature projections produced by using RCP4.5 and RCP8.5 scenarios base HadGEM2-ES are periodically compared, it is projected that;

For the period of 2016-2040, according to RCP4.5 scenario, temperature increase shall be generally limited with 2°C, this value shall slightly increase in Marmara and the Western Black Sea in summer season; and according to RCP8.5, temperature increase shall be approximately 3°C specifically in spring and summer seasons,

For the period of 2041-2079, according to RCP4.5, temperature increase in spring and autumn shall be approximately 2-3°C, and approximately 4°C in summer; according to RCP8.5, temperature increases shall be respectively 2-3°C in winter, 3-4°C in spring and approximately 5°C in autumn and summer,

For the period of 2071-2099, according to RCP4.5, temperature increase shall be 2°C in winter, 3°C in spring and 4°C in autumn and summer; according to RCP8.5, temperature increase in winter season shall be 3-4°C in western Regions and 4-5°C in eastern Regions while the temperature increase in summer season shall reach to 6°C.

When precipitation projections of both scenarios are compared, it is projected that;

In the period of 2016-2040, according to RCP4.5 scenario, precipitations in spring season shall decrease in most of the parts of the country; and according to RCP8.5, decreases shall be seen in autumn precipitations in western regions, and increases up to 40% shall be seen in summer precipitations in most of the coastal regions,

For the period of 2041-2070, according to RCP4.5, there shall be decreases in autumn precipitations throughout the country, approximately 30% decreases in summer precipitations in Eastern Anatolia, and in RCP8.5 period, there shall be an increase in winter precipitations in most of the country, approximately 20% decreases in spring precipitations throughout the country and precipitations shall decrease in autumn in all over the country,

In the period of 2071-2099, according to RCP4.5, there shall be approximately 20% decrease in spring in all over the country, 10% increase in winter precipitations in all over the country, and approximately 40% decreases in summer precipitations, decreases in autumn precipitation in all over the country, according to RCP8.5, approximately 20% decrease in spring precipitations, in all over the country, approximately 40% decreases in autumn in all over the country and increase in winter precipitations in most parts of the country.

The results of the project named "The Effect of Climate Change on Water Resources Project" started by the Ministry of Forestry and Water Affairs GDWM are as the following:

Period of 2015-2040:

- While approximately increases of 1-2°C in temperature throughout Turkey is being expected,
- It may be expressed that the temperature increases shall be seen the most in summer months and be affected specifically in the South of Turkey.
- Decreases between 100-150 mm are expected in total precipitation anomaly values.
- Decreases in total precipitation anomaly values in the Western Mediterranean and Aegean Regions are estimated.

Period of 2041-2070:

It is estimated that;

- Temperatures shall increase 3-4°C in average throughout Turkey,
- And increases shall be the most in summer months and more significant in Eastern Anatolia, Southeastern Anatolia, the Central Anatolia and Mediterranean Regions.
- It may be said that while temperature increases in winter months shall be 2-3°C, it shall be 3-4°C in summer and spring months and even over 4°C in inner parts.
- While decreases expected in winter precipitations in South coasts are approximately 150-200 mm,
- In just the opposite way in the Northern Turkey, increases between 100-200 mm in winter and spring seasons are observed in the Black Sea Region precipitations.
- In this period, Antalya, Mersin and Muğla are expected to be among the cities throughout Turkey where the most dramatic results shall be seen

Period of 2071-2099:

- It is observed that the highest increase in temperature anomalies shall be felt in this period.
- Serious temperature increases are expected in all 4 seasons, it may be projected that these increases shall be 5-6°C throughout Turkey and may be over 6°C from time to time.
- We may come to the conclusion that in Spring and Summer months, temperature anomalies shall be felt in most of the regions in the country, that it shall be felt around 5-6°C in the Eastern and Southeastern Anatolia Regions and approximately 3-4°C in Marmara and the Black Sea Regions.
- Decrease in total precipitation anomalies throughout Turkey is 300 mm and over.
- In winter months, specifically in the Western Mediterranean and Aegean Region precipitations, decreases between 200-300 mm are expected.
- Increases in precipitations are estimated to be approximately 250-300 mm, and the Black Sea Region to be among the most affected regions from these increases.
- While increases around 100 mm are expected in some

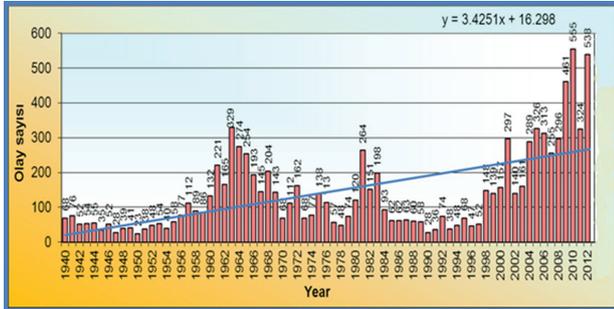
parts of the Eastern Anatolia Region, it is seen that these increases shall leave their place to decreases towards South.

### 6.1.3.7 Climate Extremes

One of the subjects being studied on climate change is increases or decreases in the observations on extreme values in climate parameters. As a result of climate change, changes are expected in frequency values of extreme values. According to the reports in the 1st Section of the 1st Working Group Report Status Evaluation of IPCC 5. Assessment Report, due to increase in average temperature and irregularities in the distribution of energy, it is concluded that there has been increases in warm and cold air waves, and in severities and frequencies of precipitation and droughty extreme weather events are experienced (Cubash, et al., 2013). In evaluation of SMS extreme events, the following parameters and criteria are taken as the basis:

- Euphrates-Tigris river valleys number of days in summer season with average temperature  $\rightarrow$ 25°C,
- Period of 1971-2000 and model reference period, temperature and precipitation 10% and 90% threshold values of stations,
- Number of days and changes which threshold values are exceeded according to 2013-2040, 2041-2070, 2071-2099 reference period for projection periods of the stations,
- Change in number of frost days,
- Change in number of tropic days,
- Change in number of severe precipitation days,
- Change in number of very severe precipitation days,
- Change in maximum and minimum temperatures,

According to IPCC (2012) reports, there is a relation between climate change and increase in extreme events (IPCC, 2012). According to SMS (2014) report, there is a relation between climate change and increase in extreme events also in "(Figure 6.13). In Figure 6.13, time serial of the number of annual extreme events (red bar) between the years of 1940 and 2012 takes place. In the Figure, there are also tendency curve (blue straight line) and 2 year moving average values (black curve) according to the smallest squares method. In Turkey, increase in temperature and extreme events is seen significantly as of 1990. According to the smallest squares method, while number of extreme events was below 50 in 1940's, this value has rapidly accelerated in 2012 and passed 200. Number of extreme events observed only in 2012 is 538' dir (SMS\_c, 2014).



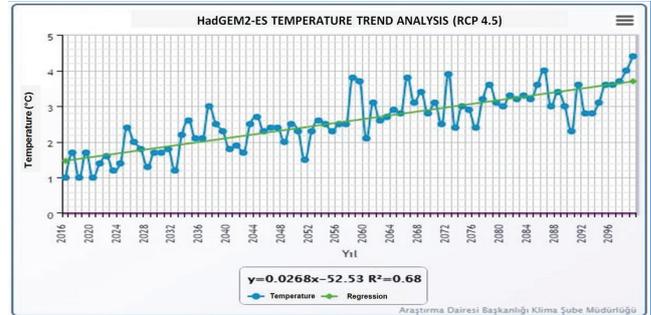
Source: SMS\_c, 2014

**Figure 6.13** Change of the number of the extreme weather events according to the years

### 6.1.3.8 Trend Analyses

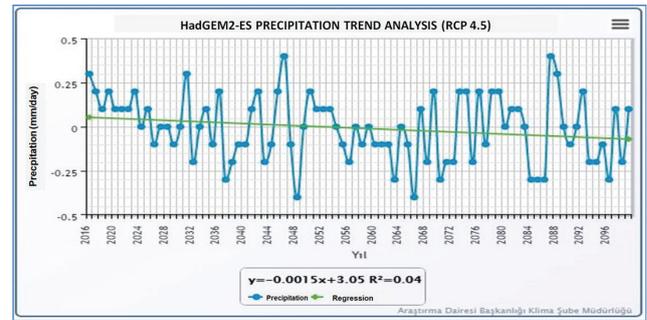
By taking SMS 1971-2000 years as a reference, temperature changes for every year between 2013 and 2099 are projected (SMS\_c, 2014). According to the studies done in the framework of regional climate projections, yearly average temperatures show an increasing trend between 2016 and 2099 in the region in which Turkey resides according to RCP4.5 scenario. The increase value between the years 2016-2099 is 2.5°C. The increasing trend is limited until the year 2050; however, in the following years, the increase is faster. Considering the temperature release in the term of question, the lowest temperature increase is 0.5°C whereas the highest temperature increase is 4°C (Figure 6.14). The values obtained by subtracting the daily average raining according to RCP4.5 scenario from the daily average raining in the reference term are presented in Figure 6.15. According to the raining scenario, it is projected that the raining will decrease by 0.14 mm/day or 50 mm/year between 2016 and 2099. In spite of this general decreasing trend, it is seen that the raining does not have a regular change in the relevant term. It is found that in some terms it increases by 0.4 mm/day (145-150 mm yearly) and in some terms it decreases by the same amounts. Because the yearly total raining amount is a little amount like 642 mm in Turkey in general, these releases in the raining regime are important. These releases in raining are important for subjects such as the planning of the water resources of the cities, determination of agricultural and forest needs and drought analysis

The results obtained according to SMS RCP8.5 scenario are given in Figure 6.16 and in Figure 6.17. According to the results of RCP8.5 scenario, the yearly average temperatures show continuous increases between 2013 and 2099. As a result of the increasing trend between 2013 and 2099, the temperature increase value increases up to 3.6°C. According to the model result, the lowest temperature increase is 0.9°C and the highest temperature increase is 6.3°C according to the reference term (SMS\_c, 2014).



Source: SMS\_c, 2014

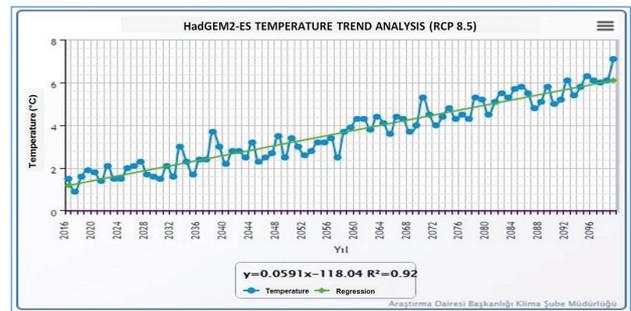
**Figure 6.14** Differences between the average temperatures between 2016 and 2099 and the reference term between 1971 and 2000 according to RCP4,5 scenario results



Source: SMS\_c, 2014

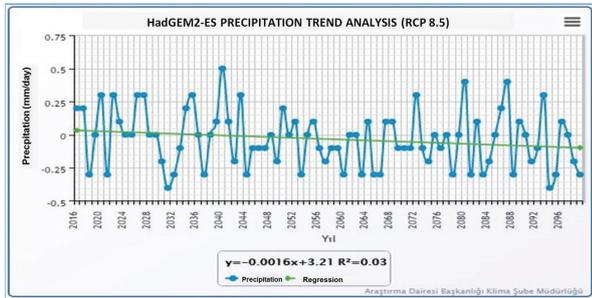
**Figure 6.15** Differences between the daily average raining between 2016 and 2099 and the reference term between 1971 and 2000 according to RCP4,5 scenario results

Considering the difference between the daily average raining and the average raining in the reference term, it is seen that raining decreases by 0.13 mm/day or 47 mm/year between 2013 and 2099. In spite of this general decreasing trend, there is not a continuous decrease in raining. The highest increase is projected as 180 mm/year and the lowest decrease is projected as 150 mm/year in the relevant term.



Source: SMS\_c, 2014

**Figure 6.16** Differences between the average temperatures between 2016 and 2099 and the reference term between 1971 and 2010 according to RCP8,5 scenario results



Source: SMS\_c, 2014

**Figure 6.17** Differences between the daily average raining between 2016 and 2099 and the reference term between 1971 and 2000 according to RCP8.5 scenario results

If the trend analyses for temperature, which are produced by using HadGEM2-ES based on RCP4.5 and RCP8.5 scenarios, are compared;

It is seen that the temperature is continuously in an increasing trend for the 2013-2099 period in both scenarios. But the average temperature increase is 2.5°C according to RCP4.5, whereas the temperature increase is 3.6°C according to RCP8.5. The lowest and the highest temperature increases are 0.5°C and 4°C for RCP4.5 respectively. These values are 0.9°C and 6.3°C for RCP8.5.

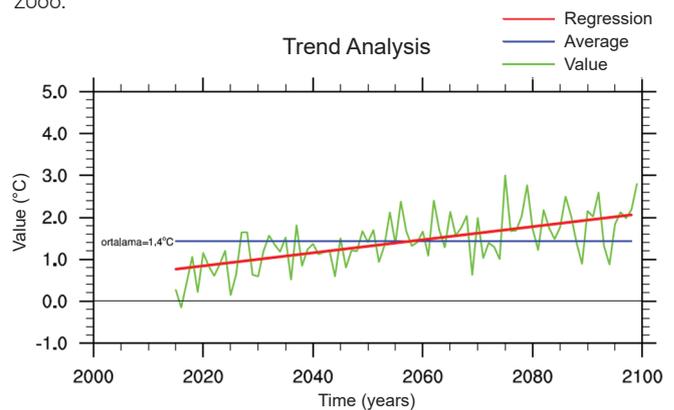
If the trend analyses for raining, which are produced by using HadGEM2-ES based on RCP4.5 and RCP8.5 scenarios, are compared;

Both of the scenarios are in accordance with each other in the trend analysis for raining just like they are in the trend analysis for temperature. In both scenarios, decreases in raining is expected for the 2013-2099 period and these decreases do not follow a regular regime. Decrease is approximately 50 mm/year according to RCP4.5 and 47 mm/year according to RCP8.5.

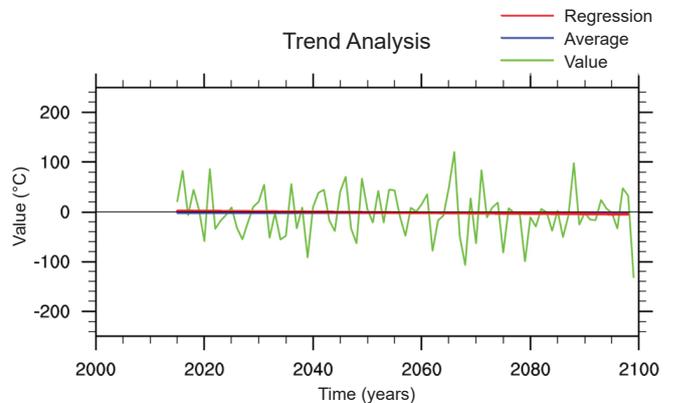
The results of the project named "The Effect of Climate Change on Water Resources Project", which was done by the Ministry of Forest and Water Affairs GDWM in 2013, about the trend analysis are as follows:

According to the studies done in the framework of regional climate projections, yearly average temperatures show an increasing trend between 2015 and 2099 in the region in which Turkey resides when we examine the results according to RCP4.5 scenario of MPI-ESM-MR model. This increase is determined as average 1.4°C. When we examine the temperature releases, higher temperature anomalies are seen after 2060s. It is supposed by the model that the highest temperature increase will be in 2075 with a 3°C difference and the lowest anomaly value will be in 2016 with a -0.1 difference (Figure 6.18). The yearly anomalies of the differences between the total raining and the reference term according to RCP4.5 scenario are shown in Figure 6.19. Termly increases and decreases are

seen in the raining anomalies. After 2060s, decreases expected in the raining are also reflected to the results. The highest decrease is seen to be 130 mm/year towards the end of the century. In addition to this situation, it is expected that the maximum increase in the terms in which increases are seen will be 120 mm/year in 2066.

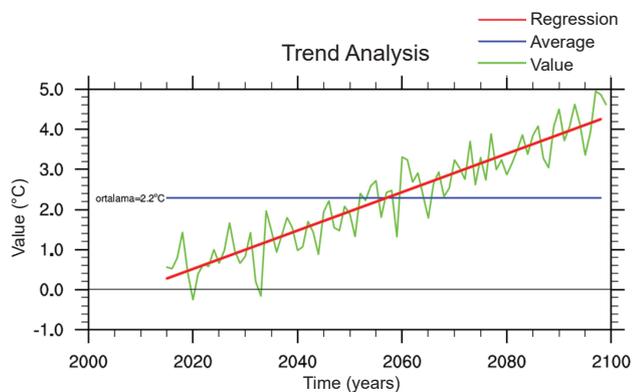


**Figure 6.18** Differences between the average temperatures between 2015 and 2099 and the reference term between 1971 and 2000 according to RCP4.5 scenario results

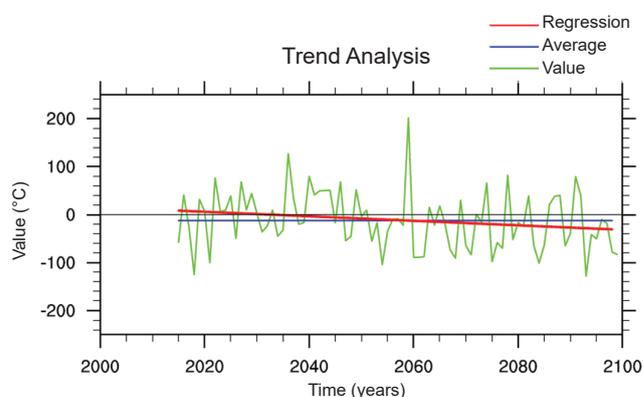


**Figure 6.19** Differences between the total raining between 2015 and 2099 and the reference term between 1971 and 2000 according to RCP4.5 scenario results

RCP8.5 results are shown in Figure 6.20 and Figure 6.21. When these scenario results are examined, it is seen that primarily the temperature results have higher anomaly values compared to RCP4.5 results. Temperatures show 2.2°C increase on average between 2015 and 2099. Temperature trends show that there will be increases higher than average in the anomalies after 2060s just like RCP4.5 results, whereas the maximum increase is estimated as 4.9°C. When we look at the yearly total raining anomalies, it is expected that the raining will not have a regular regime in years. The most interesting point in the raining anomalies is that, the highest increase is 200 mm/year in 2059. Whereas it is seen that the general trend is going to show a decrease after 2060s, the maximum decrease is estimated as 128 mm.



**Figure 6.20** Differences between the average temperatures between 2015 and 2099 and the reference term between 1971 and 2000 according to RCP8.5 scenario results



**Figure 6.21** Differences between the total raining between 2015 and 2099 and the reference term between 1971 and 2000 according to RCP8.5 scenario results

### 6.1.3.9 Climate Indexes

17 climate indexes expressing the expectations for the frequency of the extreme events in Turkey are estimated in the scope of the project “The Effect of Climate Change on Water Resources Project”, which was started by the Ministry of Forestry and Water Affairs in 2013 (Table 6.4)

Index -ID	Index Name	Description	Unit
FD0	Days of frost	Days on which the minimum temperature is lower than 0°C.	Day
SU25	Summer days	Days on which the maximum temperature is higher than 25°C.	Day
TN10p	Cool Cold Nights	Tminimum < days of which the normal is 10%	Day
TX10p	Cool Cold Days	Tmaximum < days of which the normal is 10%	Day
TN90p	Hot nights	Tminimum > days of which the normal is 90%	Day
TX90p	Hot days	Tmaximum > days of which the normal is 90%	Day
TX35	Tropical days	Number of days on which the maximum temperature is higher than 35°C	Day
WSDI	Hot wave	Tmaximum > number of at least 6 consecutive days of which the normal is %90	Day
CSDI	Cold wave	Tminimum < number of at least 6 consecutive days of which the normal is %10	Day
DTR	Daily temperature width	Difference of the daily maximum and minimum temperatures	°C
Rx5days	Maximum raining for 5 days	Maximum raining amount for 5 consecutive days	mm
RX1day	1 day RX5 maximum raining	Daily maximum raining amount	mm
R10	Number of days of heavy rain	Days on which the raining is 10 mm high	Day
R20	Number of days of very heavy rain	Days on which the raining is higher than 20 mm	Day
R25	Number of days of very heavy rain	Days on which the raining is higher than 25 mm	Day
CDD	Number of consecutive dry days	Number of consecutive days on which the raining is less than 1 mm	Day
CWD	Number of consecutive wet days	Number of consecutive days on which the raining is higher than 1 mm	Day

**Table 6.4** Climate indexes used in “The Effect of Climate Change on Water Resources Project”

### 6.1.3.10 HadGEM-ES Model Climate Index Results

#### RCP4.5 FD0 Index of Days of Frost

##### 2015-2040 term:

- The north parts of East and Middle Anatolia regions show that there will be 120 days of frost in a year.
- It can be said that the number of days, in which the temperature will be lower than 0°C, will be between 10 and 30 in the sea fronts of Aegean, Black Sea, and Mediterranean regions.
- It is expected that the number of days of frost will decrease to 90s in Middle Anatolia.

##### 2041-2070 term:

- It is seen that some of the regions in which the highest decrease in the number of days of frost can be Middle Anatolia and East Anatolia regions.
- It is expected that it is going to change between 60 and 90 days in Middle Anatolia
- and it is expected that it is going to be between 100 and 120 days in East Anatolia Region.
- It is expected that there will not be any major changes in the number of days of frost in the sea fronts of Turkey.

##### 2071-2099 term:

- Whereas serious decreases in the number of days in which the temperature is below 0°C, such as 40 days, are seen in this term,
- This decrease is going to be felt maximum in the mountain regions in East Anatolia Region.
- It can be concluded that the decrease in the number of days of frost will spread from the sea fronts to the inner parts.
- It is expected that there will be 30 day decreases in the number of days of frost in the Middle Anatolia Region (Figure 6.22).

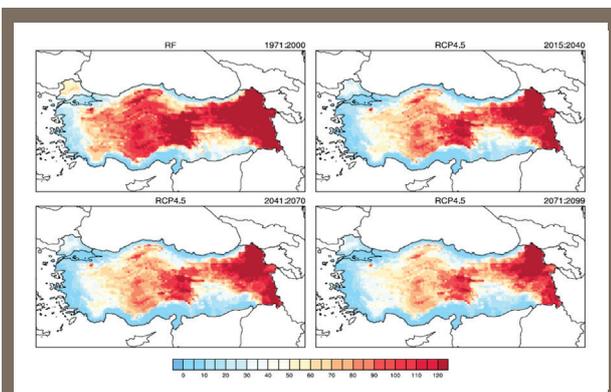


Figure 6.22 RF and RCP4.5 30 year number of days of frost according to FD0 climate index

#### RCP8.5 FD0 Index of Days of Frost

##### 2015-2040 term:

- It can be said that the decrease in the days of frost will be felt the most in the eastern parts of Turkey.
- The number of days of frost of Middle Anatolia Region, which has a high number of days of frost, is decreasing approximately by 10-20 days.
- The average number of days of frost is expected to be 100 in East Anatolia Region, 80 in Middle Anatolia Region, and 10-20 in Marmara, Aegean, and sea front regions.

##### 2041-2070 term:

- The little differences in the days of frost in the sea fronts are spreading towards the inner parts.
- It is expected that the number of days of frost will change between 70 and 80 in Middle Anatolia Region.
- It is expected that it is going to be between 90 and 110 days in East Anatolia Region.

##### 2071-2099 term:

- Whereas much higher decreases in the number of days in which the temperature is below 0°C in minimum temperatures are seen in this term,
- it is expected that this decrease will be felt the most in Middle Anatolia Region
- and the decreases will be about 60 days in this region.
- Whereas it is seen that there will be decreases in Thracia Region, it is observed that the number of days of frost will be about 10.
- And it is expected that the situation will be critical in the eastern part of Turkey and the number of days of frost will change between 80-100 days as the result of these changes in the minimum temperatures (Figure 6.23).

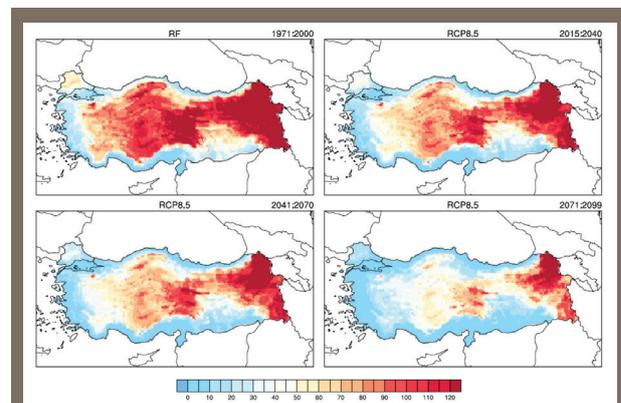


Figure 6.23 RF and RCP8.5 30 year number of days of frost according to FD0 climate index

## RCP4.5 TX35 Tropical Days Index

### 2015-2040 term:

- Whereas it changes between 40 and 65 days in the sea fronts of Aegean and Mediterranean regions,
- It is observed that the number of days in which the temperature will be higher than 35°C will change between 50 and 100 in South East Anatolia Region.

### 2041-2070 term:

- The number of days in which the temperature will be higher than 35°C will change between 60 and 100 in South East Anatolia Region.
- It is expected that the maximum temperature will be higher than 35°C in Aegean and Mediterranean Regions for 60-80 days on average.

### 2071-2099 term:

- Whereas the number of summer days changes between 10-30 days in Aegean and Mediterranean regions,
- It is expected by the model that it will change between 70 and 100 days in South East Anatolia Region (Figure 6.24).

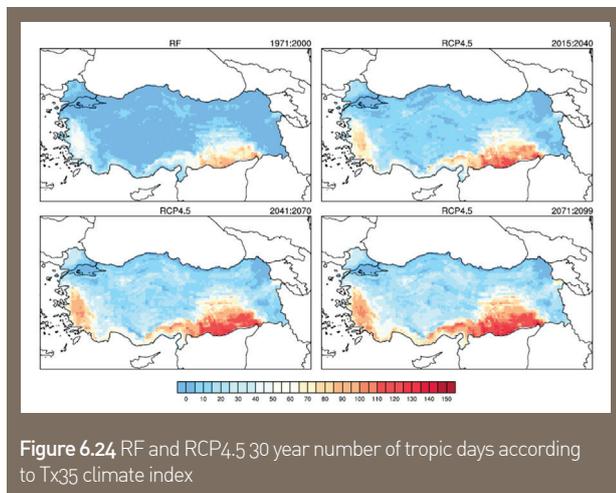


Figure 6.24 RF and RCP4.5 30 year number of tropic days according to Tx35 climate index

## RCP8.5 TX35 Tropical Days Index

### 2015-2040 term:

- Whereas it changes between 55 and 100 in South East Anatolia Region,
- the index values are higher in Aegean Region compared to the previous scenario.

### 2041-2070 term:

- Serious increases are seen in South East Anatolia Region in this term. Differences between 100-130 days are expected.
- It is expected that the number of summer days will be between 70-100 days in Aegean and Mediterranean Regions among the regions whose number of summer days will increase.

### 2071-2099 term:

- This index changes between 75-100 days in the sea fronts

of Aegean and Mediterranean regions. It changes between 5-45 days in the other regions.

- It is expected that there will be results up to 150 days in the south parts of South East Anatolia Region (Figure 6.25).

## RCP4.5 R25 Index of Extreme Rainy Days

### 2015-2040 term:

- It is seen that the number of the extreme heavy rainy days changes between 0-4 in Middle Anatolia Region, Marmara Region, East Anatolia Region, and South East Anatolia Region.
- The number of days in which more than 25 mm raining is expected is up to 30 in East Black Sea and West Mediterranean Regions.

### 2041-2070 term:

- Whereas it is expected that there will not be major differences compared to the previous term,
- It can be said that there will be more than 30 days in which East Black Sea Region will be subjected to extreme raining.

### 2071-2099 term:

- It is expected that there will be 10 day increases in the number of very heavy rainy days, especially in East Black Sea Region (Figure 6.26).

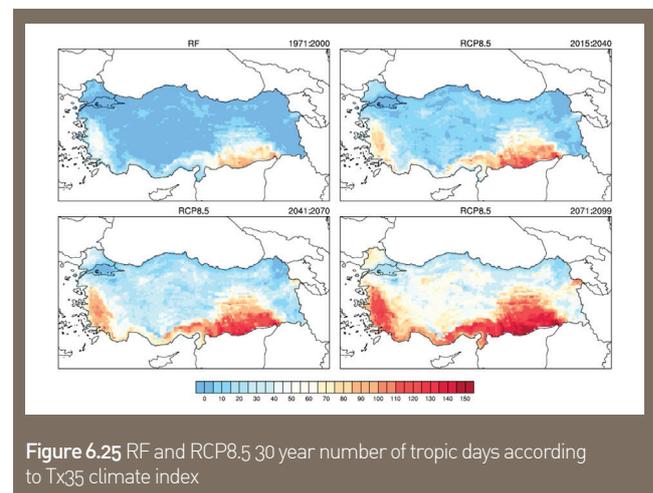


Figure 6.25 RF and RCP8.5 30 year number of tropic days according to Tx35 climate index

## RCP8.5 R25 Index of Extreme Rainy Days

### 2015-2040 term:

- It is seen that the number of the extreme heavy rainy days changes between 0-4 in East Anatolia Region and South East Anatolia Region.
- 1-2 day decreases are expected in the extreme raining in Thracia.

### 2041-2070 term:

- It is expected that Black Sea Region, which is the region in which the increase in the very heavy rainy days is the most, will be subjected to extreme raining for 20-30 days.

**2071-2099 term:**

- Whereas 1-2 day decreases are seen in Marmara Region,
- It is observed that there will not be major changes in the other regions except for East Black Sea and West Mediterranean (Figure 6.27).

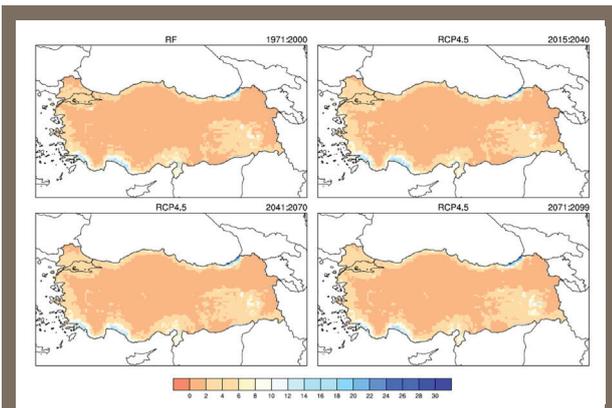


Figure 6.26 RF and RCP4.5 30 year number of extreme rainy days according to R25 climate index

**RCP4.5 CDD Consecutive Dry Day Numbers Index****2015-2040 term:**

- It is seen that the number of consecutive dry days are spread to a wider region and their duration is longer in South East Anatolia Region in this term.
- In this term, in which the drought is gradually increasing and getting intense, it is seen that the values increase up to 150 days. The possibility that there will not be any rain during the summer season for 4 months is considerably increasing.
- Whereas the number of consecutive dry days show an increase in Aegean, Middle Anatolia, and Mediterranean Regions, the values change between 100 and 130 days in these regions.

**2041-2070 term:**

- The increase in the number of consecutive dry days is spreading towards Middle Black Sea.
- The number of consecutive dry days gradually increases in GAP region.
- It is expected that there will be droughts also in the rainy regions of Black Sea Region gradually.

**2071-2099 term:**

- Whereas it is seen that the number of consecutive dry days increase up to 180s in South East Region in this term,
- It is about 110 days in the south regions and these values are around 50 in Black Sea Region (Figure 6.28).

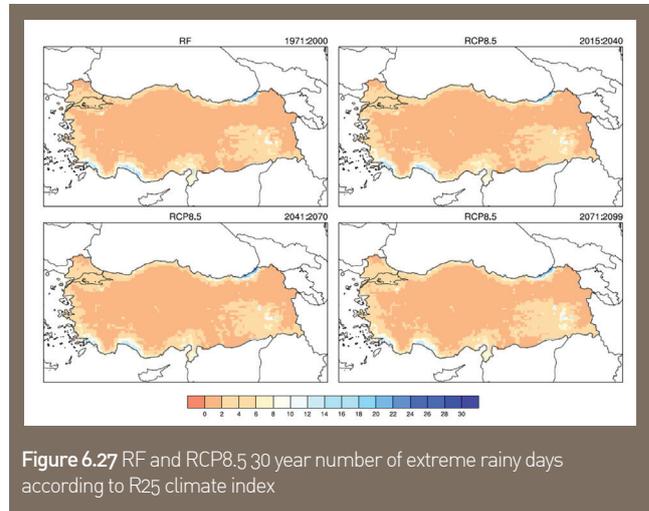


Figure 6.27 RF and RCP8.5 30 year number of extreme rainy days according to R25 climate index

**RCP8.5 CDD Consecutive Dry Day Numbers Index****2015-2040 term:**

- It is seen that the number of consecutive dry days will gradually increase and spread to a larger region, especially in South East Anatolia Region and its surroundings.

**2041-2070 term:**

- The increase in the number of consecutive dry days changes between 100-150 days especially in the south of Turkey.
- Especially because of the fact that there will be 30-40 day increases in Middle Anatolia Region, it can be supposed that there will be serious droughts in the region.

**2071-2099 term:**

- In South East Anatolia Region, especially in GAP area, the formation of the convective rains because of the increase in the average temperature and the amount of the water vapor in the atmosphere shortens the rainless days in this regions by about 10 days.

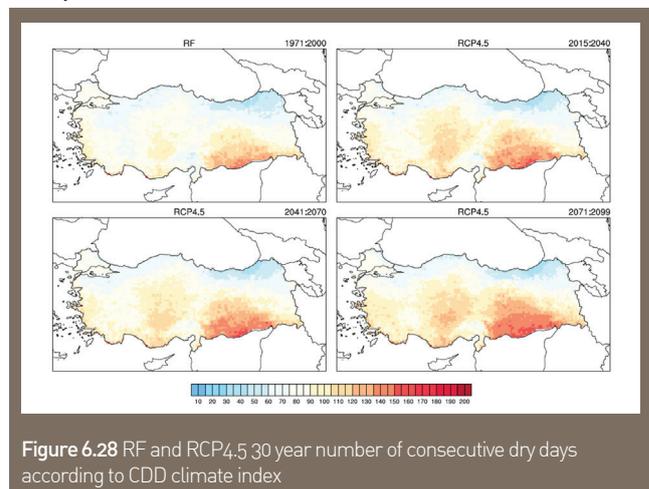


Figure 6.28 RF and RCP4.5 30 year number of consecutive dry days according to CDD climate index

- It can be thought that the increase in the number of consecutive dry days and the serious droughts that occur in these regions will considerably affect the region socio-economically (Figure 6.29).

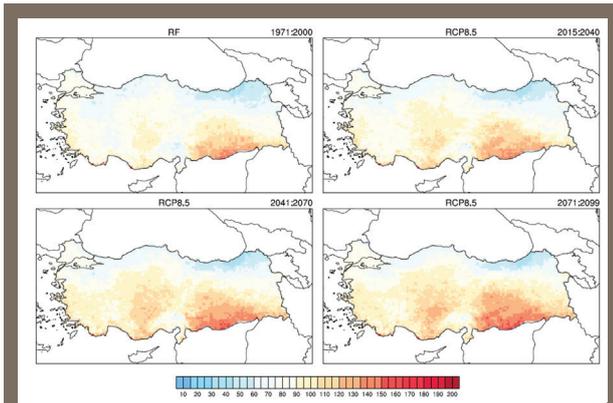


Figure 6.29 RF and RCP8.5 30 year number of consecutive dry days according to CDD climate index

### 6.1.3.11 MPI-ESM-MR Model Climate Index Results

#### RCP4.5 FD0 Index of Days of Frost

##### 2015-2040 term:

- The east parts of East and Middle Anatolia regions show that there will be 120 days of frost in a year.
- It is observed that the number of days of frost will be about 70-90 days in Middle Anatolia in this term.
- The decrease in the number of days of frost every 30 years widens from the sea fronts to the inner regions.

##### 2041-2070 term:

- In this term there is a decrease in the number of days of frost only in Middle Anatolia.
- In this region, the number of days of frost decrease to 90 days.

##### 2071-2099 term:

- In this term, the number of regions in which there are high numbers of days of frost decrease.
- Whereas there are 120 days of frost in a narrower area in East Anatolia Region,
- The decrease in the Middle Anatolia Region decreases back to 70 days (Figure 6.30).

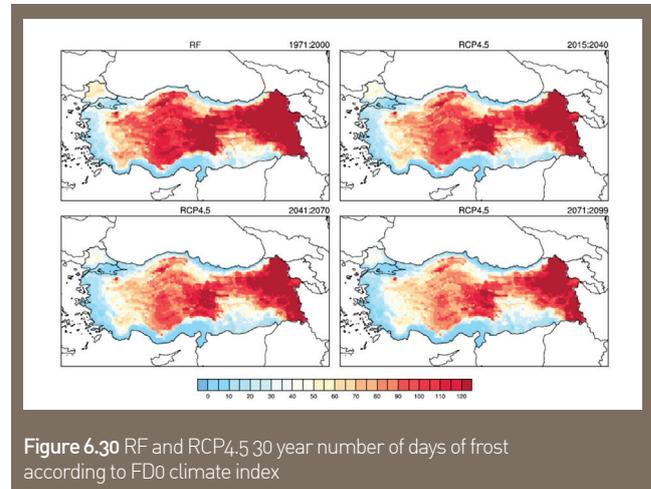


Figure 6.30 RF and RCP4.5 30 year number of days of frost according to FD0 climate index

#### RCP8.5 FD0 Index of Days of Frost

##### 2015-2040 term:

- Whereas it is expected that there will be about 120-130 days of frost in East Anatolia and Middle Anatolia,
- It can be said that there will not be major changes in Marmara and Thracia.
- In Middle Anatolia Region, a decrease in the days of frost is expected in the north-south direction.

##### 2041-2070 term:

- It can be concluded that the difference of the decrease in the days of frost will be felt the most in Middle Anatolia Region and
- There will be 60-90 days of frost in this Region on average.

##### 2071-2099 term:

- It shows that only a 50-80 day change interval can be valid in 2070-2100 term in Middle Anatolia region.
- It is expected that the sudden decreases in the number of days of frost will affect the east part of Turkey the most and there will be about 40-50 day decreases in these regions (Figure 6.31).

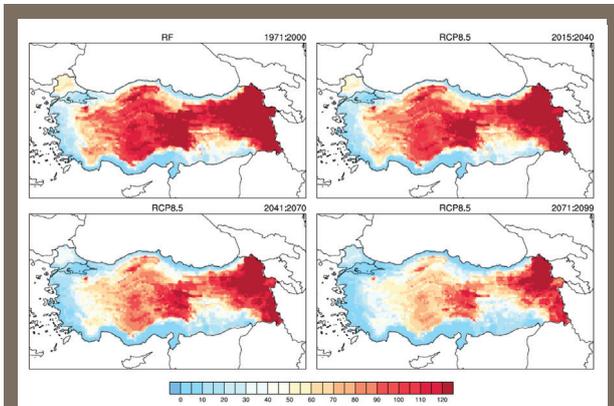


Figure 6.31 RF and RCP8.5 30 year number of days of frost according to FDO climate index

### RCP4.5 TX35 Summer Days Index

#### 2015-2040 term:

- The highest increase in the number of days in which the maximum temperature is higher than 35°C can be in South East Anatolia Region.
- It is possible to say that there will be between 90 and 110 summer days.
- 10-20 day increases are expected along Mediterranean sea fronts.

#### 2041-2070 term:

- Increases in the GAP region continue in this period.
- It is expected that it will be between 60 and 90 days in Aegean and Mediterranean Regions.

#### 2071-2099 term:

- It is expected that there will be 20-30 day increases in the number of days in which the maximum temperature is higher than 35°C in the south parts of Turkey.
- It is expected that there will be 60-80 days in which the maximum temperature will be higher than 35°C in the sea fronts of Aegean and Mediterranean Regions (Figure 6.32).

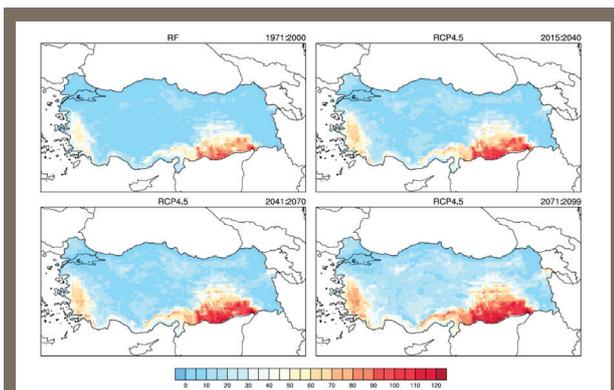


Figure 6.32 RF and RCP4.5 30 year number of summer days according to Tx35 climate index

### RCP8.5 TX35 Summer Days Index

#### 2015-2040 term:

- In this period, there are similar result to those of RCP4.5 and there are 10-20 day increases in Aegean Region and Mediterranean Region compared to the reference term.
- It is expected that these temperature increases will increase their effect from South East Anatolia Region towards the inner parts.

#### 2041-2070 term:

- Whereas it is seen that the maximum temperatures of the sea fronts with the Mediterranean climate will increase,
- The increase in the maximum temperatures are starting to affect the inner parts too. It is expected that there will be 5-10 day increases in the inner parts of Aegean Region.

#### 2071-2099 term:

- It can be said that the region in which the maximum temperature will show the maximum increase is South East Anatolia Region. There are 40-50 day increases in this region compared to the reference term.
- Whereas the maximum temperatures will be higher than 35°C in about 150 days of the year in GAP region,
- this situation changes between 100 and 130 days in Aegean Region.
- It is also expected by the model that there will be serious 40-50 day differences along the sea front along Mediterranean and Taurus (Figure 6.33).

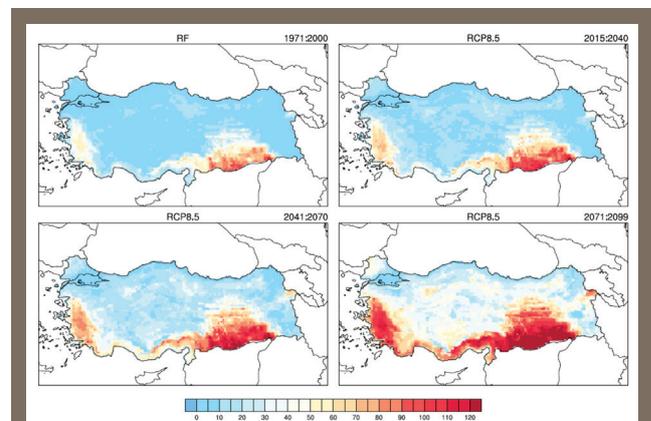


Figure 6.33 RF and RCP8.5 30 year number of summer days according to Tx35 climate index

## RCP4.5 R25 Index of Extreme Rainy Days

### 2015-2040 term:

- It is obviously seen that the number of extremely heavy rains decrease to 0-2 days.
- It is seen that the number of the extreme heavy rainy days changes between 0-4 in Middle Anatolia Region, Marmara Region, East Anatolia Region (except for GAP Region), and South East Anatolia Region.

### 2041-2070 term:

- In GAP Region, there are values up to 12 days. The number of the days in which there will be more than 25 mm raining is expected as 22 days in East Black Sea Region.

### 2071-2099 term:

- Increase is observed in the number of rainy days in South Aegean Region.
- It is expected that the number of extreme rainy days will be higher than 20 in Black Sea Region, especially in East Black Sea front (Figure 6.34).

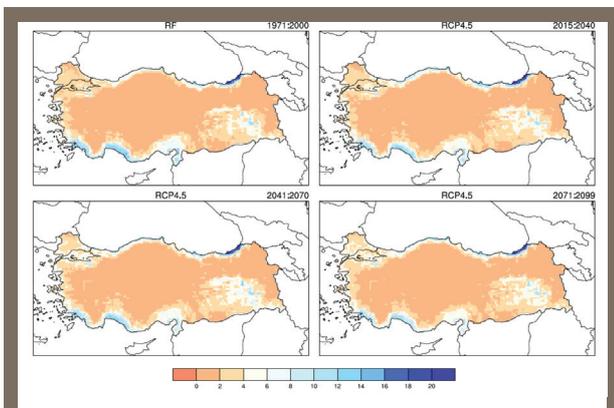


Figure 6.34 RF and RCP4.5 30 year number of extreme rainy days according to R25 climate index

## RCP8.5 R25 Index of Extreme Rainy Days

### 2015-2040 term:

- In this term, there are results parallel to those of RCP4.5.
- The number of extreme rainy days in Black Sea Region and Mediterranean Region changes between 1-2 days.

### 2041-2070 term:

- The number of the days in which there will be more than 25 mm raining is expected as 22 days in East Black Sea Region.
- It can also be concluded that there will be extreme rain in the high regions of East Anatolia Region for 8-10 days.

### 2071-2099 term:

- It is seen that the results in this term resemble those in the previous term and
- the possibility distribution of the raining is broadened in Aegean Region and GAP Region and it is narrowed about Antalya gulf (Figure 6.35).

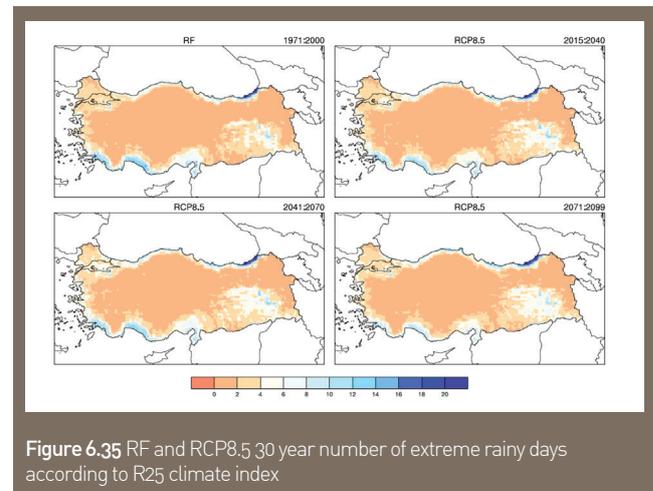


Figure 6.35 RF and RCP8.5 30 year number of extreme rainy days according to R25 climate index

## RCP4.5 CDD Consecutive Dry Day Numbers Index

### 2015-2040 term:

- The region in which the drought will be felt the most is South East Anatolia Region.
- In this term, it is seen that the droughts are up to 150 days.
- The possibility that there will not be any rain during the summer season for 4 months is considerably increasing in this case.

- Whereas the number of consecutive dry days show an increase in Aegean, Middle Anatolia, and Mediterranean Regions, the values change between 100 and 120 days in these regions.

- It changes between 20-50 days in Thracia, Marmara, and Black Sea regions.

### 2041-2070 term:

- The drought results of Middle Anatolia and Aegean Region gradually increase in this 30 year period.

### 2071-2099 term:

- Whereas it is expected that 170-180 days will be dry in South East Anatolia Region,
- it is determined that this situation will be around 100-120 days in Mediterranean Region.
- In Black Sea Region, these values are around 50-60 (Figure 6.36).

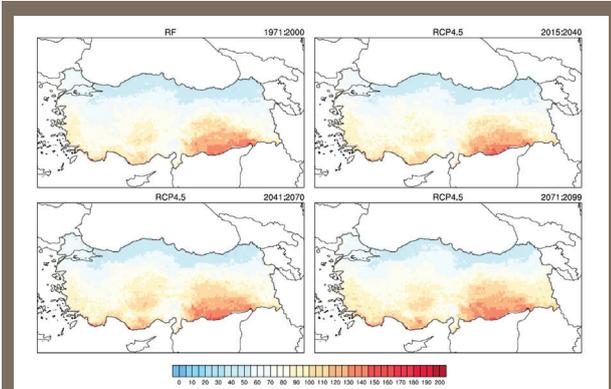


Figure 6.36 RF and RCP4.5 30 year number of consecutive dry days according to CDD climate index

### RCP8.5 CDD Consecutive Dry Day Numbers Index

#### 2015-2040 term:

- It is expected that there will be serious increases in the number of consecutive dry days in the south of Turkey.
- Whereas it changes around 120 days in South East Anatolia Region, it changes around 100 days in the other regions.

#### 2041-2070 term:

- The increases in the number of dry days in South East Anatolia Region, Aegean and Mediterranean Region will show their effects also towards the inner parts.

#### 2071-2099 term:

- In this term it is seen that the number of consecutive dry days increase also in Middle Black Sea Region and Middle Anatolia Region.
- It is expected that there will be 20-30 day increases in almost everywhere except for Black Sea Region (Figure 6.37).

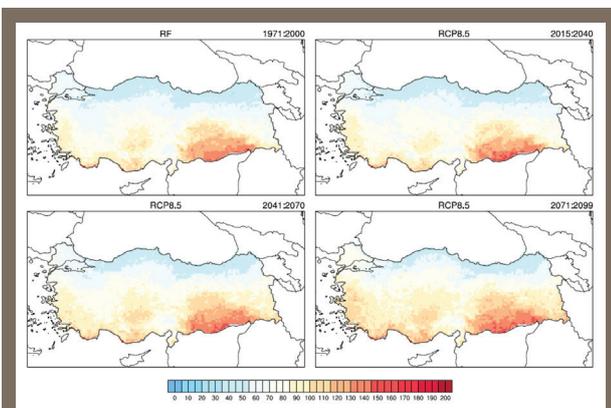
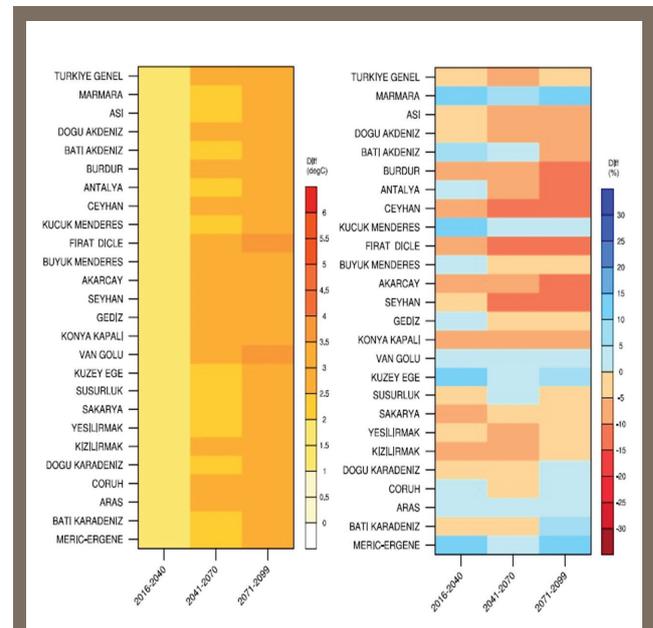


Figure 6.37 RF and RCP8.5 30 year number of consecutive dry days according to CDD climate index

### 6.1.3.12 Projections for River Basins

Temperature (Figure 6.38, left) and raining (Figure 6.38, right) differences in river basins are given according to SMS's RCP4.5 projection. The study includes 2013-2040, 2041-2070, and 2071-2099 periods for all seasons according to 1971-2000 reference period. In the products obtained with RCP4.5 in the climate projections prepared by SMS, the average temperatures in the river basins in Turkey continue to show an increasing trend until 2099. The highest increase is expected in Dicle and Van Lake river basins with 3.5-4.0°C in 2071-2099 term.

Decrease in raining is projected in 2013-2099 term in Turkey in general. Increase is projected in Marmara, Küçük Menderes, Van Lake, North Aegean, Aras, and Meriç-Ergene river basins. Besides this, whereas increase is expected in 2013-2040 term in some river basins, decrease is projected in the other terms (Figure 6.38).

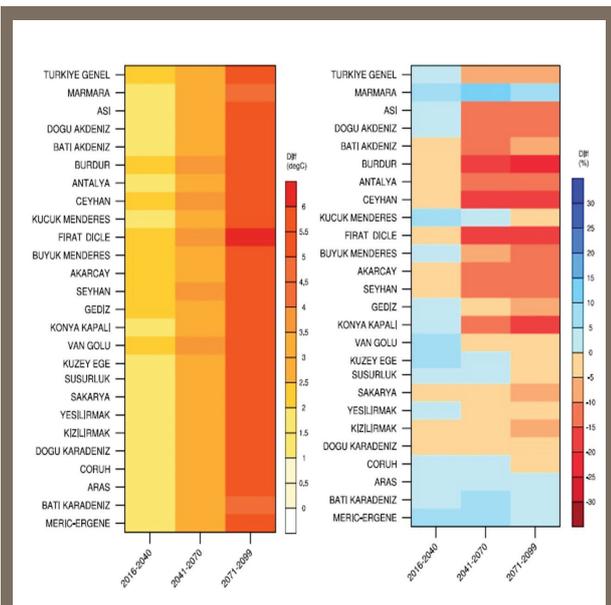


Source: SMS\_c, 2014

Figure 6.38 SMS's river basin based temperature (on the left) and raining (on the right) projections according to RCP4.5

Temperature (Figure 6.39, left) and raining (Figure 6.39, right) differences in river basins are given according to RCP8.5 scenario. The study includes 2013-2040, 2041-2070, and 2071-2099 periods for all seasons according to 1971-2000 period. An increasing trend is projected in average temperatures in all river basins according to the river basin based temperature and raining projections according to RCP8.5 of SMS. The highest

increase in the temperatures is expected in Dicle river basin in 2071-2099 term. Increase is projected in the first term in the raining averages in Turkey in general and decreases are projected in the 2. and 3. terms. Besides this, increases are projected in Marmara, Aras, and Meriç-Ergene river basins in all terms. In Burdur, Ceyhan, and Dicle river basins, decreases are projected in all terms.



Source: SMS\_c, 2014  
**Figure 6.39** SMS's river basin based temperature (on the left) and raining (on the right) projections according to RCP8.5

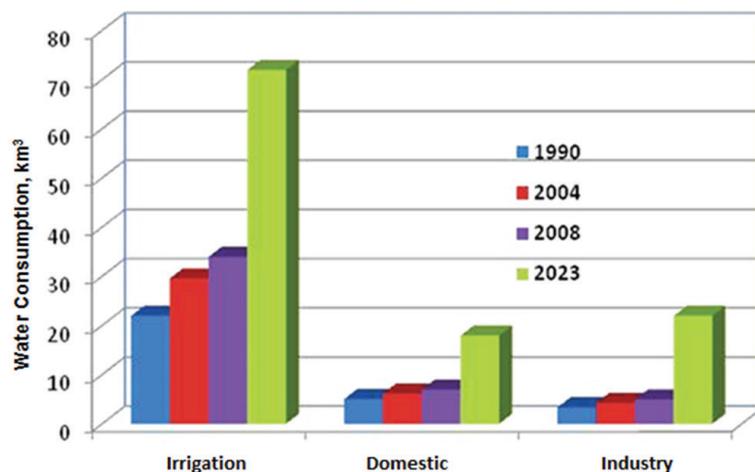
## 6.2. Expected Impacts, Vulnerability and Adaptation Measures

### 6.2.1 Water Resources

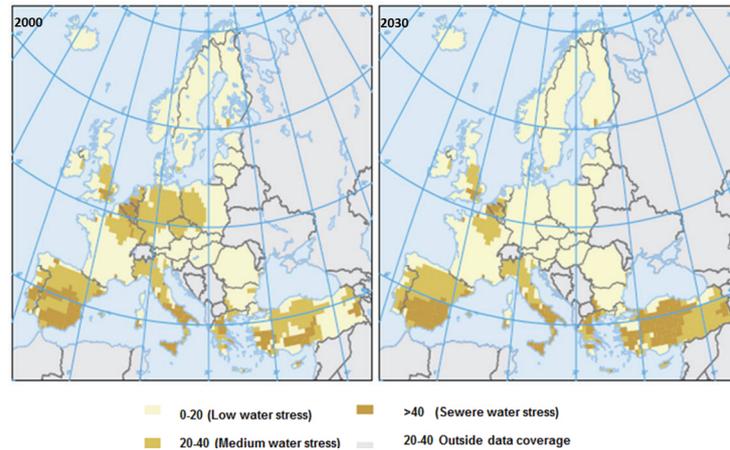
#### 6.2.1.1 Expected Impact and Vulnerability

The present sustainable and usable water potential of Turkey is 112 billion m<sup>3</sup> and 98 billion m<sup>3</sup> of this is surface water and 14 billion m<sup>3</sup> of this is underground water (SHW 2014). It is expected that the total water consumption will increase three times from 2004 until 2030 (Silkin, 2014).

According to the results of Municipal Water Statistics Survey conducted by TurkStat, 982 million m<sup>3</sup> (30.28%) of 3.2 billion m<sup>3</sup> water that was drawn by municipalities was treated in 1994 and 2.7 billion m<sup>3</sup> (55%) of 4.9 billion m<sup>3</sup> drinking and tap water was treated in 2012. The distribution of water usage according to the sectors in Turkey is given in Figure 6.40 (TÇDR, 2011). In this case, the total amount of water that is expected to be used in 2023 is close to the amount of water that can be used sustainably (yearly) from the resources.



**Figure 6.40** Distribution of water usage projection according to the sectors in Turkey



Source: European Environment Agency

Figure 6.41 Water stress levels in Turkey and EU countries

### 6.2.1.2 Adaptation Measures

Studies about saving water and reusing used water in the framework of sustainable development in industrial investments towards reducing water stress (clean production applications in industry) and applications about losses and leakages in mains (precautions towards water leakages in mains and studies about saving irrigation water) are done. Water basin based approaches are being developed, water basin protection action plans in which the controlled usage principles are determined are prepared to maintain the effectivity in water management and the follow-up of the applications is ensured. River basin protection action plans are completed in 25 river basins in Turkey in general. Besides, 30 agricultural river basins are determined with the Council of Ministers Decision with the number 2009/15173 and date 29/06/2009 with the purpose of maintaining sustainable agricultural production and increasing productivity by taking the climate conditions, earth structures, topographical properties and manageability sizes of the regions into consideration.

The subjects considered to be important among the studies done about water resources management, climate change, effects, affectability, and the sustainable rational usage of resources are summarized below.

#### Increasing the Storage Capacity

It is aimed by SHW to decrease the indefiniteness in the amount of water resources that can be faced in climate change and drought conditions in a balanced fashion by increasing the capacities of the sites with storage areas. Potential water holding capacity is increased, water shortage is prevented, and controlled usage of water is maintained by building dams and ponds for meeting the needs for drinking and tap water and for industrial and irrigation purposes. Since the end of 2014, 960 storage sites (308 dams, 652 ponds) are built and investments are being made.

#### LAKE-WATER Project

In the scope of 1,000 Lakes in 1,000 Days Project (Lake-Water Project), it is aimed to transform to water agriculture in rural areas out of big irrigation projects and to reduce the effect of drought in agricultural irrigation. The project studies, which started in 2012, are completed in 2014. With the project, new job opportunities are developed and contributions to subjects such as preventing the damage of overflows and earth erosions, protecting underground water, and reducing the negative effects of climate change.

### Basin Protection Action Plans

According to Water Framework Directive, water management is based on managing water sustainably in the framework of the usage purpose of water in terms of its amount and properties by using integrated water basin management principles. Integrated river basin management suggests forming a management plan that will include all the components including considering all biological, chemical, physical, hydro morphological, and hydrogeological properties of river basins as a whole and including all the river basin or the sub-basins.

In this scope, preparation of river basin protection action plans that is carried out by TUBITAK MRC with the coordination of Ministry of Forestry and Water Affairs is done in two steps, action plans for 25 hydrological river basins in the geography of our country, and the water quality in river basins, polluting sources, protected areas, and drinking water resources are put in a priority order (2009-2014).

### Transforming Basin Protection Action Plans to River Basin Management Plans

The purpose of River Basin Management plans that are being prepared as a requirement of Water Frame Directive, which is very important in European Union nomination process, is to carry out the study of transforming Basin Protection Action Plans to River Basin Management Plans and to develop the national capacity in this process. With Basin management plans, the classification and categorization of air based water masses, hydro morphological pressures will be determined with ecological evaluations and biological parameters and the following method of all of these parameters will be put clearly, which cannot be done in Basin Protection Action Plans in accordance with Water Frame Directive. The project is started on 29 December 2014 and is being carried out in Meriç-Ergene, Konya Closed, Büyük Menderes, and Susurluk Basins.

### Studies of Protecting Drinking Water Basins

Firat-Dicle river basin with the property of boundary-crossing waters, where Atatürk Dam Lake is placed, has approximately 28.5% of the total country area. Evaluation of the basins and sub-basins as a whole, forms the base of the process of forming and applying Basin Management Plans, which include the requirements of Water Framework Directive. All of the projects are completed between 2009 and 2014. Projects that are carried out for the purpose of protecting drinking water river basins and determining the special decisions.

- Basin Protection Plan and Special Decision Determining Project for Eğirdir Lake, which is Used as a Drinking and Tap Water Source,
- Basin Protection Plan and Special Decision Determining Project for Atatürk Dam Lake, which is Used as a Drinking and Tap Water Source,
- Karacaören I and II Dam Lake and Beyşehir Lake Basin Protection Plan and Special Decision Determining Projects
- Gördes Dam Lake Basin Protection Plan and Special Decision Determining Project

### Saving Water in Irrigation

"Improvement" studies (transforming to closed-pipe system depending on the technical and topographical conditions) are being carried out on the present irrigation networks with the purpose of preventing losses during transmission. The irrigation efficiency, which is 60% in surface irrigation, reaches 80% in raining irrigation and 95% in drip irrigation. Whereas the pipe system ratio was 6% in the irrigation systems made by DSI in 2003, it has reached 17% today. 71% of the irrigation networks, whose building is going on, is built as pipe systems by taking also the land conditions into consideration. 88% of the irrigation projects that are planned to be subject to auction until 2015 will be built with the pipe system. "Effective Use of Water in Agriculture Program" in the 10th 5-Year Development Plan including 2014-2018 term is going on. Detailed information about this program is under 6.2.2.2 topic.

### Drought Management Studies

Projects of preparing drought management plans are started in Konya and Akarçay Basins for the purposes of reducing the negative effects that will be faced in the case of possible drought risks, determining the precautions to be taken in water shortage, and determining the precautions to be taken before, during, and after drought in order to solve drought problems in the shortest time possible and it is aimed to prepare drought management plans in all of the river basins of our country until 2023.

### Drinking, Domestic, and Industrial Water Supply

The ones with urgent drinking water need having a priority, Drinking, Domestic, and Industrial Water Supply Action Plan (2008-2012) of 81 cities is prepared and then revised to include 2010-2014 years for the purpose of meeting the drinking, using, and industrial water needs of city centers. Besides, "Drinking, Domestic, and Industrial Water Supply Action Plan of Big Districts with Population Higher than 50000 (2010-2014)" is also prepared.

According to the action plan, it is found that the amount of obtained water will be enough for 36 of 81 city centers for long term (2024-2040) and for 26 of them for middle term (2016-2023). It is found that there will be water shortage in 10 city centers in a short term (2013-2015) and studies about these are going on. It is found that there will be urgent water shortage in 9 city centers (2010-2012) and studies about these are completed on a large scale. According to the action plan, which is prepared for big district centers with a population higher than 50000, it is found that the amount of obtained water will be enough for 35 of 66 city centers for long term (2024-2040) and for 14 of them for middle term (2016-2023). It is foreseen that there will be water shortage in 14 district centers in a short term (2013-2015).

41 million m<sup>3</sup>/year extra drinking water for 260 thousand people was provided from construction works included in Lodgement Program of 2014. Thus, 3.53 billion m<sup>3</sup>/year more for drinking water, tap water and industrial water in accordance with the quality standards was supplied for 38 million people with 77 plants completed by General Directorate of SHW until now. Besides, 3.31 billion m<sup>3</sup>/year more drinking water will be supplied by SHW, when other plants under construction, planning and project stage are completed. Hence, the amount of supplied drinking, tap and industrial water will reach 6.84 m<sup>3</sup>/year together with plants in operation.

### Studies for Protection from Overflow

Studies directed towards preventing overflows and reducing their damages can be separated into two categories as;

- Studies with projects including structural precautions,
- Studies that do not include structural precautions,

7,022 sites, which consist of sites built in the upper river basin (precipitation dikes, improvement terraces etc.) together with sites built downstream (levee, stone fortification, channel etc.) and 68 dams, which are aimed to protect from overflow, are built today to protect settlement places and agricultural lands from overflows with the purpose of improving rivers with risk of overflow by using integrated river basin approach. With 7,090 sites, 1,804,328 ha area is protected from overflows in total. Throughout The Turkey 7022 plants, 13567780 hectares of agricultural areas and 6682 settlements were protected from overflow.

SHW Overflow Action Plan (2014-2018) is prepared by SHW General Management in accordance with the present methods and rules in order to prevent and reduce damages be-

fore overflow and to make sure that the relevant units do the necessary interventions during the overflow and the necessary improvement activities in time and effectively after the overflow.

“Kızılırmak Basin Hydraulic and Hydrological Overflow Modeling Project”, which was started by DSI in 2013 with the purpose of building a hydrological and hydraulic overflow prediction system and forming a numerical physical-based atmosphere prediction model and a physical-based water river basin hydrology model, is completed in April 2015.

Capacity Improving for Applying Overflow Directive in Turkey Project, which makes the first step of forming “Overflow Risk Management Plans” on the basis of river basins, is applied between 2012 and 2014. The purpose of the project is to improve the capacity for the application of Overflow Directive and to reduce the negative effects of overflows on human health, environment, cultural inheritance and economic activities. In the scope of the project, Overflow Risk Pre-Evaluation is made in West Black Sea River Basin and after that, overflow danger and overflow risk maps and Overflow Risk Management Plan draft are prepared in two selected pilot areas. Besides, in the scope of the project, National Application Plan draft and Guides for Applying Overflow Directive are prepared to be able to apply Overflow Directive in all of the river basins in our country.

Projects of preparing overflow management plans are started in Yeşilirmak and Antalya River Basins by evaluating the overflows in our country on the basis of river basins for the purpose of evaluating not only a part of a river, but also all of the river basin as a whole.

In the overflow management plans that will be prepared for Yeşilirmak and Antalya River Basins, overflows will be evaluated on the basis of river basins, planning and directing of the necessary improvement and intervention actions that need to be taken before, during, and after the overflow will be ensured, and it will be possible to use the resources rationally. It is aimed that Overflow Management Plans of all of the 25 river basins of our country will be prepared until 2023.

### Distribution of water among sectors

Sectoral water distribution planning studies on the basis of river basins, which aim the fair and balanced sharing of water between stakeholders who use it in their various production and consumption processes are started.

In this scope, the allocations to be done to the sectors will be determined according to the present and future water poten-

tial by taking saving-using principle into consideration; besides, alternative solutions will be developed by determining the future situation of water potential against possible dry and restricted terms that can be faced as a result of climate effects. "Seyhan Basin Sectoral Water Allocation Plan Preparation Project" in Ministry of Forestry and Water, Affairs GDWM have started in 2015 and will be finished in the last quarter of 2016.

### Determination of Special Provision Studies

Protection studies are done on nine drinking water river basins up to this day in Ministry of Forestry and Water Affairs, GDWM. Atatürk Dam Lake Special Provisions and Porsuk Dam Lake Special Provisions came into effect in 2013. Determination of Special Provision Project for Beyşehir Lake, Karacaören I-II Dam Lake, and Gördes Dam Lake are completed in 2014 and are in the approval step. Mamasın Dam Lake Basin Protection Plan and Determination of Special Provision Project have started in 2014 and they will be completed in 2016.

### Erosion and Sediment Control Studies

For the purposes of maintaining the sustainability of earth and water resources; studies about overflow and sediment control are being carried out in order to prevent the damages done by the sediment that is carried downstream from the upper river basins with erosion to the downstream sites of SHW, dams and ponds and the sites of the other public institutes. In this scope, investigations are done on 94 dams and 110 ponds and sediment storage sites are built on 37 dams and 30 ponds of those in order to solve the sediment problem in various storages.

In addition, since 2003 afforestation and erosion control activities were started by SHW in catchment basins of dams and ponds. As a result of these activities by the end of 2013, 41,500,000 saplings were planting in 30,000 hectares area include 29 dam basins and 15 pond basins.

### Projects that are Carried out about the Application of Nitrate Directive and Regulation in Turkey

Nitrate Directive (No.91/676/EEC), which is formed for protecting waters from nitrate pollution from agricultural sources, has come into effect in EU member countries in 1991. "Regulation for Protecting Waters from Nitrate Pollution from Agricultural Sources", which is prepared with the purpose of transmitting the requirements of Nitrate Directive in our country, has come into effect in 2004.

### Application of Nitrate Directive in Turkey Project (IPA Project)

Nitrate Directive Application Project has been accepted by Financial Cooperation before Participation (IPA) in 2007. Technical Help Project, which was done in order to reduce the pollution coming from agricultural sources towards adapting and applying Nitrate Directive in Turkey, was completed in 2012. The basic purpose is to investigate the pollution with agricultural source.

According to Nitrate Directive, the determination of Nitrate Sensitive Areas (NHB) is based on the eutrophic situation of nitrate concentrations and surface waters. In the scope of Technical Help Project, it is aimed to determine the eutrophication situation in the surface waters together with NHBs. According to the evaluations that are made, it is found that the risk of eutrophication is low in 12 of the present 25 river basins for both the rivers and the lakes; the rivers carry a medium level risk in 9 river basins; and the lakes carry a medium level of eutrophication risk in 4 river basins. Eutrophication risks in the river basins is shown in Figure 6.42.

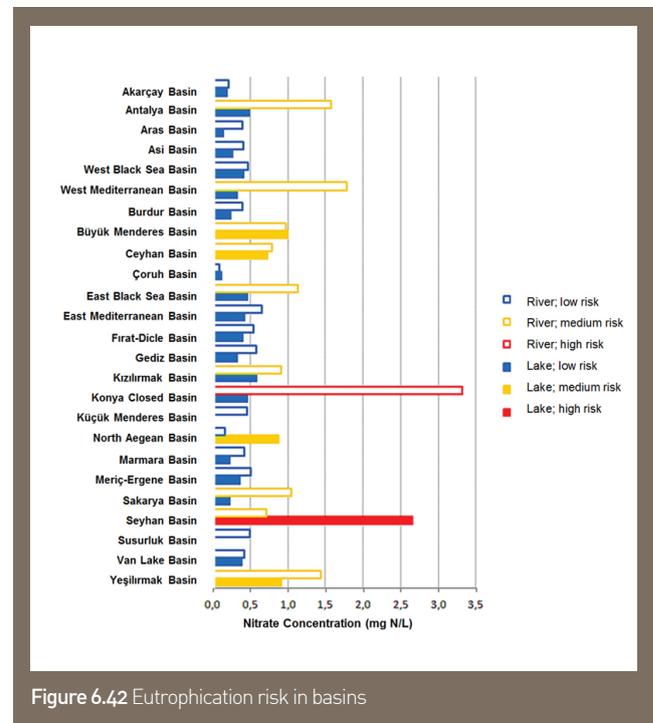


Figure 6.42 Eutrophication risk in basins

The determined NHBs cover a 148,670 km<sup>2</sup> area that represents 19.02% of the country by spreading to 53 of 81 cities and 24 of 25 River Basins. It must be taken into consideration that the fields that are drained to the determined NHBs and the fields in which there is extreme N entry are bigger than the real underground waters and surface waters. This fact highlights the importance of the fields that are drained and in which extreme nitrogen is used in NHB formation. The determined NHBs cover a 148,670 km<sup>2</sup> area that represents 19.02% of

the country by spreading to 53 of 81 cities and 24 of 25 River Basins. It must be taken into consideration that the fields that are drained to the determined NHBs and the fields in which there is extreme N entry are bigger than the real underground waters and surface waters. This fact highlights the importance of the fields that are drained and in which extreme nitrogen is used in NHB formation

### Determination of the Sensitive Areas and Quality Goals in Turkey on the Basis of River Basins

Determining the Sensitive Areas and Water Quality Aims on the Basis of River Basins in Turkey Project about the determination and management of the sensitive areas has been started in 2012 and it is aimed to be ended at the end of 2016. With the project, sensitive water areas in terms of water pollution, nitrate-sensitive water areas and sensitive areas affecting these areas, water quality aims, and precautions to be taken in order to improve water quality will be determined in surface waters in 25 water river basins in Turkey.

2,468 water bodies, 1,813 of which are river water bodies and 655 of which are lake water bodies, are determined in 25 river basins in the scope of the project. Pollution loads that come from urban, industrial, and agricultural activities are estimated by determining the pressures-effects affecting water bodies and the potential sensitive areas are determined. Biological and physicochemical monitoring studies are completed in potentially sensitive areas and the studies directed towards determining the final sensitive areas are ongoing.

### Water Quality Monitoring EU Twinning Project

There is not enough data about the chemical, biological, and hydro morphological situation of the surface water bodies in river basins in Turkey. The project that was developed in order to contribute to data obtaining is completed in 2013. With the project, monitoring plans for Meriç-Ergene, Susurluk, Akarçay, Sakarya, Büyük Menderes and Konya river basins and a monitoring program for Turkey on the national scale are prepared. And this would help Turkey in preparing river basin management plans for twenty five river basins and ensure getting good water situation for the application of these plans.

### The Effect of Climate Change on Water Resources Project

The application area of the project that is carried out by Ministry of Forestry and Water Affairs, GDWM is 25 river basins in Turkey. With the Project that is planned to be completed in 2016, studies of determining the effects of climate change scenarios on the ground and underground waters in all of the river basins. In this framework,

- Preparation of climate change projections in river basins
- Determination of the change in underground water budget and surface water levels
- Making of water budget modelings in all river basins
- Sectoral effect analysis of climate change in terms of water resources in 3 basins (for drinking water, agriculture, industry, and ecosystem main sectors)

studies are ongoing. In the scope of the project, a website containing the news and up-to-date information about the project is generated and it is also possible to reach Climate Database, in which the results obtained in the scope of the project can be visually reached.

### Project of Controlling and Improving Water that Returns from Irrigation for Reuse in GAP Region

In the scope of the project that is planned to be started in 2015, technical and administrative gap analyses will be done primarily in order to prepare a basis for the project. Following the reporting of the analysis results, the irrigation water need and irrigation areas in the pilot region will be determined by investigating the present situation of the project area and the environmental conditions. In the pilot region, the quality and the pollutants in the water that returns from irrigation will be investigated, the appropriate methods for improving the quality of these waters will be determined and reusability of them for irrigation will be investigated after improving their quality. After the selection of the place in which the waters that return from irrigation, the formation of the database of water that returns from irrigation and integration to National Water Information System steps, general evaluation studies and education, workshops, and meetings about the outputs of the project will be arranged.

### Investigating the Applicability of the Usage of Purified Waste Waters in Irrigation in Ergene River Basin

The studies about investigating the usage of purified domestic sewage that comes from sewage purification sites are completed in Ergene River Basin in 2014 and the present irrigation water need of the river basin, plant pattern, the necessary purification need for the usage of domestic sewage in irrigation and cost-benefit analyses are done in the scope of the study. Studies will continue in order to generalize the applications about the reuse of the used waters to the other river basins.

### Evaluation of Risks Originating from Climate Change with Integrated Monitoring and Modeling Systems Project.

With Evaluation of Risks Originating from Climate Change with Integrated Monitoring and Modeling Systems Project (2010-2013), in which Yıldız Technical University is a stakeholder, it is aimed to develop adaptation strategies by integrated modeling

and monitoring systems with the contribution of different disciplines, taking the fact that Mediterranean countries are especially under risk into consideration. In the scope of the project, research is done about drought, overflow, the salting of the sea front aquifers, deterioration of the rich soils, desertification, and weak and non-sustainable management applications.

### PREPARED – Enabling Change

The project that is completed in 2014 is aimed at bringing the urban public service sector in Europe and the World that can develop advanced strategies together to be able to reduce the effect of climate change on the management of obtaining water and sewage and preparing water-sewage systems against climate change effects TUBITAK MAM and Istanbul Water and Sewerage Administration were among project partners. This study is a large scale and integrated project that is developed about the adaptation of the urban water and sewage systems to the effects of the climate change. Studies done in the scope of the project can be summarized as;

- Generating a conceptual plan towards determining alternative water resources (rain water, overflow waters, gray water) and incorporating them into the main resources to be able to plan more flexible water and sewage systems,
- Making a pilot application (collecting rain water and purifying/reusing gray water) in Istanbul example about adaptation to the restricted water resources and the change in water quality for demonstration purposes,
- Developing methods towards making water and sewage purification systems ready-to-use against sudden changes in water quality and amount.

## 6.2.2 Agriculture and Food Security

### 6.2.2.1 Expected Impact and Vulnerability

Mediterranean Region is among the prominent regions in agricultural production in Turkey. According to the statistics, whereas the portion of agriculture sector in gross added value of Istanbul is a very little ratio like 0.2%, this value is reported as 16.6% for Antalya, Isparta, and Burdur in Mediterranean region in total, 14.7% for Adana and Mersin in total, and 14.4% for Hatay, Kahramanmaraş, and Osmaniye in total (TurStat\_p, 2014). These regions are expected to be affected

from climate change socio-economically more because of their portions in the gross added value.

In the Food Safety and Food Production Systems Chapter of IPCC Fifth Evaluation Report (Porter et al., 2014) it is highlighted that it is necessary to know the starting situation in which there is no climate change to determine the negative effects of climate change and that it is very difficult to determine this starting situation because of the poor definition of variety improvement, irrigation, and the usage of fertilizing besides the climate properties in food production systems. Besides, it is reported that it gets more and more difficult to explain all of the observed changes with the climate because of the usage of the assumptions about farmer behavior regardless of the fact that whether they are pointed in the used models or not. In the report, it is put forward that the water usage activity will increase especially in C3 plants in the case that CO<sub>2</sub> concentration in the atmosphere increases by 100 ppm compared to the time before the development of industry; however CO<sub>2</sub> increase may bring ozone increase together with itself and the increased ozone will cause a decrease in the yield of important products that are produced.

It is thought that climate change may affect food production in Mediterranean region in many ways in future. Direct effects may show up as increase in the carbon dioxide amount in the atmosphere and in the sea level. However, food production will be affected by climate change much more because of factors like desertification, increase in fire risk, fast spread of pests, and changes that will take place in world market. On the other hand, the possible effects of climate change on food production are not completely known. Because, comprehensive and integrated studies that will put the effects of different levels of climate change forward are not taken into consideration. Besides, most of the studies that are done were focused on a restricted number of food products and they took the conditions in which there will be 2 times more carbon dioxide in the atmosphere with the soil treatment methods of today in to consideration. Besides this, the present evidences put forward the fact that climate change will affect food production negatively in the whole region, food prices will increase, and food safety will be under threat in the whole region (Karas, 2006).

Even though the portion of agriculture in GDP has decreased in years, its added value has increased regularly in years. For this reason, agriculture sector still has an important place in the other sectors and 37% of the population in Turkey lives in rural areas. Agriculture makes 7.4% of GDP, 24.6% of employment, and 3.7% of exportation (TurStat\_g, 2014). When the role of agriculture in employment is taken into consideration, it must be expected that the effects of climate change will cause

important changes in the unemployment ratio, which is the general problem of countries. The decrease in food production on one hand, and the increase in unemployment on the other hand may affect the economy of the country negatively and would threaten food security.

The fields that are sown for agricultural production are 23.8 million hectare in 2013 and about 1/4 of this sown field can be watered and dry agriculture is carried out in an important part of it. For this reason, agricultural production depends directly on raining. Stockbreeding is also closely related to plant production. For example, the height of the grains remained very short in Isparta, which is in Mediterranean transition climate, in 2008 and the amount of obtained hay has significantly decreased because of the fact that the harvesters cannot harvest from that much below. In this year, there were serious problems with agricultural companies that do stockbreeding in and around Isparta and they had to bring hay from other cities in Turkey. Whereas there was a decrease in the total number of livestock in the time that has passed until 2010, there has been a regular increase between 2011 and 2013. Naturally, the need for feed increases parallel to the increase in the number of livestock. For this reason, the negative effect of climate change on agricultural yield may also affect stockbreeding sector negatively.

Studies that investigate the effects of climate change on agriculture in our country by taking a lot of factors and future scenarios are very restricted. In one of the present studies (Dellal, McCarl, and Butt, 2011), the changes that will show up in the production values of wheat, barley, corn, sunflower, and cotton, which are generally produced in Turkey and the economic reflections of these changes are investigated. In the study, it is predicted that there will be a 7.6% decrease in wheat and barley yield, a 10.1% decrease in corn yield, a 3.8% decrease in cotton yield, and a 6.5% decrease in sunflower yield according to 2050 projections. It is reported that there will be a narrowing in the cultivation areas of wheat and sunflower and a widening in the cultivation areas of barley and corn and that there will be an 8.2% decrease in wheat, a 2.2% decrease in barley, a 9.1% decrease in corn, a 4.5% decrease in cotton, and a 12.9% decrease in sunflower in terms of national production values. It is predicted that there will be an increase in the product prices between 0.1% and 12.6% parallel to the decrease in production and that this increase will increase the welfare of producers whereas it will decrease the welfare of consumers and the total welfare.

In a study (Varol and Ayaz, 2012) done on olive production, which has a special importance for Turkey, it is reported

that olive stops growing a crown in the shortage of water and generates a mechanism in order to survive drought conditions by continuing photosynthesis and transpiration and therefore it is a drought-resistant species; however, it is one of the agricultural products that will be affected by the global climate change the most; therefore urgent precautions must be taken in olive production. Water stress causes important changes in fruit holding, fruit ripening, and the oil content of the fruit in olive trees. In the last years, a lot of olive saplings are being planted and new olive plantations are being generated in our country. For this reason, it is obvious that the applications and sanctions necessary for preventing olive production from being affected very much by climate changes must immediately be put into effect. The first precaution to be taken is the protection of our soil and water resources and their rational usage. Climate change adaptation precautions special to olive production can be listed as follows (Varol and Ayaz, 2012):

- Drip irrigation systems that use water economically must be built.
- Soil tillage should not be made if possible, or it should be done shallowly.
- Terraces must be made on inclined fields.
- Importance must be put into mulching and weed control must be done.
- One way fertilizer usage must be avoided and green fertilizer application must be done.
- Unnecessary branches must be cut by pruning and the trees must be crowned from below.

In a study about the effect of global climate change on cotton production (Ünay and Başal, 2005), it is predicted that the CO<sub>2</sub> content in the atmosphere will increase photosynthesis in cotton, as it does in all C3 plants. It is reported that the activity of light usage increases with CO<sub>2</sub> concentration and this increase continues until 800 ppm. However, it is reported in ICCAP project report (ICCAP, 2007) that there will be no increase in the yield because of the increase in the temperature besides the increase in the CO<sub>2</sub> concentration.

In the study about the effect of climate change on agricultural products (Soylu and Sade, 2012), the effects of climate change in Konya plain are investigated in many aspects and soil preparation with climate, cultivation time, disease and weed, irrigation, pollination, and harvest relationships are put forward for wheat, barley, corn, sunflower, and sugar beet. In the study, climate change-ecological balance influence is also investigated and the results below are obtained.

- The most important subjects that came into question at the end of the climate change seen in Konya and Karapınar in the

last years is irrigation and water resources. For Karapınar region, the only key to agriculture is water. Because the annual rain in the region is never suitable for economic production from any culture plant.

- It is said that the change in the underground water is related to climate variables to an extent of 60% in Konya and 40% in Karapınar and the rest of it is related to extreme water drawing.
- The drought in the region and drawing an extreme amount of water over the yearly feeding amount makes it difficult for farmers to reach water every year.
- One of the effects of climate change in Karapınar district is the formation of katavothres in the regions. About 20 katavothres that result from collapses have been formed in and around Karapınar starting from 1977 until today.
- One effect of the climate change is Karapınar and Hotamiş reed beds' losing their wetland properties. Water levels have decreased compared to previous years also in Meke, Acıgöl, Çıralı, and Meyil lakes.
- The dry climate around Karapınar prepares a suitable condition for the earth to become salty. The salts that cannot be washed away from the soil because of inadequate raining create an important environmental problem because of excessive and unconscious irrigation.
- Some diseases are not the main diseases of the region and disease is came across intensely in some fields in relation with climate changes in 2010 and 2011.

In the study, planning for a suitable water management and determination of the water condition in the soil and irrigation by controlling the reaching of water around the stems are considered as adaptation precautions. According to the study, applied farmer education must be featured in the region in order to maintain a sustainable agricultural development by minimizing the effects of drought on agricultural production, which usually show up after climate change, its pressure on underground and ground waters, and the damage it does to natural balance.

All of the precautions must be taken towards decisions and applications made by taking product pattern and climate condition into consideration to prepare and apply action plans about programming water management and irrigation investments, generalizing new irrigation techniques that provides water conservation, adopting good agriculture applications, arranging integrated fighting plans against diseases and pests, and generating land usage plans in order to reduce the negative effects of agricultural drought on environmental, economic, and social life and maintain their sustainability [Soylu and Sade, 2012].

In another study [Demir, İ., 2013], cultivation areas and yield evaluation of oil seed plants and the effects of climate change on oil seed plants according to the 30-year climate projections until 2041 in the region including Kırkkale, Kırşehir, Aksaray, Niğde, and Nevşehir are given place. According to ECHAM5-A2 scenario results of RegCM3 regional climate model, it is predicted that the yearly average temperature increase will be 0.2-0.6 °C until 2041 compared to the average between 1961 and 1990 and the highest temperature change will be in spring and the highest temperature increase (0.6-0.8 °C) will be in summer and autumn seasons. It is expected that the yearly average raining will increase by 5-25% compared to 1961-1990 average and these increases will reach around 30% in the south of Kırkkale, Kırşehir, and Aksaray besides Niğde, especially in winter season. It is predicted that there will be decreases (5%) in the south of Kırkkale and south east of Kırşehir and Aksaray and increases (20%) in Niğde in autumn season. According to the research results, it can be said that agricultural production will be fairly good compared to the other regions of Turkey when the effects of climate change in the next 30 years are taken into consideration; however, this change will considerably affect the agricultural potential of the region. Whereas the yearly temperature increase will strengthen the temperature stress of the plants, the increase in the evaporation will affect the yield negatively and fortify the pressure on the restricted irrigation potential. The temperature increase that will occur during the seed formation term would affect sepal formation negatively and cause the formation of weak seeds on the sepal, especially in sunflower. Besides, it is also among the predictions that high temperature will increase disease risk.

In a study investigating the effect of climate change on the lands on which hazelnut is being grown in Black Sea region [Ustaoglu and Karaca, 2014], various predictions are made by using RegCM3 regional model with the purpose of determining whether the lands on which hazelnut is being grown would be affected by climate change. According to the A2 scenario that represents the worst situation, it is reported that the temperature will increase by 6 °C in the next 90 years in the region; this increase will affect hazelnut agriculture negatively, but there will not be a change in the raining regime to the extent that will affect hazelnut agriculture. This change in the temperature may cause the alignment of the areas on which olive is being grown change as horizontal or vertical. It is expected that the lands on the coastal line up to 250 m will be negatively affected by climate change and the lands above 1500 meter, which are not suitable for growing hazelnut today, will become suitable for hazelnut agriculture because of climate change.

In a study in which drought analysis of 2010-2011 agricultural year is done (Şimşek, Gördebil, and Yıldırım, 2012), it is determined that a moist term was lived in the country in general. Our country, whose yearly average raining is 640 mm, has reached an 11% increase by completing this term with 709 mm. When the last 51 years are taken into consideration, the driest agricultural season was in 1972-73 term with 477 mm and the rainiest season was in 1962-1963 term with 840 mm. Our country has an irregular raining regime. The changes in the raining do not follow a meaningful trend. And this shows that our country is face to face with drought risk even though its intensity changes. The drought in this agricultural year is felt only regionally in the south of South East Anatolia Region. Our other regions have received normal and above raining. The highest increase is in Middle Anatolia region with 35%. South East Anatolia Region is our only region, which has received under its normals with 7%.

In a study pointing that the negative effects of the climate change can be changed into an advantage (Yaldız and Şeker-oğlu, 2013), it is reported that the present water can be used in the critical terms by intensifying and generalizing the usage of systems containing plants resistant to drought and therefore minimizing the need for water. In this scope, it is highlighted that the medical and aromatic plants that will be grown in this kind of lands may produce active ingredients in higher amounts and different compositions, when the case in which active ingredient production is induced under stress conditions is taken into consideration.

In a simulation study, which is done on Fırat-Dicle River Basin, which has an important agricultural potential (Bozkurt and Şen, 2013), it is predicted according to various scenarios that there will be statistically significant increases in temperature in the river basin and that the amount of increase will reach values between 2.5°C and 6°C towards the end of the

century. According to the results of the study, the raining will decrease in the higher parts of the river basin (spring parts) and it will increase a little in the south parts near the vent. When it is estimated for the whole river basin, there will be a decrease about 20% in the raining at the end of the century. Surface flows will decrease in total and the spring flows in which high values are seen will be in earlier times. According to different scenarios, a decrease between 25-55% is expected until the end of the century in the spring parts of the river basin.

### Stockbreeding Sector Expected Effects

The effects of global warming show themselves with the changes in physical environment conditions and care and feeding conditions of the animals. Accommodation becomes more costly because of extreme climate conditions (extreme hot or extreme cold); decline in some properties related to performance such as breeding and milk and meat yield may occur. It is also expected that the production of pasture and feed plant will be interrupted because of the decrease in water resources and fields on which crop production can be done, the fields on which crop production can be done will be narrowed because of reasons like rising of the sea level, drought, or salinity, and that for these reasons, tendency of producing food for human nutrition will increase. Because vectors of some diseases reproduce more easily, it is expected that the increase in atmosphere temperature will cause negative results in terms of animal health (Görgülü, Darcan, and Göncü, 2009).

In the report prepared by Stockbreeding Special Expertise Commission in the scope of Tenth Development Plan (HOIKR, 2014), it is predicted that there will be a regular increase in the domestic meat demand (Table 6.5). This prediction shows that animal possession, which shows a tendency towards increasing since 2009 (See Section 2.11), will increase more in the next years and it will cause an increase in enteric fermentation that causes emission of greenhouse gases.

Year	Cattle		Sheep		Goat		Buffalo		Chicken meat <sup>a</sup>	Poultry meat <sup>b</sup>
	Milk	Meat	Milk	Meat	Milk	Meat	Milk	Meat		
2014	15,494	1,151	998	235	358	47	44	4.9	1,615	1,702
2015	16,141	1.19	1,035	244	372	49	45	5.1	1,702	1.79
2016	16.8	1,229	1,073	253	385	50	47	5.2	1,793	1,882
2017	17,485	1,269	1,113	262	400	52	48	5.3	1,888	1,979
2018	18,199	1,311	1,154	272	414	53	49	5.4	1,988	2.08

<sup>a</sup> Production subject to exportation is not included while calculating chicken meat demand.

<sup>b</sup> Total demand projection for winged animal meat is obtained by adding the demand for turkey and other poultries' meat, which was prepared by BESD-BIR, to the chicken meat demand that was estimated in the scope of the scenario.

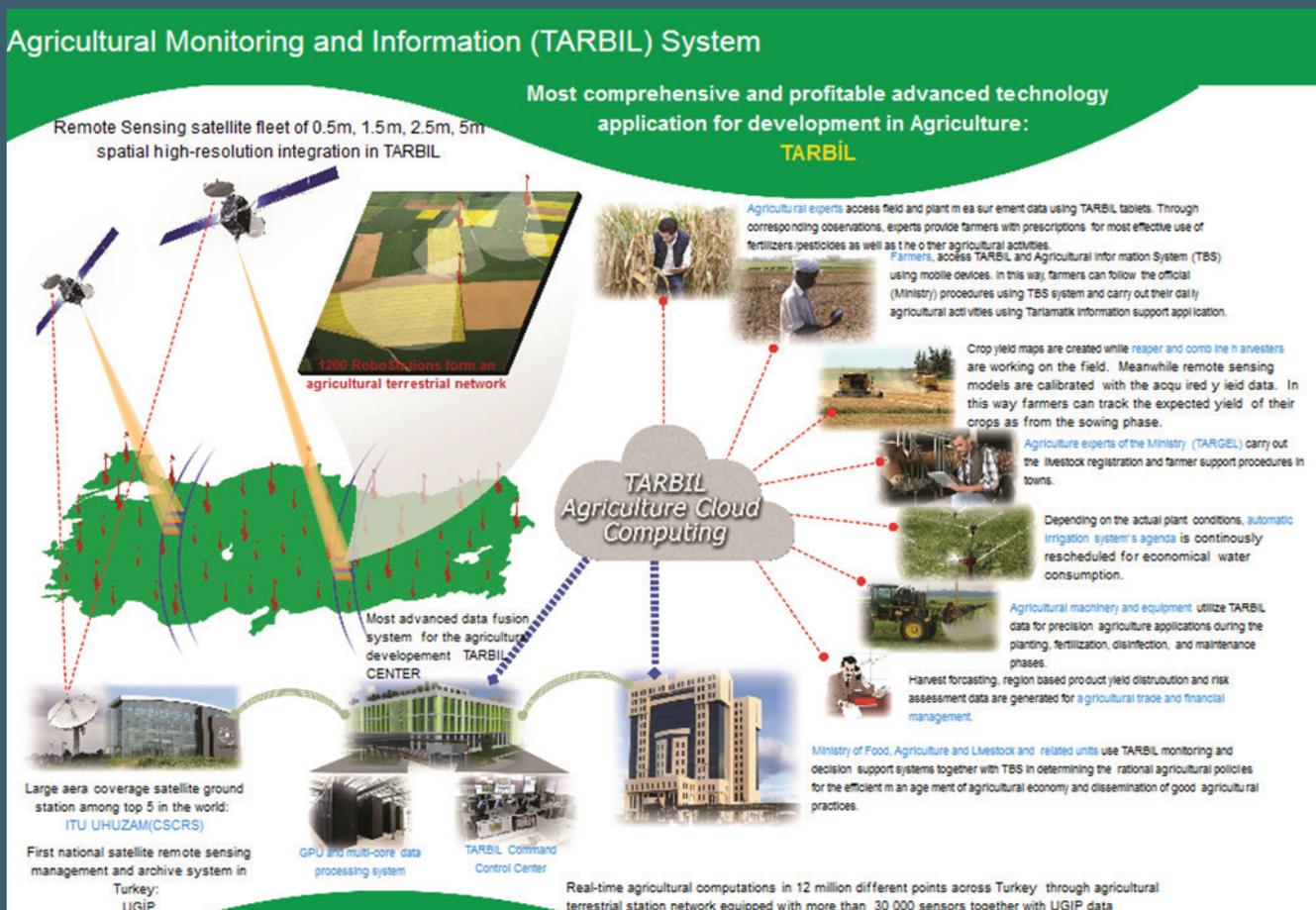
Source: HOIKR, 2014

**Table 6.5** Demand predictions for Turkey for various products between 2014 and 2018 (Thousand Tons)

## 6.2.2.2 Adaptation Measures

Detailed information about the legal regulations and applications about adaptation to climate change in agriculture sector is given in Section 4. Studies done about adaptation to climate change are given below together with various applications like fighting agricultural drought, good agriculture applications, and organic agriculture.

### Sample Applications-1: TARBIL Project



Agricultural Monitoring and Information (TARBIL) System Project aimed to evaluate the data obtained from satellite images and ground measurement networks, turn these into up-to-date agricultural information and deliver these to stakeholders instantly. In the pilot step of the project, a monitoring system that can monitor the agricultural development is developed in South East Anatolia Region. Images that are downloaded directly to the satellite ground station are processed and transmitted to data collecting center. Besides, building of smart measurement stations that can find plant properties from camera images and send data through Türksat satellite is started. In the pilot application, the building of the first 100

stations is completed and pilot telecasting is started, especially in the GAP area.

In the pilot step of the project, studies of building TARBIL System is started with the purpose of providing service to stakeholders and generalizing it to Turkey starting from the end of 2011 after successfully completing infrastructure development activities. There are four main components of TARBIL system: a) Satellite image downloading and processing center, b) Ground monitoring network collecting image properties of soil and product (metrics such as size and color), c) Data collecting and processing center, d) Live reporting, agricultural warning, and decision support system according to the selected product and place.



24 different parameters are measured every 10 minutes in the ground stations that are developed. The center produces regional product development distributions by matching the satellite images that it collects from the same points and the data calculated from the ground measurements. It will be possible to predict the yield in the next term more accurately as the past measurement data are formed.

TARBIL also has service aims towards farmers, agricultural warnings and irrigation management being the first ones. Investments made in the pilot step of the project are met to an important extent with the usage of the provided satellite images by the ministry units. In the generalization of the TARBIL system in Turkey, the number of ground measurement stations is being increased to 1200. SPOT7 satellite will be added to the capacity of monitoring from satellite that consists

of SPOT4, SPOT5, SPOT6, and RADARSAT satellites. There is a wide utilization field for farmers such as determining ideal cultivation date according to the place where they are and the seed to be planted, agricultural warnings, and irrigation management. An important strategy of TARBIL is forming a union of forces by bringing the national researcher potential, ministry experts being the first ones, live systems, and communication infrastructure together. In the variety base that TARBIL provides on the basis of phenological development, the data are important not only for agricultural yield management, but also the planned consumption of the natural resources.

The project has a critical importance in the systematic collecting and sharing of the information that will provide a basis for the precautions to be taken against greenhouse gas emissions and climate change (TARBIL, 2014).

### Developing Agricultural Publication Project (TAR-GEL)

Developing Agricultural Publication Project (TAR-GEL) is applied between 2007 and 2013 with the purpose of meeting the needs of agricultural plant owners in terms of knowledge, skills, and technical methods. In the scope of the project, contracted personnel is assigned to the determined working regions by 81 City Managements. 10,001 staff is allocated in Turkey in general, 6,129 of which being agriculture engineers, 3872 of which being veterinarians.

All kinds of publication and education activities from food security to soil protection law are under the duties and respon-

sibilities of the employed personnel. In this aspect, the related personnel has the potential to play a key role in the development of the application of the adaptation precautions by taking responsibility in the informing and education of the agricultural plants, which are the main appliers.

### Strategy of Fighting Agricultural Drought and Action Plan (2013-2017)

Agricultural City Drought Action Steps are prepared separately in dry and wet agriculture lands. In this scope, precautions to be taken in Preparation for Drought as step1, Drought alarm as step 2, Urgent Action as step 3, and Restriction as step 4 and

the strong and weak aspects of the plan are determined by using SWOT analysis. In the scope of basic development axes and priorities, the activities in the Action Plan are grouped as Drought Risk Prediction and Crisis Management, Maintaining Sustainable Water Supply, Effective Management of Agricultural Water Demand, Accelerating Supportive R&D Studies, Increasing Education/Publication Services, and Developing Institutional Capacity and the action plan in which works and precautions with priority, responsible institution, institutions to be cooperated with, starting and ending years of the work, and the explanations of the work to be done is placed for every group. Besides, Agricultural Drought Management Coordination Commission that was founded in the last term and Monitoring, Early Warning, and Prediction Committee and Risk Evaluation Committee in the center and Agricultural Drought City Crisis Centers in cities under the management of governors, which work related to this commission have started activities (MFAL\_b, 2013).

### Making the Use of Water Effective in Agriculture Program Action Plan

10. Making the Use of Water Effective in Agriculture Program studies that take place in Development Program (2014-2018) are continuing under the coordination of Ministry of Forestry and Water Affairs. With this program, it is aimed to make the use of water effective in agriculture by solving the problems stem from or expected to stem from climate conditions and wrong and excessive irrigation in the country and on the basis of river basins. The aims of the program are determined as follows:

- Increasing the portion of the field, on which in-land irrigation methods that save water (drop and sprinkler) are applied in the total irrigating field from 20% to 25% in the Plan term in the irrigating sites developed by DSI.
- Increasing the irrigation rate from 62% to 68%, irrigation efficiency from 42% to 50% in the Plan term in SHW irrigations.
- Increasing the total number of modern irrigation systems every year by 10%.
- Decreasing the usage of underground water to 5% during the term of the Plan.
- Preparing Management Maps for effective irrigation management in CBS medium.
- Providing comprehensive and applied education to the farmers with the purpose of tap water economically.

11 performance indicators are determined in the program and there are indications such as the rehabilitation of the networks in the irrigation sites in the fields, 40 thousand

hectare in 2016 and each of which are 50 thousand hectares in 2017 and 2018, formation of 30 thousand hectare underground irrigation networks every year between 2014 and 2018, and opening 168 thousand hectare field to irrigate every year (MD\_b, 2014).

### Agriculture and Rural Development Support Institution (TKDK)

The general purpose of TKDK, which was founded with the Law numbered 5648 that came into effect in 2007, is to carry out the activities directed towards the application of rural development programs in a way that will also include resources obtained from European Union and international institutions in the framework of the essentials and aims presupposed in national development plans, programs, and strategies.

In this framework, TKDK carries out accepting project and activity applications, doing their controls in their places, evaluation, determining the projects and activities to be supported, preparing application contracts, signing contracts, doing accrual, payment, and accounting processes and reporting proceedings and developments.

In the scope of Rural Development (IPARD) Program, which is prepared under the coordination of former Ministry of Ag-

Call number	Proje sayısı	Total donation (Euro)
1	4	471,415
2	58	20,828,101
3	91	31,879,973
4	52	13,639,793
5	46	14,282,557
6	44	15,102,221
7	43	14,994,317
8	111	28,895,071
9	981	106,333,369
10	417	29,194,044
11	4129	229,433,304
12	623	176,201,366
<b>Total</b>	<b>6599</b>	<b>681,255,531</b>

Source: TKDK, 2014

**Table 6.6** TKDK supported project numbers and total donation

riculture and Rural Works, the contracts of 6,599 projects in total and the total budget of these projects is 681 million Euro (Table 6.6) (TKDK, 2014).

In the supported projects, support is provided for projects such as modernization or founding of milk and stockbreeding farms, growing winged animals, eco-tourism, olive production, growing medical and aromatic plants, and developing capacity.

### Agricultural Insurances Law

Methods and essentials about the agricultural insurances application are determined in order to ensure the reimbursement of the losses that the producers will be subject to because of the risks that are pointed to in Agricultural Insurances Law, which came into effect in 2005 with the number 5363. Agricultural Insurances Pool (TARSIM) is formed in accordance with the law and 50% of the insurance premium that the farmer will pay is met. TARSIM is an important instrument in that it protects agriculture sector, which has a strategical role and function in economy, and increase is recorded in all of its basic data in years (Table 6.7).

### Studies of Fighting Erosion

Turkey is a country in which erosion, which is one of the most important ecological events, is active and its all types and levels are seen. 83% of the country is subject to wind erosion. 99% of the total erosion stems from water and 1% of it stems from wind. Rivers usually carry large amounts of sediment in Turkey. Intensive and very intensive erosion occurs in 63% of the country and erosion with medium intensity occurs in 20% of the country. The ratio of the soils, on which there is little or no erosion is only 14% (Dinçsoy, 2013).

In Turkey, the duty of fighting erosion is under the responsibility of General Directorate of Combating Desertification and Erosion (CDE), which is related to Ministry of Forestry and Water Affairs in forest fields, SHW General Management in dam river basins, and Ministry of Food, Agriculture, and Livestock in agricultural and pasture fields and the activities done by CDE are given in Table 6.8. (ODE, 2014).

Besides, city private managements and municipalities carry out studies of fighting erosion in the framework of their duties and responsibilities. Non-Governmental Organizations such as Fighting Erosion, Planting Trees, and Protecting Natural Possessions Foundation (TEMA) also contribute to studies of fighting erosion.

	2007	2008	2009	2010	2011	2012	2013	2014
Total Insurance Charge	1,478,415	2,224,972	2,900,560	3,987,867	6,986,309	9,497,477	11,252,737	13,894,744
Total Premium Production	64,104	98,444	120,349	185,434	440,879	499,349	526,835	683,536
Total Occured Damage Charge	51,192	50,843	109,813	155,345	280.9	332,121	469,980	579,352
Total Paid Damage Charge	43,906	44,101	95,232	121,399	225,228	280,267	410,858	532,285
General Expenses	4,856	7,989	8,905	12,333	15,686	18,731	20,143	23,233
Financial Income	2,186	5,616	4,531	4,362	6,879	17,413	26,323	22,767
Technical Income (Net)	5,407	2,515	4,375	7,971	65,638	80,012	60,853	60,318
Total Actives	12,362	51,504	37,768	73,688	223,085	347,534	329,628	391,049
Policy Number (Piece)	219	261	307	371	588	744	892	1,087
Number of Insured bovine livestock (Head)	54	72	112	188	361	420	404	436
Number of Insured ovine livestock (Head)	-	-	-	-	69	337	424	608

Source: TARSIM, 2012.

**Table 6.7** TARSIM basic data (x1000 TL)

Activity	2012	2013	Total*
Tree plantations	34,538	46,656	2,116,066
Rehabilitation	347,719	106,182	585,208
Erosion Control	81,781	83,964	1,098,974
Improving Pastures	9,635	992	161,754
Private tree plantation	4,944	1,975	123,557
TOTAL (ha.)	478,617	248,697	4,085,559
Investigation Project (ha.)	121,029	37,593	2,246,275
Sapling Production ( million/number )	471	**	13,626
Seed Production ( ton )	982	**	7,497

\* All of the activities done by ODE about this subject until today have been included in the total value.

\*\* There is no record in these fields.

Source: CDE, 2014

**Table 6.8** Activities done by ODE

### Bahri Dağdaş Drought Test Center

“Drought Test Center”, which was founded in Bahri Dağdaş International Agricultural Research Center in Konya can be shown as one of the first steps taken against drought, which is the most serious result of climate change in agricultural terms. This study, in which the studies done about drought in this institution, which is the third drought study center of the world, are evaluated, aims sharing the results of research done about both regional development and adaptation of Turkey to climate change. The mission of the center is determined as “Doing comprehensive scientific research about drought studies; guiding these studies by generating suggestions, policies, and solutions.”

In Turkey, one of the regions in which drought is the most intensive is Middle Anatolia Region. And Konya plain needs advanced studies about drought, because it is the place to be affected the most by climate change and drought in Middle Anatolia Region. In this scope, Drought Test Center started scanning studies by taking the drought resistance parameters of improvement ma-

## Sample Projects

### 1. Determination of Tolerance to Drought and Diseases and Quality Properties of Winter Bread Wheat Hybrid Garden

In Middle Anatolia Region, drought is the most important factor that restricts yield because of the inadequacy of raining and irregularity of its distribution. The aim of the project is to generate a hybrid garden by determining the genotypes adapted to drought by applying methods that are easy, applicable, fast, repeatable, cheap and can be selection criteria in determining resistance to drought in wheat improvement and form an infrastructure that is prepared in order to be used in the drought studies in the next years. It is aimed to get new varieties tolerant to drought approved by hybridization from the obtained genotypes and the study is being carried on in this direction (BDUTAEM\_a, 2014).

### 2. Determination of Tolerance of Corn Lines of the Country to Drought

Konya endorheic river basin is one of the important potentials in corn production in our country and is one of the regions in which the effects of climate change and drought are the most intensive. International studies of improving corn tolerant to drought are being carried out for the last 20 years. In the framework of this study, a start is made in order to do similar studies in our country and to give dynamism to them. In the framework of this project, analyses done as a result of yield, yield components and morphological, phenological, and physiological observations under different water stress conditions and determination studies are being carried out. In the project, 8 lines belonging to the institute that carries out the project, 9 lines obtained from other national institutes, and 3 hybrid varieties that are used as controls, in total 20 genotypes, are evaluated in 4 different water application (BDUTAEM\_b, 2014). The workshop about the change in agricultural activities is given in Workshop Sample Applications (BDUATEM\_c, 2014).

materials of national bread and durum wheat and barley variety development programs in greenhouse, laboratory, and field conditions into consideration as a start. Besides, wheat and barley improvement materials tolerant to drought started to be integrated to improvement programs and variety development studies are started. This center, which is founded in the scope of fighting drought, has primarily determined the research aims below;

- Determining water usage capacity and activity in all of the field plant species grown in Turkey,
- Determining the levels of drought tolerance in early generations and developing plant materials that will be used as genetic sources in developing drought tolerant varieties.
- Increasing effectivity by shortening test durations in variety development. Saving time in developing drought resistant varieties and putting the drought tolerance levels of candidate varieties and varieties forwards with scientific data and make their usage possible (Özdemir F. , 2014).

### Climate Change National Action Plan - Agriculture Sector

Agriculture Sector and Food Security topic is under the Adaptation to Climate Change Chapter of NCCAP, which is prepared under the coordination of Ministry of Environment and Urbanization and started to be applied in 2011. Under this topic, the purposes are reported as integration of adaptation to the effects of climate change approach to food safety policies; determining the climate change effects in agriculture and developing and generalizing R&D studies and scientific studies in order to determine the effects of climate change in agriculture and adapt to climate change; planning agricultural water usage sustainably; protecting the soil and the agricultural biodiversity from the effects of climate change; and developing the institutional capacity and cooperation between institutions about adaptation choices in agriculture in Turkey. Besides, action plans are also put forward under every purpose.

### New Approaches

#### Biochar

Studies about Biochar are accelerated in our country; however, there is no study determining the emissions occurring during Biochar production separately for various raw materials and putting forward sink/emission situation. It is estimated that it is profitable to encourage such studies.

### Sorghum Production

Sorghum, whose new variety and hybrid studies are going on, is a hope promising plant about fighting the effects of global warming. Data about sorghum production started to be collected in 2012 in our country. According to this, sorghum is grown in a 1908 ha field and 51,375 ton fresh biomass harvest is made in 2012. In 2013, 59,358 ton of fresh biomass is obtained from a 1840 ha field. While the yield is 26.9 and 32.3 ton fresh biomass/ha in 2012 and 2013 respectively, the yield of corn, which is thought to be the alternative or support for sorghum and presently being cultivated on a large field, is 43.1 and 44.9 ton/ha in the same terms. The yield of the present sorghum varieties is lower than the yield of corn.

### Rhizobacteria Supporting Plant Development

Studies about determining rhizobacteria, which produce hormones preventing ethylene production in the stem part and supports plant development by maintaining healthy development of plant under stress conditions, and using them in agriculture are started to be carried out in our country.

## 6.2.3 Extreme Weather Events and Disasters

### 6.2.3.1 Expected Impact and Vulnerability

According to climate change scenarios, one or two degrees Celcius of increase that can be seen in average air temperature means a couple of times increase in extreme air temperatures and intensive rains. In the last years, a lot of the regions of the world are facing matchless hydro-meteorological disasters in terms of their intensity, effects, duration, and place.

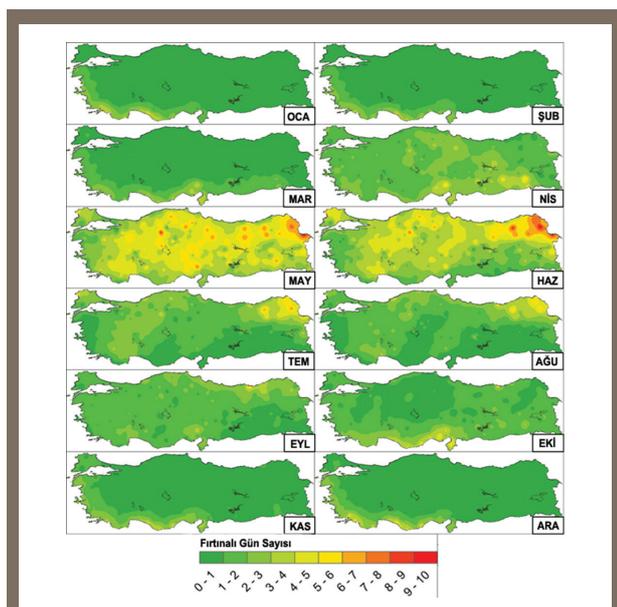
Turkey is in a geography in which almost all of the 31 natural disaster varieties (except for active volcanoes and typhoons) are being observed. Besides the seismicity, which is being put more importance into after 1999 Marmara earthquakes, awareness of meteorological disasters that usually take place in Turkey is also increased. In the last years, the formation of climatologies is started by collecting the records about disasters in which especially meteorological processes of meso and small scale. In this context, it is realized that disasters such as tornado and lightning stroke, which are thought to be seen rarely in our country, are at least as primary as floods, strong winds, hail, landslide, and frost. Besides these, disasters like heat waves, avalanches, fog, strong snow, drought, and forest fires also cause important life and property losses.

According to the data of International Disaster Epidemiology Research Center, there have been 89,236 deaths as the result of 77 fatal earthquakes between 1900 and 2014 in Turkey. The number of people who dies in floods and overflows is 1,342, the number of affected people is 1,778,520, and the total damage is 2.2 billion dollars (CRED, 2014). There have been 700 deaths because of landslides, 100 deaths because of windstorms, and 15 deaths because of wild fires. The deaths in extreme temperatures are reported as 100.

In the report with Climate Change Risk Management in Turkey topic, according to the records of Disaster and Emergency Management Authority (DEMA) Turkey Disaster Databank flood cases in Muğla, Edirne, Kırklareli, Manisa, Bitlis, Hatay, Sinop, and Trabzon in 2013; and drought cases in Konya, Tunceli, and Bilecik are reported, and these data, which do not represent Turkey in general, show that there is no significant change in the last two years.

### Convective Storms and Their Effects

Convective storms are clouds or cloud clusters that cause lightning, intensive raining, and sometimes hail and tornado and the thunderous storm frequency distribution that is formed based on the monthly average number of thunderous days of 277 SMS stations in 1960-2013 years is seen in Figure 6.43. Thunderstorms are usually seen in May and June in the country in general, especially in inner and northeast parts.

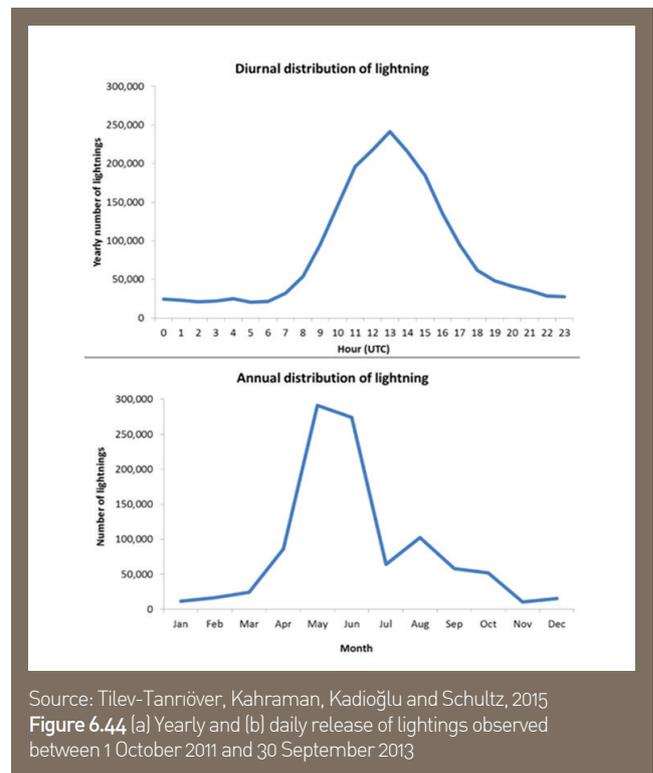


Data: SMS  
Source: Tilev-Tanniöver, Kahraman, Kadioğlu and Schultz, 2015  
**Figure 6.43** The average number of thunderstorm days observed in each month between 1960 and 2013 in Turkey

Maximum thunderstorm frequency slides to Aegean and Mediterranean shores in the term between late autumn and early spring (Tilev-Tanniöver, Kahraman, Kadioğlu, and Schultz, 2015).

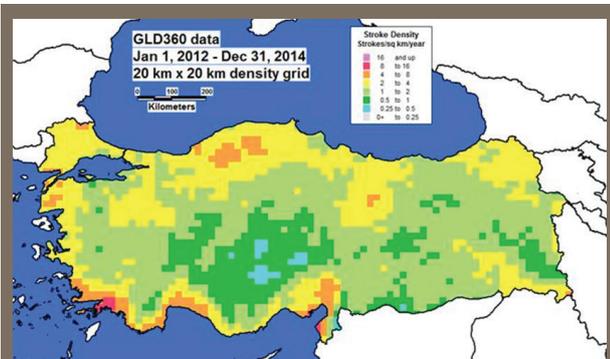
### Lightning Stroke

The data about the lightning events that occur the most in spring and summer months are seen in Figure 6.44(a). Besides, according to the daily distribution, the time interval in which the lightning is the most intensive is afternoon (Figure 6.44b). Again, observational data provided by Vaisala show that the frequency of lightning and lightning stroke are generally more in the sea fronts compared to the inner parts and the lowest lightning intensity occurs in Konya plain and around (Figure 6.45).

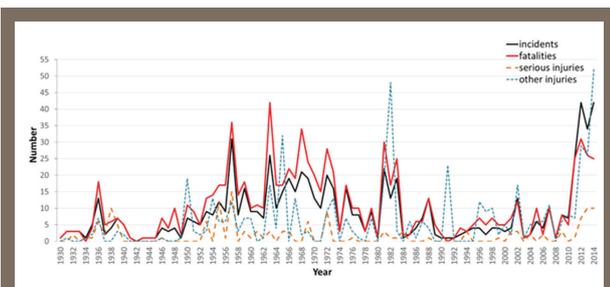


Source: Tilev-Tanniöver, Kahraman, Kadioğlu and Schultz, 2015  
**Figure 6.44** (a) Yearly and (b) daily release of lightnings observed between 1 October 2011 and 30 September 2013

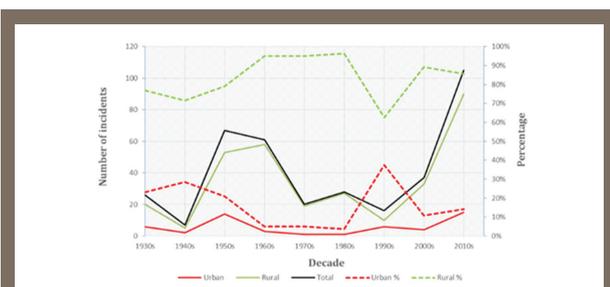
Distribution of lightning strokes that result in deaths or injuries between 1930 and 2014 in Turkey is seen in Figure 6.46. According to the study including the time interval between 1930 and the end of June in 2014, there have been 742 lightning stroke events that resulted in deaths or injuries in Turkey in this period. These events resulted in 895 deaths, 149 serious injuries, and 535 injuries. A big portion of the events (89%) has occurred between April and August and the peak months are May and June (Figure 6.44 (a) and (b)). Almost all of the events (86%) have occurred in rural areas and only 14% of them occurred in city or district centers (Figure 6.47). The places in which the events have occurred are shown in Figure 6.48 on the map.



Source: Tilev-Tännöver, Kahraman, Kadioğlu and Schultz, 2015  
**Figure 6.45** Lightning intensity distribution between 1 January 2012 and 31 December 2014 in Turkey (km<sup>2</sup>-year<sup>-1</sup>)



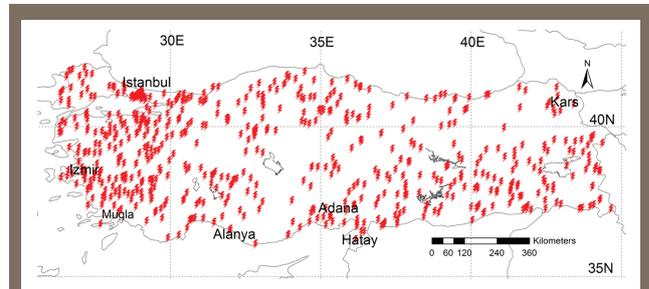
Source: Tilev-Tännöver, Kahraman, Kadioğlu and Schultz, 2015  
**Figure 6.46** Lightning stroke events causing deaths or injuries that occurred between 1930 and 2014 and numbers of deaths, serious injuries, and injuries related to them



Source: Tilev-Tännöver, Kahraman, Kadioğlu and Schultz, 2015  
**Figure 6.47** Distribution of lightning stroke events that resulted in deaths or injuries in Turkey according to the places in which they occurred (urban/rural)

## Tornado

Tornado was considered a rarely seen, even exceptional meteorological event until a few years ago in Turkey. 2004 Ankara Çubuk tornado, which has resulted in 4 deaths and serious damage, 2012 Elazığ tornado, which caused 7 deaths, and especially the tornadoes observed on the Istanbul shores have attracted attention to this event in the last years. Because of some tornado events that took place in visual

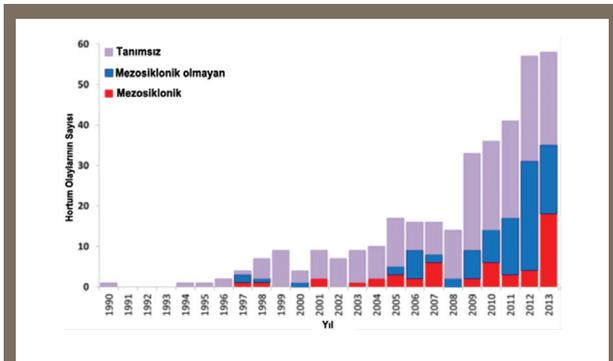


Source: Tilev-Tännöver, Kahraman, Kadioğlu and Schultz, 2015  
**Figure 6.48** Geographical distribution of the lightning stroke events resulting in deaths or injuries that have occurred between 1930 and 2014

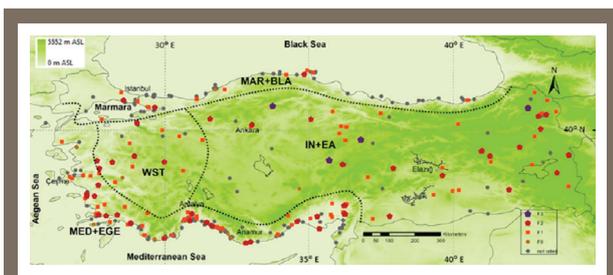
and written media, the subject of tornadoes in Turkey became a more current issue in the last years. The first study about the tornadoes in Turkey is published in scientific literature in 2014 (Kahraman and Markowski, 2014).

Turkey's tornado climatology, which is formed with the records collected from various sources, includes data about 385 tornado events starting from 1818 until today. According to the records, at least 31 people have died as a result of these tornadoes and 204 people are injured. Besides this, it is not possible to directly attribute the tornado events to climate change.

The intensity of the tornadoes in Turkey are between F0, whose wind velocity changes between 84 and 116 km/h and which cause minor damage, and F3, whose least wind velocity changes between 182-253 km/h and which can cause important damage, according to Fujita Scale. When the data of the last 5 years, which is thought to be more representational, is taken into consideration, 45 tornado events, 7 of which are mesocyclonic, are observed on average in a year in Turkey (Figure 6.49). An important portion of the tornadoes is of the "spout" type, which mostly occurs on the shores. The tornadoes seen in Mediterranean and Aegean shores especially in winter months dominate the tornado database of Turkey (Figure 6.50). Especially Antalya-Anamur coastal line is one of the regions having the highest tornado frequencies in Europe and has a statistics of 19 tornadoes in 10,000 km<sup>2</sup> in a year. However, a big portion of these tornadoes is weak waterspouts that do not landfall. And the frequency of the tornadoes on Black Sea shores increase at the end of summer and at the beginning of autumn. And in the inner regions, there are stronger tornadoes, which have a mesocyclonic character and are occurring less. Peak months are May and June. The daily distribution of the tornadoes in Turkey shows that more tornadoes are observed in the afternoon and early evening hours and the frequency decreases during night hours.



Source: Kahraman and Markowski, 2013  
**Figure 6.49** The change of tornado events with time between 1990 and 2013 in Turkey

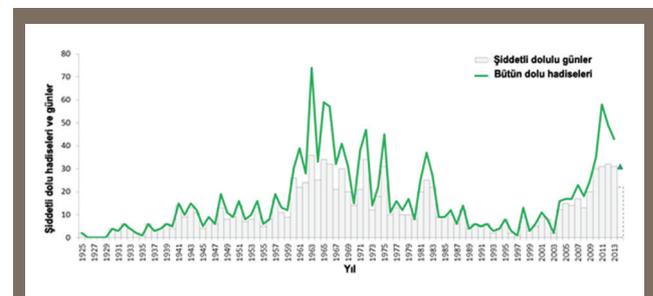


Source: Kahraman and Markowski, 2013  
**Figure 6.50** Geographical distribution of the tornadoes in Turkey. (MAR: Marmara Region, BLA: Black Sea Region, MED: Mediterranean Region, IN: Middle Anatolia Region, EA: East Anatolia Region)

## Hail

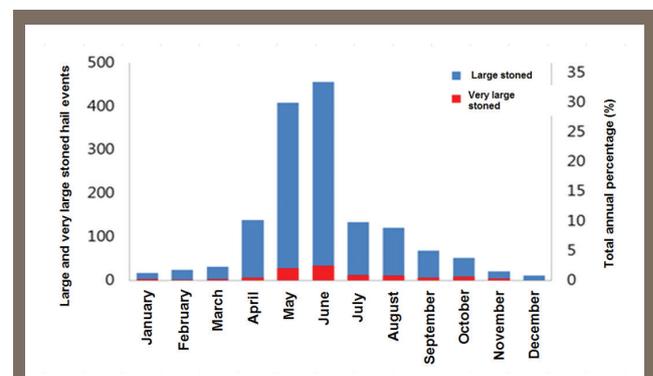
Hail is one of the most observed damaging meteorological events in Turkey. Especially its occurrence in spring months, in which the plants are the most fragile, makes hail the most important disaster among all of the natural disasters in terms of agriculture. According to the large hail climatology of Turkey, which is formed with the records collected from various sources, more large hail events occur in May and June compared to all of the other months. The severe hail climatology, which is formed from hail records with 1.5 cm and above diameters, includes information about 1,489 events that occurred in 1,107 days between 1925 and 2014. The distribution of the cases according to the years is shown in Figure 6.51. According to the study, 60 % of the insurance payments that are related to meteorological disasters originate from hail and the most important portion of the hail damages occur on agricultural lands. According to TARSIM data, more than half of the disaster payments in the scope of agricultural insurances is made for the reimbursement of the damages done by hail in the last 7 years (Kahraman,

Tilev-Tanriover, Kadioglu, Schultz, and Markowski, 2015). Hailstones with up to 750 gram weight are observed and hail heights up to half a meter are reported. According to the data of the last five years, 42 large hail events is observed in 29 days in a year in Turkey. The diameter of 8.3 % of these is bigger than 4.5 cm. The years in which the large hail events are seen the most are 1960s, in which at least 29 events are recorded in a year. Besides, there is an increase in this frequency since 2005.

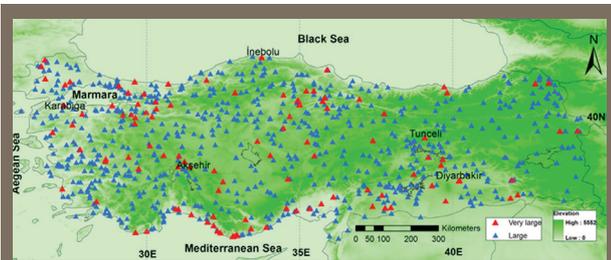


\* 2014 data is up to 27 May.  
 Source: Kahraman, Tilev-Tanriover, Kadioglu, Schultz, and Markowski, 2015  
**Figure 6.51** Severe hail events and days with severe hail in Turkey (1925-2014)

Severe hail events occur more frequently in spring and summer months (Figure 6.52). 58% of all of the severe hail events in total are observed in May and June and December has the lowest frequency. According to the daily distribution, peak hours are afternoon and evening hours. The places of large and very large hail events on served in Turkey are seen in Figure 6.52.



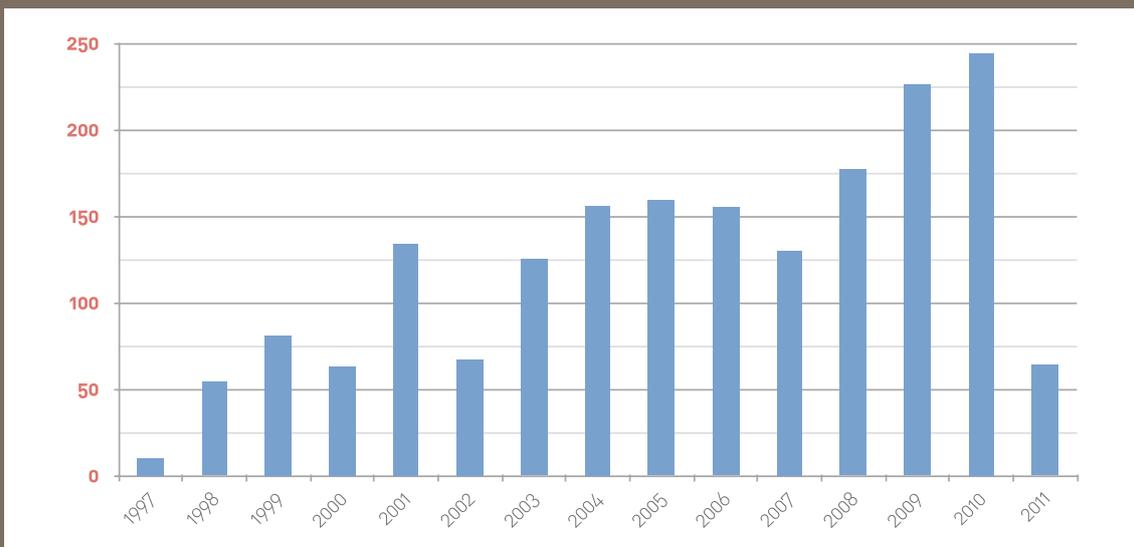
Source: Kahraman, Tilev-Tanriover, Kadioglu, Schultz, and Markowski, 2015  
**Figure 6.52** Yearly distribution of large [diameter between 1.5-4.5 cm] and very large stoned [diameter above 4.5 cm] hail events in Turkey



Source: Kahraman, Tilev-Tanriover, Kadioğlu, Schultz, and Markowski, 2015  
 Little blue triangles represent big stoned hails and big red triangles represent very big stoned hails.

**Figure 6.53** Places in which severe hail events occurred between 1925 and 2014

that took 12 and more hours in the time distribution graph are thought to be events of synoptic scale, which occur as a result of dynamic strain. 212 events that took more than 12 hours have occurred in the investigated period. And it is thought that the events that took less than 6, 3, 1 hours, and 15 minutes can be classified as events of mesoscale that occur with convective strain. The places in which the highest number of events occur are Kocaeli and Bandırma in the west, Nevşehir in the Middle Anatolia, and Elazığ and Malatya and around in the east (Figure 6.55). There are 6-recorded deaths and 73-recorded injuries in the investigated years.

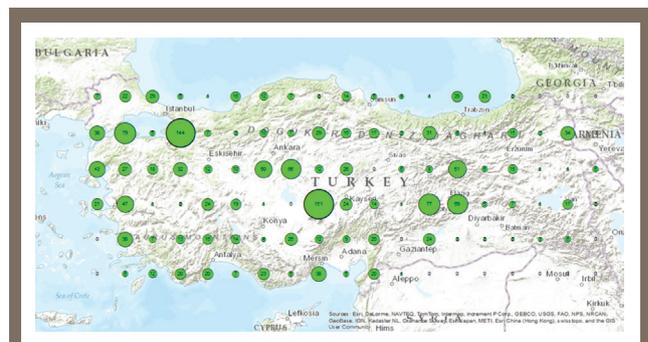


Source: Coskun ve Kadioğlu, 2013

**Figure 6.54** Distribution of severe straight-line winds in Turkey according to years

### Severe Straight-Line Winds

Severe straight-line winds have an important place in the disasters in Turkey. In Turkey, severe winds with a disaster level occur 35 times on average in a year (Kadioğlu, 2012). According to a study based on SMS upper observations between 1997 and 2011, 244 severe straight-line wind events have occurred in 2010 (Coşkun and Kadioğlu, 2013). 1997 is the year in which the least number of events have occurred with 10 events (Figure 6.54). The average of the 15 years that are investigated is 123. According to the monthly distribution graph, February and March are the peak months of intensive straight-line wind. 259 of the 579 events that have time data have occurred between 12:00 and 18:00. The events



Source: Coskun and Kadioğlu, 2013

**Figure 6.55** Regional frequency of severe straight-line winds in Turkey

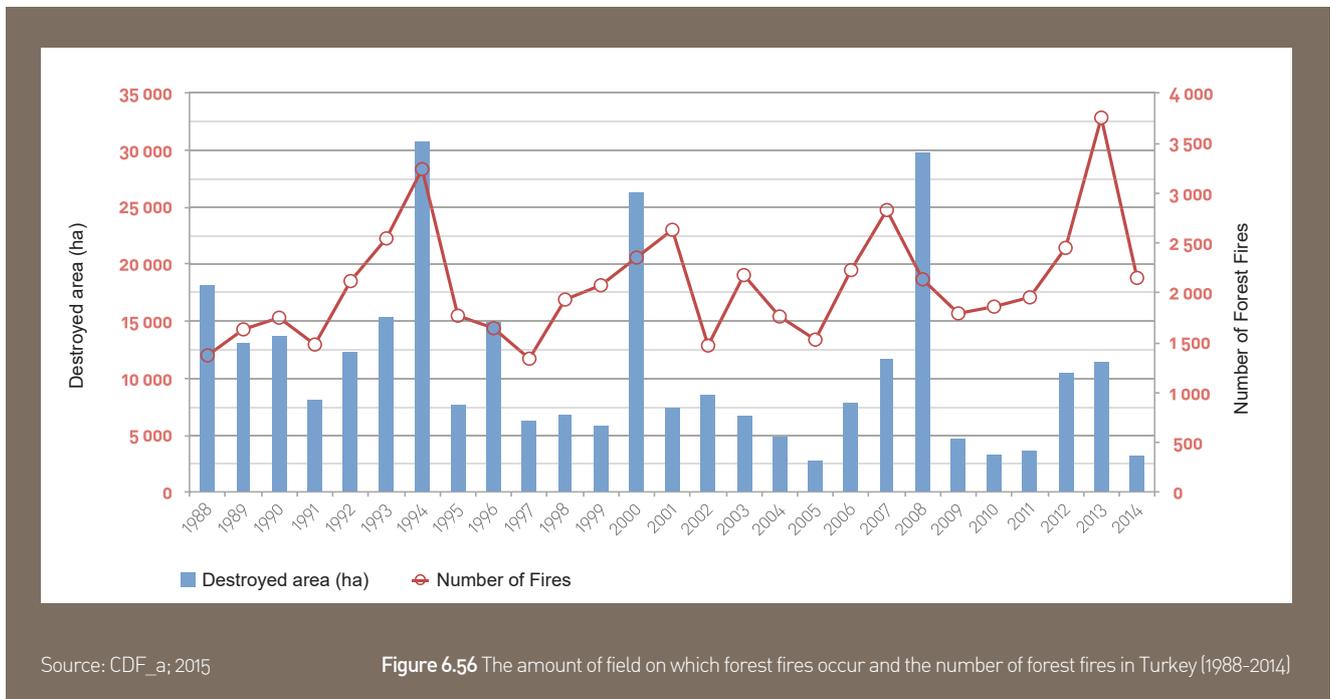
## Forest Fires

There are 21.9 million hectare forests in Turkey. This area contributes approximately to 27.6% of the country. The first threatening factor towards our forests, which produce 38.7 million ton of oxygen every year, is forest fires, just like it is in a lot of parts of the world (GDF\_a, 2015).

In Figure, the number of forest and/or wild fires that occur every year starting from 1988 until 2014 and the amounts of area that these fires destroyed are seen. In 2014, the num-

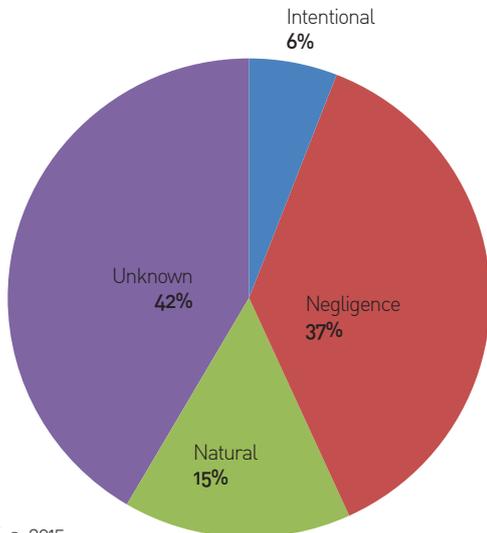
bers of forest fires that occurred and the forest fields that are damaged by fire have increased.

When the averages of long years (1997-2014) are taken into consideration, the primary cause of the forest fires is negligence with a 52.6% portion. This is followed by unsolved crimes with 25.2%, intentional crimes with 11.7%, and natural causes with 10.4%. The reasons for 41.6% of the forest fires occurred in 2014 could not be determined. Besides this, 37.3% of these fires have occurred because of negligence, 5.9% because of intentional crimes, and 15.3% because of lightning stroke (Figure 6.57).



Source: CDF\_a; 2015

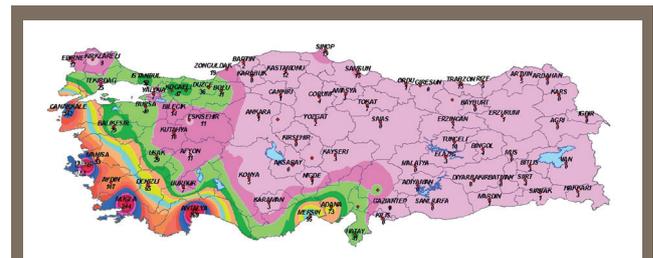
Figure 6.56 The amount of field on which forest fires occur and the number of forest fires in Turkey (1988-2014)



Source: CDF\_a; 2015

Figure 6.57 Distribution of the causes of the forest fires that occurred in 2013 in Turkey

Forests in Aegean and Mediterranean regions are very sensitive to fire (Figure 6.58).



Note: Because the numbers of forest fires are written on this map, a separate legend is not given on the map.

Figure 6.58 Distribution of the numbers of forest fire disasters according to the cities between 1950 and 2010 in Turkey

### 6.4.3.2 Adaptation Measures

Precautions taken in the last years with the purpose of managing disasters are given below.

- Making a decision about building 35 lightning detection and monitoring system by SMS in 2015,
- Developing observation and early warning systems by SMS and SHW General Management and arbour and erosion control studies done by General Directorate of Combating Desertification and Erosion and GDF in the scope of 2010 Overflow Protection Campaign of former Ministry of Environment and Forestry,
- South East Europe Disaster Risk Reducing and Regional Cooperation Project (2008-2013) carried out by World Meteorology Organization (WMO) and UNDP in order to reduce the damages of hydro-meteorological disasters and develop regional cooperation in Turkey,
- National Climate Change Adaptation Strategy and Action Plan of the Ministry of Environment and Urbanization,
- It is determined how the water resources are affected special to the river basins with "The Effect of Climate Change on Water Resources Project" that Ministry of Forestry and Water Affairs has started since 2013 and sectorial adaptation planning is being done in the river basins.
- Overflow Management Plans in Yeşilirmak and Antalya River Basins are being prepared in the scope of the activities of generating Overflow Risk Management Plans on the basis of river basins in Turkey, which was started by which was started by Ministry of Forestry and Water Affairs, General Directorate of Water Management in 2012.

Besides this, to be able to minimize the increasing ecological, environmental, social, and economic losses of the disasters in Turkey, risk management strategy, all of the policies about adaptation to climate change, and the plans and the programs must be thought about and considered under the name of "climate risk management (CRM)" and there should be an effective cooperation and coordination between stakeholders, especially public institutions.

### 6.2.4 Ecosystem Services

Turkey, which is separated into three biological regions, with the important biodiversity values that it has, as two terrestrial (Caucasian and Mediterranean) and one marine (Mediterranean) regions and is in 200 ecological regions on the global scale. These regions are shown among the most important ecological regions of the world because of the protection values that they carry.

### 6.2.4.1 Expected Impact and Vulnerability

Climate changes would cause changes in the structures and functions of ecosystems, because the most important factors that determine an ecosystem type are the temperature and the precipitation regime. In the last terms, the effects of climate change on species and ecosystems has started to be felt more gradually. It is thought that especially the species with restricted habitats and sensitive ecosystems will be affected more by the climate change.

In this chapter, in which the effects of climate change on ecosystems and findings of the national studies about the subject are given, ecosystems are considered under three subtopics as inland water, terrestrial, and marine ecosystems.

#### Inland Water Ecosystems

Turkey has inland water resources with its rivers and lakes on approximately a 10,000 km<sup>2</sup> area, which are very important for keeping biological diversity alive. The inland water potential of Turkey consists of 33 rivers, 200 natural lakes, 159 dam lakes, and 750 ponds. Van Lake, which is the biggest and deepest lake, has an area of 3,712 km<sup>2</sup>. The second biggest lake, Tuz Lake in Middle Anatolia, is 925 m high from the sea, its area is 1,500 km<sup>2</sup>, and is a shallow lake. There are primarily four regions in which the lakes reside; these are Lakes Region (Eğirdir, Burdur, Beyşehir, and Acıgöl), South Marmara (Sapanca, İznik, Ulubat, and Bird Lakes), Van Lake and around, and Tuz Lake. There are nine rivers that are longer than 500 km in Turkey; these are Kızılırmak, Fırat, Sakarya, Murat, Aras, Seyhan, Dicle, Yeşilirmak, and Ceyhan.

There are 135 wetlands in Turkey recognized as being of international significance; 14 of these wetlands are protected by the Ramsar Convention. Besides, inventory studies are ongoing in order to determine the wetlands with international and regional importance as a requirement of "Regulation on Protection of Wetlands" that was renewed in 2014. Lakes, swamps, deltas, marshes, and mudflats are very important for wildlife, especially for birds. More than half of the bird species in Turkey are migratory birds. Wetlands are a critical habitat type for many species of birds who use them for breeding, feeding, wintering, or as migratory stopover sites. The Meriç, Gediz, Büyük Menderes, and Küçük Menderes Deltas formed by rivers that discharge into the Aegean Sea, and Göksu, Seyhan, and Ceyhan Deltas, formed by rivers that discharge into the Mediterranean Sea, provide suitable habitats for a large number and variety of water birds, especially as lakes in Anatolia freeze in winter. The delta formed by the Kızılırmak which discharges into the Black Sea has great importance especially for migratory birds that pass directly over the Black Sea.

**The expected effects of climate change on inland water ecosystems are summarized below;**

The expected effects of climate change on inland aquatic ecosystems are the loss of area and volume of water bodies, decreasing of fresh water resources, and decreases in current and flow rate and these effects would cause becoming arid, water shortage and inadequacy, deterioration of biological diversity and habitats, yield decreases in agriculture, and food inadequacy.

Wetlands are one of the most fragile ecosystems against climate change. Terrestrial fresh water wetlands will be affected by the changes in the rains and the more frequent and intensive droughts, storms, floods, and inundations. The changes in timing and amounts of precipitation that feed river systems change the water procurement in the coastal wetlands such as deltas and estuaries.

When the levels of the effects of climate change are regionally investigated, trends such as increase in temperature and evaporation and decrease in precipitation are seen in Mediterranean River Basin and Mediterranean Climate areas, in which Turkey resides (Türkeş, Sümer ve Çetiner, 2000).

The increase in the concentrations of the nutritional salts as the result of the decrease in the lake waters with the warmer temperature causes harmful algae blooms and especially toxin-producing cyanobacteria blooms. During dry periods, rapid increase in the population of algae (especially cyanobacteria populations) and eutrophication in the lakes of Turkey are completely parallel to the expectations for lakes in dry climate regions together with global warming. Because the concentration of nitrogen and phosphorus that comes from the rivers that feed inland waters will increase because of the increased drought, the same situation will be faced also in the lakes. Algal blooms will also deteriorate the ecological balance in the lakes and will cause the decrease of water plants, fishes, and birds.

Narrowing will be observed in the lake surface areas in wetlands in Inner Aegean and Middle Anatolia to a large extent and in Marmara and East Anatolia to a smaller extent. Even though narrowing is expected in the surface areas because of the evaporation that originates from temperature increase, there may not be very much change in the situations of deltas and lagoons in the sea fronts because of the sea level that is expected to increase. However, because of the increasing salinity and changing flora elements, there will be a certain change and loss in the fauna and bird species that feed on these.

When the studies investigating the relationships between the climate changes in Turkey, level changes of lakes, and changes of water resources are taken into consideration, in the study by Cengiz and Kahya (2006), in which the trend and harmonic analyses of some lakes in Turkey are done, it is stated that there will be an increase in the lakes in the north part of our country, a decrease in the lakes in Middle Anatolia and Mediterranean Regions, and no trend in the lakes in Marmara Region.

In a study on the relationship between the level change in Acıgöl, which resides in the south west part of Turkey, and climate change, it is highlighted that there is a strong significance between drought and lake level. Besides, a continuous decrease in the lake level and a loss of area by 2/3, which are related to the increase in temperature and the decrease in raining, are found in this area in the term between 1975 and 2010 (Özdemir and Bahadır, 2008).

In the study, in which the statistical analysis of level and volume changes of Kovada Lake that is in Isparta in Mediterranean Region and the change in the climate elements are investigated, increase in temperature and evaporation and decrease in precipitation amount are found in Kovada Lake river basin in long yearly term (1975-2010). This change in the climate elements has reflected to lake level and volume as loss and decrease has occurred in the level and volume of the lake in the same term. In the study area, a 0.7 °C increase in temperature, 120 mm increase in evaporation, and 20 mm decrease in precipitation amount have occurred. When the relationship between climate elements and the changes in the level and volume of the lake are investigated, a negative relationship with medium significance is found between temperature and level (-0.502) and volume (-0.473) change. A positive relationship with strong significance is found between the precipitation and lake level (0.758) and volume (0.751) changes and a negative relationship is found between evaporation and lake level (-0.476) and volume (-0.426). According to the analyses done, it is found that the level and volume changes of Kovada Lake are related to the changes in precipitation rather than the changes in temperature and evaporation (Bahadır, 2012).

In the study, in which the effects of climate change on water resources are investigated, literature data about the decreases in water levels in Tuz Lake, İznik, Eğirdir, Manyas, Van, Ladik, and Sapanca lakes are collected. In this evaluation, it is reported that there was a 35% decrease in the surface area of Tuz Lake between 1987 and 2005, an approximately 23% decrease in the water potential of Beyşehir Lake, an approximately 10 m decrease in some coastal areas of İznik Lake, a 56 cm decrease in the level of Eğirdir lake, and an approximately 0.4 m decrease in the depth of Manyas Lake. Besides, it is reported that the 2 meter level decrease in Van Lake has resulted in an increase in

the salinity and soda level of the lake water (Yüksel, Sandalcı, Çeribaşı, and Yüksek, 2011).

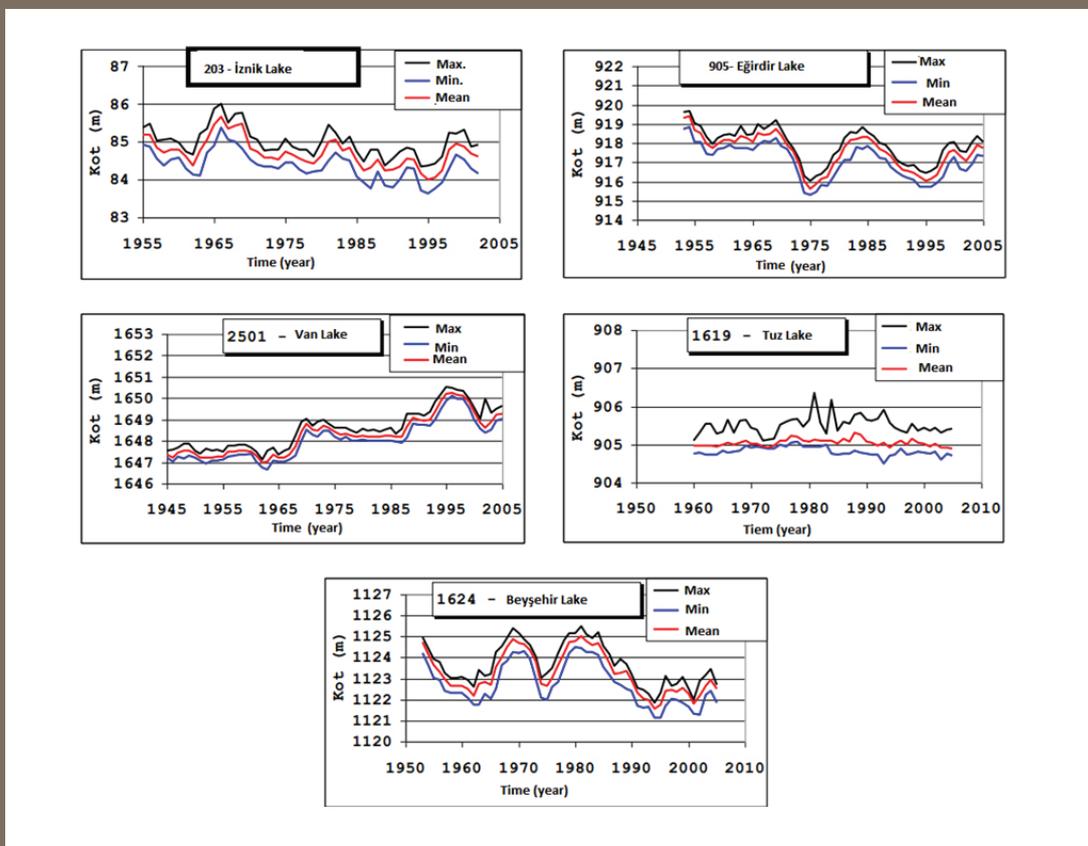
In another study, in which climate data and satellite photographs are tested, it is reported that the water and salt reserves have decreased between 1987 and 2005 related to drought and uncontrolled water usage (Ekercin and Örmeci, 2010).

In the study, in which the minimum, maximum, and average changes in the water levels are investigated with non-parametric Mann-Kendall and Sen's T methods, statistically significant and increasing trends were determined in all of the maximum, minimum, and average yearly water levels according to both of the methods and decreasing trends were determined in the water levels of Beyşehir, Eğirdir, and İznik lakes according to both of the methods. Statistically significant trends are not found in the yearly maximum and average water levels in Tuz Lake, because the results of Mann-Kendall and Sen's T test are lower than the critical value of 1.96.

While a trend cannot be determined for the yearly minimum water level according to Mann-Kendall test, a decreasing trend is determined according to Sen's T test (Figure 6.59).

In the study, in which the effects of climate change on water resources in the last 45 year term are investigated by taking hydrology, temperature, and precipitation data in Büyük Menderes River Basin in the west of Turkey essentially, important decreases are recorded in the current values that have strong relationships with the changes in temperature and precipitation on the main arms of Menderes river, especially between 1985 and 1998 (Durdu, 2010).

Especially in the river basins that are fed by snowing, the early melting of the snow affects the currents of the rivers. The increase in temperature causes the change of hydrological regimes and the climate conditions of the region by causing the early melting of snow. In the study, in which the early melting of the snow is analyzed with center-time method for 15 river monitoring stations that are picked from Fırat, Dicle, Aras, and



Çoruh river basins between 1970 and 2010 (Güventürk, 2013) meteorology stations that represent current stations according to river basin characters are also picked to be used in the analyses. Trend analyses are applied to temperature, precipitation and current data in order to relate the change in the center times with temperature and raining and the number of days, in which the temperature is lower than 0 °C, freezing point, and the number of rainy days in these days are analyzed until the center time day. In the study, it is determined that the changes about the regional temperature, precipitation cause important early snow melting and distinctive early melting is determined in eight of the fifteen stations in Firat, Dicle, and Aras river basins in the region.

### Terrestrial Ecosystems

The terrestrial ecosystems in Turkey consist mainly of agricultural ecosystems, steppe, forest, and mountain ecosystems.

Agricultural ecosystems (cultivated areas), make approximately 35% of the total surface area of Turkey and most of them reside in steppe regions. 70% of the total agricultural area consists of grains, 5% of it consists of fruit gardens, 2.7% of it consists of vegetable gardens, 2% of it consists of vineyards, and 2% of it consists of olive groves.

Steppe Ecosystems, steppes and meadowlands that are described as areas covered with gramineous plants cover a 21 million hectare area in Turkey. In Middle Anatolia, Aegean, and Mediterranean ecosystems, generally one or more year gramineous plants are common. Floristic composition of steppe vegetation is very rich and there are many endemic plants in it. In the high parts of East Black Sea Mountains and in the north and north east parts of East Anatolia, subalpine and alpine meadows cover large areas.

Forest Ecosystems, according to 2013 data, forest ecosystems cover 21.9 million hectare field in Turkey. In Aegean and Mediterranean regions, there are meadows and maquis, humid and semi-humid coniferous and dry forests (oak, larch, and red pine) together with coniferous and broadleaf forests.

### Mountain Ecosystems

The types of mountain ecosystems in Turkey change according to biogeographical regions, formation way, and altitude. These rich terrestrial ecosystems that Turkey has provides habitat for lots of endemic plant species, important bird species and a lot of wildlife species. Again in these ecosystems,

wild relatives of a lot of cultivars that are important in terms of agricultural biodiversity are present

The expected effects of climate change on terrestrial ecosystems are summarized below with the findings obtained from the results of the studies about the subject.

- Climate properties is the primary factor determining the biological diversity in a region and system. Species distribution according to climate conditions and form habitats. In this scope, because the changes in temperature and precipitation will affect the distribution of the organisms, the distributions of the species will change and a lot of species, primarily sensitive and endemic species, will be face to face with the risk of becoming extinct.
- A 1°C increase in the global average temperature will affect the species composition and the functions of forests importantly. New forest types may form with the formation of new species compositions. Besides, effects such as disease and fire will increase related to the increase in temperature. North forests will be affected by the increased temperatures more than the tropical forests.
- Especially the habitats of the species that spread in coastal areas and low altitudes and ecosystems will slide to higher altitudes.
- Increases are expected in the frequency, duration, and intensity of forest fires with the increase in the temperature and the decrease in the precipitation. Besides, the area of the forests that are very sensitive to fires, which consist of 60% of the forests of Turkey today, will widen .
- The change of life cycles of insects and pathogens and deterioration of forest trees and ambient conditions as a result of increasing temperature and drought will cause the increase of the numbers of secondary pests. The increase in the damage done by insects to the Fir and Spruce forests in Turkey can be considered in this scope. Besides, the biotic pests that normally do not exist in Turkey can enter our country through the neighbor countries. It is predicted that the deaths observed in Boxwood forests in East Black Sea in the last couple of years have occurred with the effect of the fungus species named *Cylindrocladium buxicola* and *Volutella buxi* (Tolunay et. al, 2014).
- Plant and animal species may migrate to areas with appropriate ecological conditions in order to adapt to the changing climate conditions. The vegetation zones observed in mountain areas in Turkey and forest boundaries may slide to higher altitudes. However, because there is generally no soil in the zone above forests and there are lots of rock areas, it can take very long times for the forest boundary to spread towards alpine zone. There may be problems because of habitat fragmentation and ecological barriers, especially in the migration of animal species.
- With the increase in temperature, the vegetation periods will

start earlier and will take longer by also covering autumn season. Some species will not be able to adapt to the changing conditions.

- The increase in the storms in the last years in Turkey are causing the falling down of the trees in the forests or getting damaged by being broken. In 16-17 October 2011, when the trees haven't shed their leaves yet, the snow and then the storm caused a lot of trees to fall down. The process of getting the fallen trees out of the forest is still going on and the estimated damage is 200 thousand m<sup>3</sup>. According to the records of General Management of Forests, approximately a 9.7 million m<sup>3</sup> tree property on a field above 1 million ha has been damaged by snow, wind, landslide, overflow, and drought between 2009 and 2013 (GDF\_c, 2014).
- One of the negative effects of climate change in turkey is the decrease of precipitation. This situation may especially cause the trees to shed their leaves early in order to adapt to summer drought. According to the defoliation ratio observations that are done in the scope of Forest Ecosystems Monitoring Program, the highest defoliation ration is observed in 2008, in which the decrease of precipitation is on the peak (Figure 6.60).
- In Turkey, alluvial forests generally reside in the areas in which the rivers fall off to the seas and their estimated total area is 11 thousand ha (Çiçek, 2004). The water that the rivers, whose flow rate increase because of the melting snow and raining in spring months, carry is very important for alluvial forests. At the same time, the increasing water amount of the

rivers in the spring months also opens the river openings, which were closed with sand piles in the dry seasons. However, the amount of water that the rivers carry has decreased because of the decrease in snowing in İğneada, in which important alluvial forests of Turkey reside. This situation affects the ecology of alluvial forests negatively. Besides it is also predicted that the decrease in the flow rate of the rivers and the increase in the sea levels will cause salting-related damage to the alluvial forests and riparian vegetation.

- While the steppe ecosystem in Middle Anatolia is a narrow line near the forest boundaries in the north and south, the steppe areas that cover large areas today will easily turn into a desert ecosystem in a large area surrounding Tuz Lake. Because Middle and South East Anatolia are dry areas predisposed to desertification with their sparse vegetation, desertification would easily occur in these regions. However, because there will be an improvement in the direction of sub-humid climate conditions in the north parts of Middle Anatolia, it may be expected that the present forest boundary will go down to south to a small extent.

### Marine Ecosystems

The coastline of Turkey which is surrounded by the Mediterranean, Aegean, Marmara and Black Seas is 8,592 km in length, excluding islands and 22% of these shores are under protection. These long sea and shore areas show different properties and have very rich biological diversity values in them. About 3000 plant and animal species were found in the territorial waters of Turkey until today.

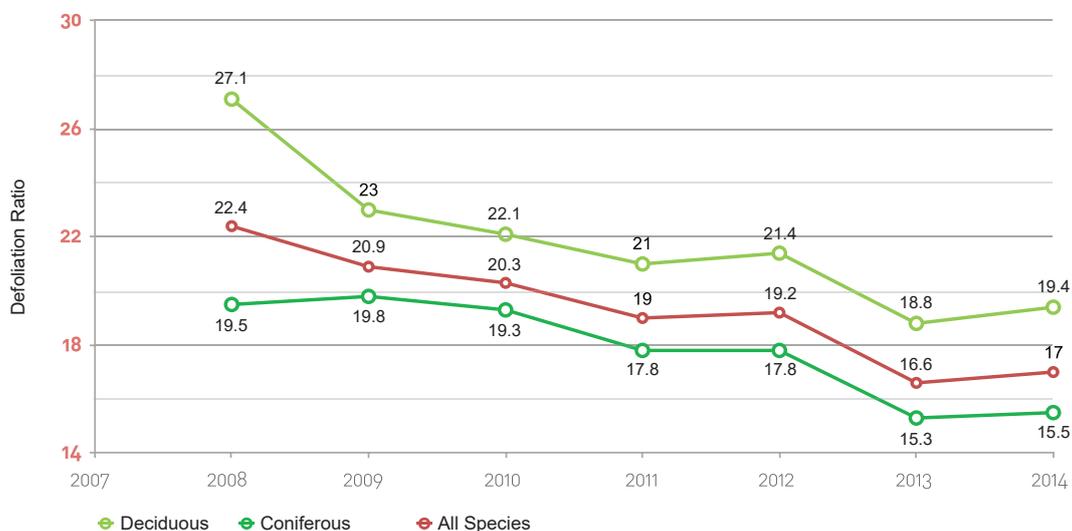


Figure 6.60 Average defoliation ratios in forests in Turkey between 2008 and 2013 [%]

Coastal ecosystems are very special in that they are important sudden transition regions (ecotones) in which marine and terrestrial ecosystems intersect. 4.1% of terrestrial resources that make the surface area of the country consist of coastal ecosystems. The difference between the alignment patterns of the mountains to the sea and the shore topographies in the shores of Turkey gave rise to various shore ecosystems such as dunes, caves, deltas, lagoons, calcareous terraces that differ according to different regions. Mediterranean Sea, which has the highest salinity and temperature rate among the seas of Turkey, is the region in which the biological diversity is the richest. There are 400 species of fish in the waters of Turkey in Mediterranean Sea, 300 species of fish in Aegean Sea, 200 species of fish in Marmara Sea, and 151 species of fish in Black Sea. The coastal areas in the East Mediterranean region are rich ecosystems with a very high flora and fauna diversity (MEF-a. 2007)

While the protected areas system of Turkey has a lot of sea and coastal protection areas, these areas have terrestrial and marine connections in many places. About 346,138 hectare marine area in Turkey is under protection and about 4% of the territorial waters are being protected (UNDP, 2014). Special Environment Protection (OCK) Areas are areas protected with national legislation in the scope of Barcelona Convention- Mediterranean Action Plan. 11 areas are under protection as Special Environment Protection Region in total in the Mediterranean and Aegean coasts in the shores of Turkey in order to maintain the sustainability of their sea and coastal biodiversity.

The effects of climate change on marine ecosystems show themselves especially as the increase in seawater temperature and seawater level, changes in the salinity, density and currents, destruction of biological diversity, alien species invasion, and loss of natural resources and the changes observed in the seas of Turkey are given below.

### Temperature increase

Mediterranean Sea has a 0.82% ratio among the ocean surfaces of the world and has 4-18% of the world's sea biodiversity. Besides its being a closed sea, it is defined as "miniature ocean" by physical oceanographers.

Climate modelings show that Mediterranean basin will be one of the regions that will be affected by the global warming trend with the increase of extreme events. A lot of studies done about the risks that the Mediterranean biological diversity is face to face with the temperature increase in the sea water verify this evaluation.

Béthoux et al. (1990) have determined a 0.12°C decrease (yearly average increase value is 0.004°C) in the bottom water temperature in 30 years at the end of evaluating the data obtained about the west part of Mediterranean Sea between 1959 and 1989 (Bethoux, Gentili, Morin, Nicolas, Pierre, and Ruiz-Pino, 1999). The data and observations obtained from this study have verified this result (Vargas-Yáñez, Jesús García, Salat, García-Martínez, Pascual, and Moya, 2008). However, there is no comparable data set/observation about the temperature increases in the east part of Mediterranean Sea, which includes Turkey. Besides this, some unexpected effects are observed in the thermocline circulation of East Mediterranean Sea in 1987 and 1992. Between those years, the strong anomalies in the temperature and raining have changed the hydrology of East Mediterranean Sea bottom waters to an important extent. The temperature, salinity (from 38.9 to 39.1), stratification, and circulation of the body waters have been affected (Roether, Klein, Manca Theocharis, and Kioroglou, 2007). The change in the carbon and nitrogen cycles has negatively affected deep sea biota. These observations that are done between 2004 and 2006 show that this change will also occur in the west basin of Mediterranean Sea (Schroeder, Ribotti, Borghini, Sorgente, Perilli, and Gasparini, 2008). This effect also caused cold water layer formation at the bottom in Aegean Sea (Lascaratatos et al., 1999).

Besides the fact that it cannot be known whether this change in the bottom waters will affect the shore waters or not, two types of climate effect is determined in the shallow depths as temperature increase trend and increase in the frequency of extraordinary events. The study done with a 30 year data set (1974-2005) obtained from the shores of Spain in West Mediterranean Sea has shown the temperature increase in littoral zones of four different depths from the surface down to 80 m for the first time. This data set has shown that there is an important temperature increase at 20 m with 1.4 °C and there are obvious temperature increase trends at all depths.

A study showing the temperature increase for East Mediterranean Sea, which does not have a data set, shows a 1.8 °C temperature increase trend in Aegean Sea with the satellite data about the sea surface temperature in the last 20 years (Theocharis, 2008).

In the study, which is done by using a three dimensional ocean model (ROMS) for the simulation of hydrodynamical and ecosystem properties of East Mediterranean - North Levant River Basin currents, studies about 5-year time periods in the past and in the future in order to investigate the sensitivity to climate in the near times. In the results of the study, 0.33 °C and 0.035 psu increases are estimated in the daily average values of surface temperature

and of saltiness respectively in the climate change scenario made for 30-40 years later. Besides this, an 8% increase prediction is made in the surface chlorophyll averages. Besides, a time sliding is determined in the terms in which the phytoplankton fecundity is the highest [Aydoğdu, 2012].

### Increase in the Number of Alien Species

All of the aquatic organism show distribution according to their salinity and temperature tolerances. Natural barriers in the seas, such as temperature, salinity and big lands prevent the species from being dispersed and cause them to remain in specific regions. This situation forms the natural biogeographical regions in the seas of the world. The changing of ocean currents, climate conditions, and a lot of other environmental conditions cause the changing of natural dispersion events. And this causes the development of the species, the change of the biogeographies and biological diversity, and as a result, the change of global ecosystem. The direct effect of temperature increase is observed as increase in the abundance of the species that can tolerate the temperature increase and decrease in that of stenothermal species. This change is found by the differences in the distribution ratios of the species since the first years of 1980s.

In the last years, the increase in the water temperature because of the tropical current from Strait of Gibraltar to Mediterranean Sea and climate change have caused the water of Mediterranean Sea to become tropical. The increase in the number of alien species that enter from the Suez Canal has also an important role in this change. Mediterranean Sea has

become the sea, in which the most biological diversity change has occurred with the increase in the number of alien species that enter from Suez Canal, in the last years and has become a region, in which the effects of climate change on the biological diversity can be ideally observed. Whereas the number of species that enter, settle, and disperse from Suez Canal to Mediterranean Sea was very little until mid-20th century because of the temperature and salinity barriers between the Red Sea and Mediterranean Sea [Zenetos et al., 2008], there was a very remarkable increase in this number later. This increase is directly related to the temperature increase in the water of Mediterranean Sea. Today, the number of species that has come from Suez Canal and settled in Mediterranean Sea is above 600. Some of the alien species cause changes on biological diversity with no return by competing with the indigenous species, collapse of the fishing industry, deterioration of the stocks of culture fishing, increase of the production costs, and the human health to be affected.

Çınar et al. (2011) have prepared an alien species inventory for Turkey coasts by considering alien species vectors and their origin seas by carrying out a detailed study by investigating scientific articles and reports, in which the alien species records of Turkey coasts between 1865 and 2011 are given. 400 foreign species record is given for the coasts of Turkey and 330 of these species are on Mediterranean, 165 of them are on Aegean, 69 of them are on Marmara, and 20 of them are on Black Sea. 74% of the 300 species, for which record is given in Mediterranean Sea, are Lessepsian species that have been carried by Suez Canal (Çınar et al., 2011).

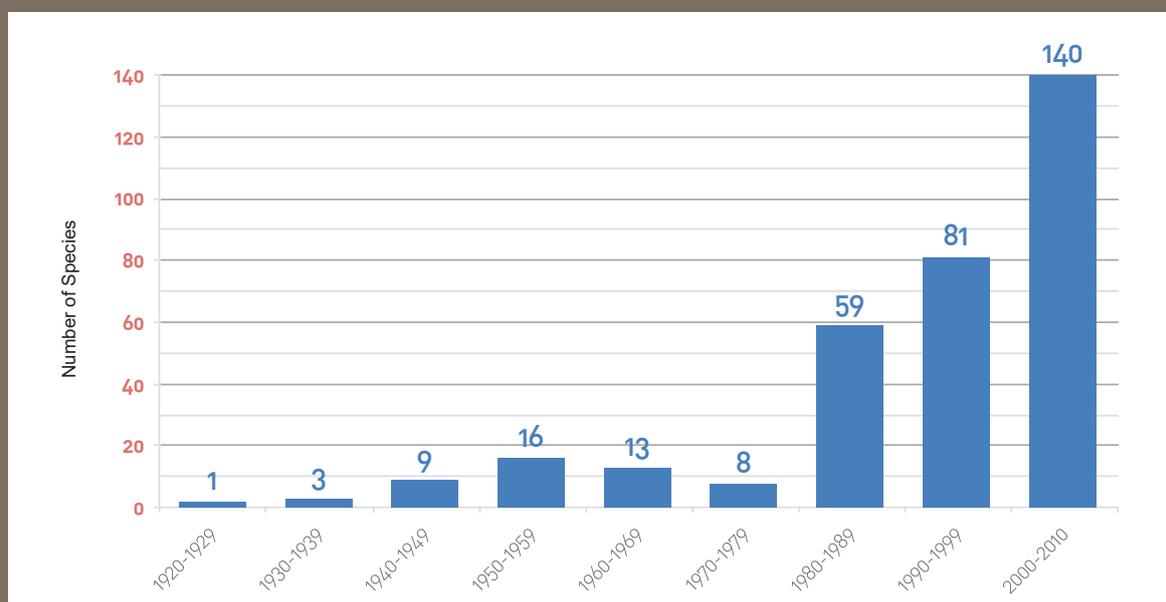


Figure 6.61 Alien species transportation number on Turkey-Mediterranean shores with 10-year periods

In Figure 6.61, the increase in the alien species transportation number on Turkey-Mediterranean coasts with 10-year periods is seen. In the last 20 years, more than two times this increase has occurred. In the report that was prepared about alien species in Turkey in 2015 by the Ministry of Forestry and Water Affairs, the number of alien species in East Mediterranean Sea is considered 450 (Uysal & Boz, 2015).

### Effects on biological diversity

*Posidonia oceanica* (Linnaeus) Delile is an endemic species of Mediterranean Sea and it can form beds down to depths of 40 m in clean and light waters. *Posidonia* is a species, which is under the protection of Barcelona Convention and the beds that it forms are considered among the habitats with priority in 92/43/EEC Habitat Directive. *Posidonia*, which is a marine flowering plant and is endemic to Mediterranean Sea, can live in shores down to 30 meter depth (it can even form barriers like reefs) and it has an effect of preventing coastal erosion to a large extent with the help of its subterranean body (rhizome). *Posidonia* meadows are an important component of biological diversity as habitats in which a lot of sea creatures ovulate and raise their offspring. This sea plant also plays a basic role in the fixation and storage of carbon (blue carbon) and has a very high primary production. It is an important species, which is used in the evaluation of water quality.

In the terms, in which the environmental conditions are not suitable, one species can change places with another. The basic pressures on Mediterranean sea grass meadows originate from the development on the shores, excessive consumption of live resources, solid and liquid wastes, cruise boats, and tourism. However, especially the invasion of exotic foreign species, the increase in the temperature of surface water, and the increase in the sea level, which are among the new pressures that are directly or indirectly related to climate change, cause important collapses of sea grass habitats (Jordà, Marbà, and Duarte, 2012).

The entering and settlement of macrophytes with exotic invader property to Mediterranean Sea and the competition of these species with the endemic sea bed species cause a very important effect. Especially the alien species from Red Sea that enter Mediterranean Sea through Suez Canal find very suitable conditions, in which they can continue their lives, because of the tropicalization of the water of Mediterranean Sea. *Caulerpa taxifolia*, *C. racemosa* var. *cylindrica* species, which are invasive species in Mediterranean Sea, are causing negative effects on *C. nodosa*, *P. oceanica*, and *Zostera noltei*, which are endemic species that started to deteriorate

because of various effects. *C. racemosa* has started to take the place of *Posidonia* meadows, which have been damaged in the shores of Turkey in the last years (Pergent et al., 2014).

Water temperature is a highly determining factor in the distribution of sea meadows. Because of the increasing temperature of Mediterranean Sea, there are differences in the distribution of these meadows and these changes are ongoing. The absence of *P. oceanica* in the south east basin of Mediterranean Sea is closely related to the increasing surface water temperature in the summer term. In the south east shores, there is a sudden decrease in *P. oceanica* meadows (Çelebi, Gucu, Ok, Sakinan, and Akoglu, 2006). The anomalies recorded in temperature values in the summer terms of 1999, 2003, and 2006 have caused important decreases in the liveliness of sea meadows.

Because phytoplanktonic organisms are the basic providers of organic materials both in seas and fresh waters, they are the primary producers of aquatic ecosystem. For this reason they both make the food of aquatic animals and provide protein, carbohydrate, fat, vitamins, and mineral salts to the zooplanktons, which are primary consumers. There are close relationships between the productivity of the aquatic medium and the planktonic organisms. It is known that there are relationships present between all of the feeding steps and these relationships are directly or indirectly affected by the properties of the medium, in the food chain that starts from phytoplanktons and continues to fish. Naturally, the changing of organisms in the food chain by amount or variety affects the living creature groups in the upper steps of the food chain. The strongest and fastest changes that occur in the structure of the aquatic ecosystem are seen in phytoplanktons.

In Integrated Pollution Monitoring in Seas Project - Marmara Sea Pollution Monitoring Study, which is supported by Ministry of Environment and Urbanization, it is determined that the phytoplankton data obtained monthly between 2007 and 2010 in Marmara Sea shows differences between years. Increases are observed in terms of the diversity and the fecundity of the species. While the phytoplanktons of diatom group are observed in February 2008, they are observed the most in September 2009 and April and September 2010. And while the phytoplanktons of dinoflagella group were dominating in spring, summer, and autumn months in 2008, it is determined that their domination slides to winter months in 2009. It is obvious that these observations in different times are related to the climate changes in the environmental conditions (Ediger et al, 2010).

As a result of a study done by Aktan et al. (2004) about the seasonal change of the fecundity and diversity of the epipelagic algae

groups (benthic algae groups) in the Bosphorus of Istanbul, the increase in cyanobacteria species is shown. Cyanobacteria increase is closely related to both eutrophication and global changes. Cyanobacteria are a living creature group that can well adapt to environmental stress such as UV, high solar radiation, increase of nutritional salts, and climate changes. Especially the change in the environmental conditions that are related to global climate change, especially in shallow and closed inner waters, cause algae explosions that these living creatures give rise to (Aktan, Balkis, and Balkis, 2014).

In the study, in which the changes occurred between 1960 and 1999 in Black Sea ecosystem are explained quantitatively and the changes that Black Sea ecosystem can show under the predicted physical and biogeochemical changes in the future are investigated; it is put forward that the structure of Black Sea ecosystem has changed as a result of a series of trophic cycles that occurred in the food web after 1960s. Dynamic model results have shown that eutrophication, excessive hunting, and extreme increase of trophic species have caused a breakage in the balance of the ecosystem. Model sensitivity tests have shown that the competition between species and excessive hunting is the main reason of the changes occurring in the ecosystem and these changes have reached more serious levels with the extreme increase of opportunist species such as Noctiluca and jellyfish, and all of these factors occur under the effects of the changes in primary production (Akoğlu, 2013).

### Increase of Water Level

In a study done by Kuleli et al. (2009), it is reported that the increase in the sea level is not very important on the coasts of Turkey, just like it is in a lot of regions of the world, and the coasts have regionally high sensitivity related to topography and collapses. In another study done by Kuleli et al. (2010), it is reported that Mediterranean shores of Turkey is the area, which will lose the most land in the case of an increase in sea level. When these findings are considered in terms of the natural resources and richness of Mediterranean Sea, it is predicted that especially the wildlife that uses the shore and the plants will be affected by this change importantly. There will be losses in the nesting areas of the turtle species, *Caretta caretta* and *Chelonia mydas*, whose number on Mediterranean shores is 21 and which are under protection. By the same way, coastal living areas of Mediterranean Sea, which is under protection as "critically threatened", will vanish.

Another important effect of the increase in the sea level is the loss of resource and biological diversity that will occur in the increasing salinity in the coastal areas.

## 6.2.4.2 Adaptation Measures

Following Turkey's taking part in United Nations- Convention on Biological Diversity 1996, "National Biological Diversity Strategy and Action Plan" is prepared as Turkey's responsibility according to the 6. Article of this Convention. This strategical plan has been updated by also considering the requirement that the activities of Turkey in this area must be in accordance with the regulations of European Union in the scope of nature protection sector and in this framework, six thematic working areas have been generated in order to adapt to the effects of climate change. These areas are agricultural biological diversity, forest biological diversity, steppe biological diversity, mountain biological diversity, inner waters biological diversity, and shore-sea biological diversity thematic areas. Climate change is added to the Action Plan as an article and it is decided that it will be considered in the scope of determining and monitoring the effects of climate change on biological diversity.

Based on National Biological Diversity Action Plan and according to the Directives number 92/43/AET and 79/409/AET in Turkey National Program About Undertaking the Acquired Rights of European Union, it is guaranteed that a frame law towards protecting biological diversity will be made starting from "after 2011" and "Nature and Biological Diversity Protection Law" design is prepared.

"Protected Areas and Climate Change National Strategy of Turkey", which was prepared by Ministry of Forestry and Water Affairs in 2011, is prepared in order to develop the effective management of the protected areas in Turkey, make the role of the protected areas understandable for all of the parts, and carrying out activities in this direction for decreasing climate change in the process of global climate change and adapting to its effects. In this strategy, generating a "protected areas system" in Turkey, planning protected areas, and generating a policy about their management, increasing the number of research, raising awareness, and information sharing are subjects with priority in the context of protected areas and climate change. The strategy is considered in three basic groups and these groups are forest, wetland, steppe, and coastal ecosystems.

The aims, goals, and strategies of General Directorate of Forestry Strategic Plan (2010-2014) are prepared in accordance with the Ninth Development Plan (2007-2013), Tenth Development Plan (2014-2018), Forestry Special Expertise Commission Report, National Forestry Program, Medium-Term Program (2009-2011), Medium-Term Financial Plan (2009-2011), and the other forestry sector plans and programs. In also GDF Strate-

gic Plan, seven basic goals with priority are determined for sustainable forest management and all of these are directly or indirectly related to the aims of adapting to climate change.

### Studies/projects that are being carried out

There are a lot of projects that are carried out with the coordination of Ministry of Environment and Urbanization and Ministry of Forestry and Water Affairs with the purpose of protecting ecosystems, nature, and biological diversity in Turkey and maintaining their sustainability. Especially the studies done on protected areas, which are an important part of the global campaign against climate change, are important in maintaining the sustainability of natural ecosystems of terrestrial/marine scale and ecosystem services.

In Decreasing the Effects of Climate Change and Sustainable Usage of Biological Diversity and the Wetlands in Turkey in Order to Protect them (2009-2011) project, it is aimed to develop national and local wetland management systems with the purpose of decreasing the effects of climate change on wetland ecosystems. In the studies done by GIZ (German Technical Cooperation Institution) and General Directorate of Nature Conservation and National Parks, a management model that covers protection of wetlands for their adaptation to climate change, their rehabilitation, and sustaining their ecological functions is generated.

Determining the Climate Change Decreasing Potentials of Yeniçağa Lake (Bolu) and Akgöl (Konya) Wetlands (2012) project is a part of the project above and in the framework of this project, activities towards protecting the wetlands and restoring them are carried out in Yeniçağa Lake and Akgöl, which include two important peat beds of Turkey. Peat beds are the most important terrestrial ecosystems for carbon holding on the World. Carbon and the other greenhouse gases that are held in two pilot areas are estimated by taking the global indexes and the other studies of the project into consideration. It is revealed how much the protection studies and restoration applications that were done by using this information have prevented gas release to the atmosphere and how valuable this is economically. In the project study that was done in 2012, an effective tool is generated for protection by revealing the effect of protecting and restoring the wetlands in Turkey on the campaign against climate change.

Reinforcement of Protected Areas System in Turkey: Generalizing the Sustainability of Sea Shore Protection Areas Project (2009-2014) - In the project, which is supported by GEF 4 - Global Environment Fund, it is aimed to reinforce the national sea and shore protection system of Turkey and maintaining its effective management.

The project named Reinforcement of Forest Protection Areas Management Project - Küre Mountains National Park (Kastamonu-Bartın) (2008-2012) is carried out under the coordination of General Directorate of Nature Conservation and National Parks and it is aimed to develop the position of our forests in the national protected areas and their administrative effectivity by generating an effective and integrated management model, which is based on participation principle with the purpose of nature protection and sustainable resource management.

In the project named Developing Forest General Management Capacity for Sustainable Forest Management Applications in the Context of the Water Usage of the Forests - 1. Step (2012-2013), it is aimed to check the present policies and strategies for sustainable forest management by bringing a deeper understanding to the potential results of climate changes including desertification and loss of biological diversity on forest and water interactions and integrating water function to forest management plans in order to adapt to climate change and contribute to reducing it.

In the scope of Wetland Management Plans Preparation (2011-2017), it is aimed to prepare management plans for all of the wetlands with international importance based on "Ramsar Convention - Guidelines on Wetland Management Planning" in the framework of the decisions in Protection of Wetlands Regulation (Official Gazette with the date 17 May 2005 and number 25818), (especially 26. article). The project is being managed by Ministry of Forestry and Water Affairs.

## 6.2.5 Coastal Areas

### 6.2.5.1 Expected Impact and Vulnerability

The total length of the shores of Turkey is 8,592 km, except for the islands. There are 28 coastal cities in these regions. According to 2009 population counting data, approximately 54.7% of the population of Turkey live in these cities.

The population density approximately doubles in the cities on the coastal line in Turkey. Besides this, the pressure on coastal cities is even more because of intensive migration. It is predicted that climate change will affect coastal areas, which show more sensitive properties and structure compared to the inner parts, very much. Coastal erosion, flood, and inundation are of the important problems on our sea fronts in Middle and East Black Sea, North Aegean and East Mediterranean regions, especially when the near past is considered. Touristic and coastal

cities are especially under threat.

Water need is usually met from underground reserves in coastal areas. Excessive use of underground water causes salty water entrance and increase in water resources used for purposes such as agriculture. Aquifers in and around Istanbul can be shown as examples to this (Öztaş, Dumlu, & Vardar, 1995).

The effects of climate change will be very much on the coastal areas. Coastal and shore areas, on which the pressure of urbanization is the most intensive, are more sensitive to the effects of climate change compared to the other areas (IPCC\_c, 2007). With a possible increase in the sea level, wetlands close to the shore may face the threat of disappearing by mixing with sea water (IPCC\_d, 2007). It is put forward that especially the settlement areas at sea level and up to 10 m above sea level are under threat, 2% of the world consists of these areas, approximately 10% of the population (approximately 600 million) of the world lives in these areas, and 13% of the urban population (approximately 360 million) lives in these areas (Tacoli, 2011, and Çobanyılmaz, 2011). The acidification that can be seen in seas and oceans in relation to the increase of greenhouse gases would damage the present ecosystems (EPA, 2012). Sea level measurements are being done since 1922 with intervals and since 1985 continuously in Turkey (TUDES, Turkey National Sea Level Monitoring System, www.hgk.msb.gov.tr). The obtained results are shared with Global Sea Level Observing System (GLOSS).

In order to determine the general risk situation of coastal regions against sea level increase and disasters, CVI (Coastal Vulnerability Index) analysis is applied to all of the coastal regions. In the evaluation, affectability indexes are estimated with a simple model by using coastal population density, vegetation percentage, topography, and human development situation indications. In the end of this study, Adana, Çanakkale, Samsun, Balıkesir, and Aydın, which have delta areas, were determined as the most risky regions. There are studies about land losses that can be expected in Turkey according to the sea level increase scenarios (Demirkesen, 2008; Alpar, 2009; Kuleli et al., 2009). The results of the study show that the places to be affected the most by climate change on the coasts of Turkey are coastal deltas, in which agricultural production is the highest, wetlands, and tourism regions with low altitudes.

Simulations about the future predict that there will be a decrease in the total precipitation amount in Aegean and Mediterranean shores and increases in Black Sea shore of Turkey (DEMA, 2014).

## 6.2.5.2 Adaptation Measures

Studies of adaptation to climate change that were carried out on the coastal regions are given below.

### Determination and Classification of Sea and Coastal Waters Project (2011-2014)

In the scope of the project, it is aimed to generate the necessary information and application tools that will support "management with ecosystem approach" principle applications for the applications of EU Water Framework Directive (2000/60/EC) and EU Marine Strategy Framework Directive (2008/56/EC), which have come into effect in 2008. Besides, it is also a strategic aim of the Project to prepare the proposals that are directed towards the sustainable usage of our shore and sea resources and are based on good environmental level aims and present them to the decision makers and appliers that need to do mutual planning. The studies done in the scope of the project can be summarized as the definition of coastal and transition waters, determining coastal water typologies and water management units, classifying coastal waters according to their ecological qualities, determination of the gaps, local evaluation of the "good environmental situation" of the seas, determination of the aims and their indicators, and formation of the application structure.

### Management of Urban Sewage on the Coasts of Turkey Project

In the scope of SINHA project, the coasts of our country is evaluated in terms of eutrophication risk according to Urban Sewage Purification Regulation and classified as sensitive and a little sensitive. Sensitive coastal areas that were determined in 2009 were updated in 2011. Loads with urban and industrial source are estimated on the shores in order to be able to do pressure-effect analysis. Loads that will come to urban sewage purification sites in 2020, 2030, and 2040 in the present situation and related to the population productions are determined. Sewage purification conditions of municipalities on the coastal areas of Turkey are investigated and their improvement needs are determined. Settlement areas, in which there is not urban sewage purification sites, are evaluated according to specific principles (sensitivity of the coast to eutrophication, population, etc.) and sewage purification site processes are proposed. Coastal area classifications that were determined at the end of the evaluations done on coastal areas are given in Figure 6.62.



Şekil 6.62 Classification of the coastal areas of Turkey according to their sensitivities

### Integrated Coastal Area Plans

Integrated Coastal Area Plans are being prepared under the coordination of Ministry of Environment and Urbanization. Aims of the study can be summarized as;

- Bringing a new approach to coast planning and application studies in our country,
- Determining the precautions about protection and inspection on the coasts,
- Directing local expectations and requests in coastal areas,
- Regulating the authorization areas that intersect on the coasts, and
- Maintaining integrated policies and decision making processes that take all of the sectors into consideration for encouraging the usage of coastal areas by protecting them in a coherent and balanced way and producing instructive strategies and aims for applications about the coastal buildings that will be made on coastal areas.

By September 2014, Integrated Coastal Area Plans are approved for 20% of the coastal areas and 15% of the plans are in the approval step. It is planned to complete the remaining 65% until the end of 2016.

With the Legislative Decree about the Governances and Duties of Ministry of Environment and Urbanization with date 4 July 2011 and number 644, it is stated that management and planning works of the integrated coastal areas are among the duties of Ministry of Environment and Urbanization. In the present situation report prepared in the scope of Upper Scale Spatial Strategy Planning Preparation, Application, and Monitoring Process, Determining the Method and Essentials Project (2012-2014), it is stated that there is no definition for Integrated Coastal Areas Management (BKAY) and Plan (BKAP) in the legal regulations in our country and there is a need for this definition. At the end of the regulation studies started later; in the scope of "Spatial Plans Building Legislation", which has come into effect by being published in the Official Gazette

with the date 14.06.2014 and number 29030, the definition of "Integrated Coastal Areas Plan (BKAP)" is made and these plans are defined as plans that do not take place in spatial planning echelonment, are prepared with the strategical approach special to the coastal and interaction area, and direct construction plans. Besides, with the legislation, Essentials about Integrated Coastal Area Plans, which are planned to be prepared as a guide document for the planning, project designing, and applications of institutions and corporations authorized on the coastal areas, legal managements and enterprisers, are determined. BKAP is shortly defined as a plan that considers coasts, all sectoral activity and plans together with their interaction areas in a way that it will also include social and economic subjects, and includes the protection of the coastal ecosystem in the direction of sustainable development principle, and spatial aim, strategy, and action proposals in which the usage of natural resources is primary.

### Detection of Dangerous Substances in the Coastal and Transition Waters of our Country and Ecological Coast Dynamic Project (2012-2014)

Determination of dangerous substances that affect our coastal and transition waters, development of the receiving media standards for these substances, determining and classifying water quality, and as a result of this, taking the necessary precautions in order to reach good water quality are important in EU adaptation process. For this reason; in the scope of the project that was carried out and completed in 2014 by Ministry of Forestry and Water Affairs, dangerous substances that are and may be present in the coastal and transition waters as a result of point-sourced discharges are determined on the sectoral basis, monitoring studies towards putting forward the presence of these substances in the receiving media were carried out, environmental quality standards were developed, their effects on the ecosystem were investigated, and the precautions that need to be taken on the sectoral basis were put forward.

### Integrated Hot Point Management for the Protection of Black Sea Ecosystem. (2013-2015)

Aims to reinforce cooperation over boundaries by developing mutual policies by determining environmental threats that come to Black Sea River Basin from pollution sources that stem from the land and evaluating the results of receiving media monitoring studies.

## 6.2.6 Health

### 6.2.6.1 Expected Impact and Vulnerability

The effects of climate change on human health may be direct or indirect. Whereas extraordinary climate events such as flood, extremely hot waves, and storm affect human health directly, the long term effects of climate change have indirect effects on human health by causing water, food, and shelter problems. Climate change can cause changes in the distribution of vectors that carry contagious diseases by disrupting ecosystems and population density, and in this way, an increase in the frequency of the diseases that are transmitted by vectors (Estrada-Peña, Vatansever, Gargili, and Ergönül, 2010).

The direct or indirect effects of climate change on human health are given below:

- Deaths and injuries related to extreme climate events
- Increase in the diseases transmitted via water and food
- Increase in the respiratory diseases related to the disruption of air quality
- Increase in the allergic diseases related to seasonal slide and disruption of air quality
- Increase in the diseases transmitted by vectors and rodents
- Increase in the skin cancers related to the thinning of the ozone layer

### The Effect of Extreme Climate Events

**Heat waves:** The negative effect of hot waves on human health are well known. Especially children, elderly people and people with underlying chronic heart and lung diseases are affected very much (Lowe, Ebi, and Forsberg, 2011). When extremely high temperatures are in question, especially the admission of people in this risk group to the hospitals and deaths increase. There is not enough data about this issue in our country. A study done by Oktay et al. in Antalya shows that the frequency of people with congestive heart failure admitted to the emergency services is higher in hot months (Oktay, Luk, Allegra, and Kuşoğlu, 2009).

**Floods:** An expected effect of climate change is the floods that occur as a result of sudden raining and especially take place in cities. According to the data of international disaster database (EM-DAT), 1350 people died because of the floods occurred between 1970 and 2014 in Turkey and about 2 million people were affected by these floods (EM-DAT, 2015).

### Diseases that are Transmitted by Vectors and Rodents

Climate changes can cause increase in the population of the vectors and rodents that carry microorganisms causing diseases in people. As a result of this, serious increases occur in

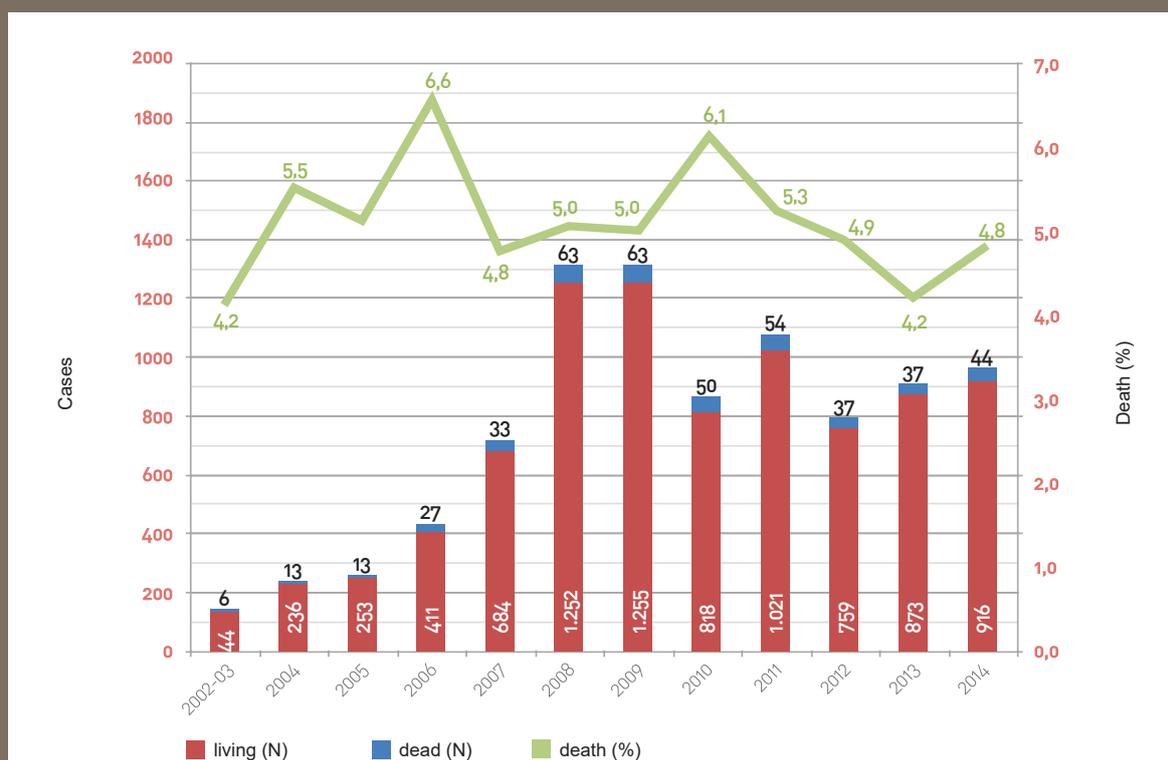


Figure 6.63 Crimean-Congo Hemorrhagic Fever cases in Turkey

the frequency of the infections that these microorganisms cause in people. Among these infections, tularemia, malaria, and Crimean-Congo hemorrhagic fever are diseases candidate to generate public health problem in Turkey.

**Tularemia:** Tularemia is a disease that is transmitted to people by water and food that is contaminated with the urine and other excretions of rodents and present with high fever and lenfadenopathy. There is a remarkable increase in tularemia cases in Turkey in the last years. According to the results of a large scaled study about this subject, 866 (60%) of the 1441 patients, who were diagnosed in the 75-year time period between 1936 and 2011, were diagnosed in the last ten years (Gürcan, 2014). Most of the tularemia cases in the last 10 years were found in south east of Marmara Region and north parts of Middle Anatolia Region, in which a temperature increase trend is observed. It is possible to claim that the increase in the tularemia cases are because of the increase in the temperature, when the fact that the average temperature curve of Turkey shows a regular increase since 1995 is considered.

**Malaria:** Malaria is the first one of the diseases that are known to be related to climate change (MEF\_b, 2007; Lowe, Ebi, and Forsberg, 2011). However, climate change is not the only factor determining the malaria case numbers and health services are also deterministic besides this. As a result of this, Malaria case numbers have decreased distinctively in the last 10 years in our country.

**Crimean-Congo Hemorrhagic Fever:** Crimean-Congo hemorrhagic fever is a disease, which is especially seen in Asia, Africa, Middle East, and East Europe, and it was seen for the first time in Kelkit valley in 2002 in our country.

According to the official records, 9062 people were diseased and 440 people died because of Crimean-Congo hemorrhagic fever between 2002 and 2014 in Turkey. Corum, Kastamonu, Tokat, Yozgat, Karabuk, Samsun, and Sivas are the cities in which the disease is the most common and more than 80% of the cases in Turkey are being reported from Middle and North Anatolia regions. Among the reasons for the disease to be this much common, the increase in the number of ticks that carry the disease virus because of the climate change, turning forests into agricultural areas, and the increase in the number of rodents that play the role of blood resource for the ticks, again because of climate change (Estrada-Peña, Vatansever, Gargili ve Ergönül, 2010).

## 6.2.7 Settlement Areas and Tourism

### 6.2.7.1 Settlement Areas

#### Expected Impact and Vulnerability

The settlements are directly affected by climate change and indirectly affected by the events that occur related to the change (temperature increase, increase in the sea level, change of raining regimes and wind velocities, hot waves, heat island effect, and disasters like tsunami, flood, overflow, erosion and landslide, and drought) (IPCC 2001f; ICLEI, 2010). This response has effects especially towards urban life quality and sustainable development. The central role and importance of the settlements in climate change have come into subjects with international priority starting from IPCC Third Evaluation Report. Controlling the direct and indirect urban emissions has a high potential of decreasing total greenhouse gas emissions (McKinsey and Company, 2009).

When the urbanization experience of Turkey is investigated as related to climate, the unbalanced distribution of the increasing population to the settlements is one of the first urbanization problems about climate change. Because the urban population absorbs the general population increase and a part of the rural population, it is expected that the rural population will decrease in the world in general starting from the next ten years (MD\_a, 2013).

The present spatial development types and consuming habits in Turkey and the increasing urban population continue to be a source of greenhouse gas release. Because its adaptation capacity is not high, Turkey, which is one of the developing countries, is more vulnerable in terms of its being prone to damage against the effects of climate change (CBCC, 2009, Çobanyılmaz, 2011). The demographical and spatial development fashions and the general structure towards urban habits that determine this condition is given in the reports (2013) that the Ministry of Development has prepared.

The urbanization ration, which was about 24% in the country in general during the first years of the republic, it has reached 53% in 1985 and 76% in 2010 and it is expected that the urbanization ratio will swiftly increase in the west of the country in the next term. For this reason, the number of large settlements and their ratio in the total population are swiftly increasing (MD\_a, 2013). As seen in Table 6.9, there has been important changes in the sizes of the metropolises, especially of the ones with high population, in 2010 in Turkey in general.

An increase is seen in the size distribution of the metropolises especially with high population in 2010 in Turkey in general.

City Size Distribution	2000	2010	Population	Ratio to Country %
>5 mile	1	1	13,255,685	17.98%
5-2 miles	2	3	11,326,059	15.36%
2-1 mile	4	8	13,749,812	18.65%
1 mil. 500.000	13	12	13,365,926	18.13%
500.000-250.000	26	22	13,168,275	17.86%
250.000-100.000	26	27	7,810,978	10.60%
<100.000	9	8	1,046,253	1.42%

Source: K rođlu, 2012

**Table 6.9** Distribution of the urban ratios

When it is investigated in terms of urban density, an important portion of the population prefers to live in the settlements in the west regions, especially parallel to the development differences between the regions. While the population density increases in the west and coastal parts of the country, it decreases in eastern parts.

Building stocks have a large portion in greenhouse gas emissions. For this reason, building sector is the sector which presents the most possibility for energy efficiency improvement. TOKI (Housing Development Administration of Turkey) has built approximately 500,000 houses between 2003 and 2011 in Turkey (TOKI, 2015).

Related studies carried out by the Ministry of Environment and Urbanization, Infrastructure and Urban Transformation Services Directorate General are shortly these:

- Increasing energy efficiency of the buildings in the regeneration areas: It is known that the areas and buildings, in which the American LEED system is applied, 24-50% energy efficiency (electric, natural gas, etc.) is obtained and 33-39% decrease in CO<sub>2</sub> emission is obtained. The comparison is according to the base building defined in American Ashrae 90.1 standard. The base building defined in the National TS 825 standard is at a lower energy efficiency level compared to this building.
- Increasing of the energy efficiency originating from the operating of the infrastructures: By decreasing the amount of drinking water that enters the buildings and decreasing the solid waste produced in the buildings, it will be possible to decrease the greenhouse gas emissions, which are originating from the purification, transmission, recycling, and disposal of these. Besides the fact that there is no national data in our hands, it is known that the water consumption is decreased by 40% and the solid waste production is decreased by 70% in the areas and buildings in which the American LEED system is applied. With the help of this decrease, besides the decrease of

CO<sub>2</sub> related to energy efficiency originating from the processing and transmission of sewage and solid waste, it is possible that other greenhouse gases such as methane, which are released in these processes.

- Increasing of the energy efficiency originating from the reuse of building debris waste by recycling: In the case that the ruin wastes that originate from the demolishing of 6.5 million independent units are not stored in the nature but they are recycled and their usage in building new buildings is encouraged, not only will the carbon sink capacities of the areas in which these are stored and from which new raw materials are extracted be protected, but also will the energy and water resources that are consumed while extracting and carrying these to the production places be protected. Because sectors like cement, steel, aluminum, glass, and ceramic production are sectors that consume intensive energy, but on the other hand they are important industrial sectors of our country and their locality is important for the urban regeneration to be supported, CO<sub>2</sub> emissions that originate from these sectors are inevitable. However, the mining activities that are carried out in order to produce the raw material that these sectors need are as energy intensive as those activities. With the purpose of avoiding these, R&D and legislation studies that will direct the sector about selective dismantling and recycling are being carried out.

The main topics that are considered in urban planning in the context of climate change are transportation, settlement, green areas, energy, and waste management and these topics form the basis of the sustainable city planning approach, which is defined as "...settlements with low carbon emission, which present high life quality" by EU (2009). In this scope, especially in Metropolitan Municipalities, strategical development goals are determined and projects are prepared in order to increase the efficiency in urban water and energy usage, increasing the amount of open and permeable areas and urban green fields, reducing the deterioration of air quality, and reducing the amount of released greenhouse gases. Examples to the projects that are prepared in this scope by local managements are given in the following chapters

### Adaptation Measures

In the scope of "National Climate Change Action Plan-NCCAP", there are the aims of

- Determine the amount of carbon held in the settlement areas in land use and forestry sector in 2012 and increase this value by 3% with green space until 2020,
- Effectively applying 'Regulation Regarding Energy Performance in Buildings' and other energy efficiency legislations in all of the buildings in buildings sector until 2017, obtaining at least 20% of the yearly energy need of the new buildings from renewable energy resources starting from 2017, decreasing

greenhouse gas emissions at least by 10% in the new settlements compared to the present settlements until 2023,

- Restricting the emission increase rate originating from personal vehicle usage in transportation sector in local transportation, doing the necessary legal legislation and administration for sustainable transportation in the settlements until the end of 2023, taking the local precautions in order to encourage alternative fuel and clean vehicle usage in urban transportation until 2023,
- decreasing the amount of biodegradable waste that will be accepted to the regular storage sites to its 75% until 2015, 50% until 2018, and 35% until 2025 by weight, by taking 2005 as the basis in the waste sector, building solid waste disposal sites in the country in general until the end of 2023 and dis-

posing 100% of the municipality wastes of in these sites, completing Package Waste Management Plans, closing 100% of the wild storage areas until 2023,

- Considering the water management of the settlements with the adaptation to climate change point of view, in water resources management.

The contribution that the urban regeneration activities that are done by Ministry of Environment and Urbanization in the framework of The Law of Transformation of Areas under the Disaster Risks (Law No. 6306) the campaign against climate change in the settlements is summarized in Table 6.10.

Sectors in which Greenhouse Gas Emission Control will be Applied	Sectoral Aims and Goals	Precautions that can be Taken in the Framework of Urban Regeneration
Buildings	<p>Increasing energy efficiency in the buildings</p> <p>Increasing the usage of renewable energy in the buildings</p> <p>Restricting the greenhouse gas emissions originating from settlements</p>	<p>Buildings, whose building and lifetime cost are the cheapest can be encouraged instead of the buildings whose first building cost is the cheapest.</p> <p>Buildings with zero CO<sub>2</sub> emission can be encouraged (heating, cooling, illuminating).</p> <p>With the help of mixed usage, the waste heat that originates from some urban usages can be used in the heating of the other usages with heat pumps.</p> <p>For people who live in singular green buildings, the cost per one consumer in the scale of island or district can be made fungible for the renewable energy investments, whose costs are non-fungible. A collective building management system that can make a collective investment decision can be founded.</p>
Industry	<p>Reinforcing industry sector capacity for fighting climate change</p>	<p>Environmental effects of the settlements and buildings can be evaluated with life cycle assessment (LCA) and following their Environmental Product Declaration (EPD), the products to be used in the buildings can be released to the market with CE sign. In this way, it can be encouraged that the building materials will be more efficient by also including processes of raw material obtaining, production, and carrying to the construction area.</p>
Transportation	<p>Reconstruction of urban transportation in the direction of sustainable transportation principles</p> <p>Generalizing the usage of alternative fuel and clean vehicle technologies in transportation sector</p> <p>Developing the information infrastructure in transportation sector</p>	<p>Empty areas can be obtained in the collective property by incorporating parcels in the regenerated settlements. In these places, equipments, workplaces and mercantile usages that will decrease the transportation demand in the area can be made and operated. Transportation to these site can be maintained by pedestrian and bicycle transportation.</p> <p>Precautions such as prohibiting the parking of vehicles with fossil fuel or not giving concession to the gas stations can be taken. Additional public improvements right can be given to the functions that can be certified that will have positive effects to the sustainability of the area in the framework of life cycle analysis by calculating the transportation demands in the area.</p>

Sectors in which Greenhouse Gas Emission Control will be Applied	Sectoral Aims and Goals	Precautions that can be Taken in the Framework of Urban Regeneration
Waste	Maintaining effective waste management	Increasing of the lifetime and potential of recycling of the materials to be used in the buildings can be encouraged (in the framework of EPD) by certifying the contribution of the buildings and settlements to the sustainability performance. Building rubbles and packages that cannot be recycled can be reclaimed as filling material in the regular waste sites and the other infrastructure projects in the area. The decreased wild storage can be reclaimed as carbon sink potential. With the help of the economics of collecting on the scale of settlements, the separation of all of the domestic waste and entry to the recycling sites can be ensured. Biological wastes can be turned into heat energy with the ability of biomass.
Agriculture	Increasing the carbon sink capacity of agriculture sector Restricting the greenhouse gas emissions that originate from agriculture sector	By making agriculture on the roofs and flats in the collective property areas in the settlement, carbon sink capacity can be maintained in the settlement. With the help of the fact that there will be no need to carry the agricultural output to the settlement, greenhouse gas emissions can be restricted.
Land Use and Forestry	Restricting the negative effect of land usage and changes such as forest, pasture, agriculture, and settlement on climate change	By making the settlements tidy rather than widespread, new zoned area demands may be decreased. It can be encouraged to make the equipments privately in the collective property with the public improvements rights. (DOP) left for public usage can only be green area and roads. In this way, the sink capacity of the settlements can be increased. Sink capacity can be increased by decreasing the base area of the buildings and increasing the ratio of soft ground. (building car parks and other sites underground)
Mutual Subjects Between Sectors in the Emission Control	Building the necessary infrastructure in order to prepare a more healthy emission inventory. Using the emission trade mechanisms that contribute to effective cost restriction of greenhouse gas emissions at the optimum level	A national structure and a settlement certifying system based on Life Cycle analysis can be made. In this way, the environmental effects of urban regeneration can be certified in the framework of the methods based on standards and which are accepted internationally. A national Environmental Product Declaration (EPD) program can be founded. In this way, the real environmental effects of our lifestyle can be put forward, including not only the building materials, but also the other products used in the buildings. Contribution of the certified savings to our country guarantees about the climate change can be maintained. The owners of the savings can be directed to carbon trade.
Adaptation to Climate Change Action Areas	Aims and Goals about the Action Areas	Precautions that can be Taken in the Framework of Urban Regeneration
Management of Water Resources	Integration of the approach to adaptation to the effects of climate change to the policies of water resources management	The application of building technologies that decrease daily personal water usage can be ensured. (e.g.: water-saving taps, purifying and using gray water and rain water, etc.)
Agricultural and Food Safety	Planning the agricultural water usage in a sustainable way	By making agriculture in mutual living spaces (flats and gardens) the sewage in the area can be reduced to zero.

Sectors in which Greenhouse Gas Emission Control will be Applied	Sectoral Aims and Goals	Precautions that can be Taken in the Framework of Urban Regeneration
Ecosystem Services, Biological Diversity, and Forestry	Integration of the approach of adaptation to climate change to ecosystem services, biological diversity, and forestry policies	Precautions can be developed in order to protect the endemic species in the areas to be opened for usage for new settlement as reserve area.
Natural Disaster Risk Management	Reinforcing intervention mechanisms to natural disasters related to climate change	Social organization can be maintained in order to protect the sustainability of the area by founding "collective building managements" at the level of settlement.
Human Health	Determination of the present and future effects and risks of climate change on human health.	Minimum requirements can be defined for the inner air quality and heat comfort conditions of the buildings.
Common Subjects Between Sectors in Adaptation to Climate Change	Ensuring adaptation to climate change in the parallel subjects	Encouraging precautions can be developed about settlement residents' taking the necessary responsibility about their life-style adaptations and management.

Source: Yalazi, 2014

**Table 6.10** Contribution of the Urban Regeneration to Climate Change Action Plan

Attempts were started by Ministry of Environment and Urbanization, Infrastructure and Urban Transformation Services Directorate General in order to prepare an Ecological Settlement Unit Standard, in which all of the precautions described above can be included (Yalazi, 2014). "Ecological Settlement Unit" standard study and pilot project application aim the formation of a new application language in the framework of the urban regeneration studies to be carried out in the scope of the Law No. 6306. It is aimed to add the sustainability level to the aim of forming brand settlements that are resistant to disasters of the Ministry, together with the financial supports and planning precautions that will be separately defined based on the law. Ministry and related directorates continue their studies especially in the scope of increasing carbon sink potential originating from improving the urban area use.

In the case that the application of Ecological Settlement Unit standard during urban regeneration activities is ensured with new projects, which is aimed by Ministry of Environment and Urbanization, Infrastructure and Urban Transformation Services Directorate General to be completed in 2015, it is aimed to decrease the greenhouse gases by bringing down 6.5 million independent units and rebuilding them.

With Heat Insulation Legislation in Buildings of June 2000 (TS 825), insulation standards are developed in the new buildings and the present buildings, 15% of which are renewed. The standards helping the development of the policy of Turkey towards increasing the energy efficiency in the building stock and the relevant legal framework The national energy policy started to be formed with the preparation of Energy Efficiency Strategy Draft in 2004 and making of Energy Efficiency Law in 2007 (Law No. 5627) by Ministry of Environment and Urbanization. It is aimed to restrict the greenhouse gas emission of the buildings in terms of primary energy and carbon dioxide

(CO<sub>2</sub>) emission and regulate the protection of environment with "Building Energy Performance (BEP) Regulation", which was prepared in accordance with "Energy Performance of Buildings Directive (EPBD)" of EU with number 2002/91/EC in 2008 and revised in 2011. As per this Regulation, Energy Identity Certificate (EKB) system of buildings has been brought into effect in 2011 and an obligation is made in order to have EKB as a part of the new buildings residential usage license. According to this, the buildings are classified from A to G according to their energy consumption level and greenhouse gas emission amounts and it is predicted that all of the present buildings take EKB until 2017. Buildings are separated into categories from A to G according to their energy consumption levels and CO<sub>2</sub> releases. This system ensures that the building sector, property owners, and local managements put importance into the subjects of energy consumption and CO<sub>2</sub> release. It is thought that investing in energy efficiency will be encouraged by giving information about how energy efficiency can be increased and energy bills can be decreased. "Legislation about the Certification Methods and Essentials of Sustainable Green Buildings and Sustainable City" is published in 2014.

In the areas and buildings, in which the standards of Leadership in Energy and Environmental Design (LEED) are applied in the scope of the urban regeneration activities carried out by Ministry of Environment and Urbanization, a decrease of 24-50% energy efficiency (electric, natural gas, etc.) and a decrease of 33-39% carbon dioxide emission related to this are maintained. In a similar way, it is known that water consumption decreases by 40% and solid waste production decreases by 70% in the buildings in which these standards are used. For this reason, it is proposed to decrease the greenhouse gas emissions, especially carbon dioxide, that originate from the buildings and studies carried out with this purpose are these:

- As per the decision of Council of Ministers with the number 2014/5813, it is decreed that the interest support ratio related to

the provided credits will be applied by increasing by 50 base points for buildings with B class energy efficiency certificate and by increasing by 100 base points for buildings with A class energy efficiency certificate in the framework of Energy Performance Legislation in the Buildings.

- Studies of designing ecological settlements and determining standards.
- Studies in the scope of increasing carbon sink capacity originating from the improvement of urban land usage are ongoing.

Spatial planning studies that were carried out by Ministry of Environment and Urbanization are given below:

- With the change made in the Physical Development Planning Law in 2013(Law No. 3194), it is ensured that the minimum urban standards can be determined with environment order plan and the duties of preparing climate-sensitive and ecological plans and projects, building buildings with these properties, and providing long term credits with this purpose are imposed to the Ministry.
- With the Regulation for the Preparation of Spatial Plans that has come into effect in 2014, it is stated that it is necessary to do the research, investigations, and studies about the disasters and the other urban risks and to take the risk reducing precautions should be taken in the plans according to the research and essentials are determined in order to maintain the protection and usage balance while making the plans.
- In the Regulation for the Preparation of Spatial Plans published in 2014, the procedures and principles about the preparation of these plans are determined. Spatial Strategy Plans described in the legislation will consist of settlements system and urbanization, transportation system, water, risk, infrastructure, economy and special expertizing regions, areas whose development is described with restricted or special conditions, areas that need to be planned in the direction of special principles, and sectoral and thematic decision threads prepared about the similar subjects, and the plan report.
- Spatial Strategy Plans will be prepared based on the results of the comprehensive research that are prepared with the contribution of expert reports about different subjects, that affect the spatial structure and the formation of this structure, that determines the present situation of the country and the region, their change trends and the capacities of the regions, their relative superiorities, fragilities, and problems and guides long term spatial strategies. In the scope of "Research Report of the Areas Whose Development will be Restricted or Which Have Special Conditions" among these, climate conditions and meteorological data will be under Ar-

reas to be affected by Climate Change topic and analyses about the effects of climate change will be under Natural Danger and Risk Areas topic.

- A chapter of the Plan Research Report which was prepared by a group of experts from different disciplines in the first step of Territorial Plans which were described in the Regulation for the Preparation of Spatial Plans that was published in 2014 is reserved for "Climate" data and data such as temperature, raining, relative humidity, evaporation, overcast and insolation, wind, and pressure are collected in this chapter. In another chapter of the report, environmental problems such as air, water, and soil pollution are mentioned. And later, natural structure analysis is made in the direction of all of the data about the natural structure, including climate data. In this scope, areas that are sensitive, under risk, and not under risk are determined in terms of nature. In the synthesis chapter in the results part of the report, settle ability synthesis is done by bringing all of the analysis done about the area together. Areas suitable for settlement, areas not suitable for settlement, and risky areas are determined in the planning area with the synthesis in question. In this scope, areas that have the possibility to be affected by climate change are also determined and the plan decisions (protection and improvement) are made in this direction.

GEF, Increasing Energy Efficiency in Buildings in Turkey Project (2011-2015), which is supported by an investment company that consists of the government of Turkey and TOKI and which is applied by UNDP, is a 5-year project with a budget of 17.6 US dollars. In the scope of the project, it is aimed to increase the building energy performance standards, increasing the sanctions of the related legislations as application tools, increasing the efficiency of the energy management of the building, and development and application of the integrated building design approach in the national scale in order to decrease the energy consumption and CO<sub>2</sub> release in public buildings.

In the scope of Sustainable City Planning for Urban Resistance and Ecosystem Services (Tezer et al., 2014), studies of research about the negative effects of Land Usage/Land Cover (LULC) change on climate change are ongoing.

In the scope of İstanbul Seismic Risk Mitigation and Emergency Preparedness (ISMEP), which was started after signing credit contract with International Bank for Reconstruction and Development (IBRD), it is aimed to take supportive precautions in order to develop the institutional and technical capacity, raising the consciousness of the public about preparation and intervention to emergency situations, investigating the situations of the public buildings with priority against seismic risk and rein-

forcing them according to the results of these investigations or bringing them down and reconstruction them, supporting national disaster studies, drawing inventories of the buildings in the scope of cultural and historical inheritance, doing seismic risk evaluations and their projects designs, and the more effective application of public improvements and building legislation with the purpose of making Istanbul ready for a possible earthquake.

In Sustainable Development Report of Turkey (2012), in the scope of regional development, it is stated that especially the improvements to be maintained in the regions with low income will provide important contributions in terms of environmental sustainability. Development Agencies, which are the main elements of management at the regional level together with the settlements, are developing projects for sustainable aims. Regional Development Strategies (2014-2023) are determined by Ministry of Development in 2013 (MD\_a, 2013).

It is aimed to decrease possible life and property loss and rehabilitate the deteriorated land to protect the land, including decreasing the possible life and property loss and damage decreasing studies in sites such as land/settlement/road etc. by Ministry of Forest and Water Affairs in different urban scales in the scope of flood, landslide, and snowslide control projects (2012-2014). KOYDES (Village Infrastructure Support) Project, which is developed for rural settlements, has been turned into an integrated rural infrastructure program by including agricultural irrigation on a small scale in 2012 and sewage components in 2011. In 2005-2013 term, approximately 8.8 billion TL resource is allocated to the Project with current numbers. Besides, 2600 km of locked parquet was furnished and 32 thousand km of road was repaired. In the scope of drinking water component, 47,461 units, 4,116 units of which (village and village-related) without water and 43,345 units of which with inadequate water were supplied with adequate and healthy drinking water.

Applications of protecting and improving the land by preventing its loss and loss of its properties by natural or artificial ways and maintaining planned land usage in accordance with the sustainable development principle with environmental priority are being carried out by Ministry of Food, Agriculture, and Livestock by making CATAK, Land Consolidation, Supporting Modern Irrigation and Processing Methods that will Provide Water Saving Program, Soil Protection and Land Usage Law (5403) with the purpose of decreasing the greenhouse gas emissions that cause climate change, especially for rural-urban settlements and land usage.

Integrated Urban Development Strategy and Action Plan (KENTGES), which is a strategy document, which has the property of a reference framework document on national level, and Integrated Urban Development Strategy and Action Plan (KENTGES, 2009), settlement and urbanization in the framework of sustainability principle and the spatial planning and sectors related to it are considered with an integrated approach. Studies of Action Plan indicators and monitoring are ongoing. It is aimed to take the important steps in order to meet the liabilities in the scope of Climate Change Action Plan and KENTGES by transparent reporting and reaching trustworthy results based on measuring, validating, and verifying greenhouse gases with the low carbon application study. It is said that the 'clean city term', which has a priority in Climate Change, natural Resources, Ecological Balance, Energy Efficiency, and Urbanization Commission Report should be started (BIB, 2009). In this context, aims for 2020, which include decreasing carbon release by 20% with the increasing of energy effectivity and the usage of 20% renewable energy, are developed. In these aims, 50% increase until 2050 and 100% increase until 2100 and zero carbon aims are estimated. In the scope of Climate Change Commission Report, it is indicated that the sustainable planning strategies should be developed instead of changing the content of urban planning.

Integrated Urban Development Strategy and Action Plan (KENTGES 2010-2023), which puts forward the principles, strategies, and actions towards maintaining balanced and habitable urban development, determines the application principles of these, relates these to an action program, and which is a strategy document with the property of reference framework document on the national level, considers the sectors related to spatial planning in the framework of sustainability principle. Municipality actions are monitored with "Urban Development Report" prepared according to the results of the surveys done to the municipalities and central institution actions are monitored with the studies that the institutions do about the actions that they are responsible for.

In the scope of Increasing the Institutional and Technical Capacity for Developing Climate Adaptation Strategies Project, which is supported by Ministry of Environment and Urbanization, Adaptation to Climate Change Support Package is prepared special to Bursa Metropolitan Municipality. While making this package, the adaptation support tool, which was developed by Europe Environment Agency consisting of 6 steps is taken as example. Adaptation to Climate Change Support Package for the Cities is an example for the process of adaptation plan preparation process of municipalities in Turkey (Cindoruk, 2014).

A lot of municipalities from Turkey took part in the Presidents Contract, which was generated in the scope of Europe Commission and signed by about 5 thousand local management president. Among these municipalities, Bornova Municipality and Antalya Metropolitan Municipality, which have prepared Sustainable Energy Action Plan, are prominent. Besides, Local managements have various authorizations and duties about setting goals in sectors related to climate (waste, building, energy, etc.), making legal regulations about these subjects in their local bodies, generating various application tools, and doing applications themselves. Local managements do applications about subjects such as urban planning related to adaptation to climate change besides the precautions to decrease the greenhouse gases. There are the precautions that the municipalities will apply about climate change in NCCAP.

## 6.2.7.2 Tourism

### Expected Impact and Vulnerability

There is a reciprocal interaction between tourism and environment. Tourism sector is different from a lot of sectors in that it both affects the natural environment and it gets affected by the natural environment which it uses as a resource. Greenhouse gases that are released during tourism activities are causing climate change and climate change is affecting tourism activities. Tourism is responsible for 5% of the human-sourced CO<sub>2</sub> emissions in the whole world. In the case that the sector does not change its structure in a way that it

will decrease the greenhouse gas emissions, this amount will double in the next 25 years (OECD, 2013). According to the report of World Bank about climate change, which was published in 2012, a 4°C increase in the air temperature will cause a 13.5 billion US Dollar yearly GNP loss in tourism and agriculture sectors in the whole world in 2080. In the same report, it is stated that the sea level will increase by 0.5-1 meter and this would affect coastal tourism negatively (World Bank, 2012).

Tourism is a sector, which is highly sensitive to climate. Climate conditions play a role in the determination of a lot of facts such as the suitability of the locations for the touristic activities, tourism season, and costs. Temperature increase, increase in the sea level, and extreme weather events will directly affect mass tourism. Drought and desertification, forest fires, water shortage, biodiversity losses, coastal erosion, diseases observed because of extreme weather events, and observation of contagious diseases originating from vectors affecting tourism activities are the indirect effects of climate change on tourism (Simpson et al., 2008). In Climate Change and Tourism Policy in OECD Countries report, which was published by World Tourism Organization and United Nations Environment Program in 2008, there are hot summers, water stress, biodiversity losses in terrestrial and naval ecosystems, and contagious diseases among the events that may be observed in Mediterranean river basin because of the effects of climate change (WTO-UNEP, 2008). There are striking predictions for Mediterranean basin in the results charter of the Climate Change and Tourism Conference that World Tourism Organization has organized in Tunisia in 2003. According to this charter, it is stated that the temperature will increase by 0.3 to 0.7°C every decades, heat index



Source: Antalya, 2014

Figure 6.64 Antalya Yearly Average Temperatures (1990-2012)

(Temperature-Relative Humidity Index) will increase, and the number of days above 40°C will increase (WTO, 2003).

Tourism activities, which are more generally with sea-sand-sun axis in Turkey, concentrate on Mediterranean and Aegean coasts. In these regions, Antalya being the first, Muğla, Aydın, and İzmir are important tourism centers. When the average temperatures of 1990-2011 years of Antalya, which is the city that receives the highest number of foreign visitors in our country, are investigated, the increasing trend is obviously seen (Figure 6.64). Yearly average temperature value is determined as 17.9°C for 1990-1999 term and yearly average temperature value is determined as 19.4°C for 2000-2009 term. The average of the second 10-year term is 1.5°C higher than the average of the first 10-year term and this value is considerably higher compared to the predictions that World Tourism Organization has made in 2003.

According to Viner and Agnew (1999), there will be big increases in the number of days in which extreme temperatures above 40°C are measured in 21th century on Mediterranean shores of Turkey and these regions will not be able to meet the need of resting and relaxing, which are the characteristic properties of mass tourism because of the extreme temperatures. Heat index values of Antalya are estimated by using the meteorological data of 2011. Heat index calculator of American National Oceanography and Atmosphere Department is utilized for the heat index calculations (NOAA, 2015) and heat index values estimated by using average and maximum temperatures are shown in Table 6.11. Heat index scale and information about the results that can emerge according to the felt temperatures are in Table 6.12 (Ahrens, 2000; MMO, 2015). For 2011, heat index values estimated according to the average temperatures are in the "Attention" category, which is shown with yellow color in July, August, and September. Even in average temperatures, it

Months	Average Temperature (°C)	Maximum Temperature (°C)	Average Relative Humidity (%)	Heat Index (°C) [According to the Average Temperature]	Heat Index (°C) [According to the Maximum Temperature]
May	19.9	30.6	65.7	20	35
June	25.1	38.5	57.1	25	55
July	28.6	42.2	60.1	30	72
August	29.6	41.5	50.0	30	60
September	26.7	37.6	50.3	27	48

Source: Antalya, 2012; NOAA, 2015

**Table 6.11** Antalya Heat Index Values according to the average and maximum temperatures (2011)

Felt Temperature (°C)	Category	Effects
27 – 32	Attention	Weakness, irritability, and a lot of disturbances in cardiovascular and respiratory systems can occur because of the thermal stress related to physical activity and the duration of being affected in these conditions.
32 – 41	Extreme Attention	Heat stroke, heat cramps, and heat exhaustions are possible together with strong thermal stress related to physical activity and the duration of being affected in these conditions.
41 – 54	Danger	Sun stroke, heat cramps, or heat exhaustion. Heat stroke together with intensive thermal stress related to physical activity and the duration of being affected in these conditions.
→ 54	Extreme Danger	Heat or sun stroke, sudden thermal shock may occur.

Source: Ahrens, 2000; MMO, 2015

**Table 6.12** Heat Index Scale

is possible that the negative health conditions will obstruct touristic activities because of the weather conditions. Heat index values estimated by using the maximum temperature values are in the level of "Extreme Danger", which is the last category and shown with red color, in June, July, and August. The maximum temperatures felt in September are in the level of "Danger", which is shown with dark orange and the maximum temperatures felt in May are in the level of "Extreme Attention", which is shown with light orange. In the light of these data, it is possible to say that even the heat index values in 2011 are in the level that would constitute threat for tourism. If we think about the fact that the summer temperatures on Mediterranean shores will be above 40°C in the future because of climate change, the felt temperature will be 55°C (Extreme Danger level) in the case that the humidity ratio will be at least 50%.

Various mathematical methods were developed in order to be able to measure the effects of climatic factors on tourism. One of them is tourism climate index. Tourism climate index, which is estimated by using maximum and average daily temperature, minimum and average relative humidity, amount of rain, insolation time, and wind velocity, is used in order to determine the comfort level of people and developed by Mieczkoswki in 1985 in order to determine the suitability of the tourism location for the outdoor activities. This index, which can be used in order to measure the feasibility of the mass tourism based on sea, sun, and sand trio, cannot be used for winter tourism. As tourism climate index score, 80 indicates ideal climate conditions for tourism and between 60 and 80 indicate good and very good conditions. In a study done by Amelung and Viner (2006), it is indicated that tourism climate index scores of Turkey were "summer peak" (highest in summer months according to the other seasons) in 1970s. According to Emission Scenarios Special Report for 2020s, 2050s, and 2080s, which takes place in the same study, it is seen that the tourism climate index scores of Turkey on Aegean and Mediterranean coasts will show a bimodal distribution starting from 2050s. In another study, in which tourism climate index scores of the term between 1975 and 2006 are estimated for the coastal regions of Turkey (Deniz, 2011), it is seen that the tourism climate index scores on Aegean and Mediterranean coasts show bimodal distribution (higher in spring and autumn, lower in summer). In the study, it is stated that tourism will be negatively affected because of the high temperatures in the Aegean and Mediterranean coasts in the summer months and it will be positively affected in spring and autumn.

Today, tourism season is extending to spring months and the season is partially getting longer with the increase in temperature. However, in 2050s, even though spring months are suitable for tourism activities, it may not be possible to carry out tourism activities on Aegean and Mediterranean Coasts. Especially because tourists go on vacation in summer months, in which the schools are on holiday, the south and west coasts of Turkey are face to face with the danger of not being preferred tourism destinations in summer months. Besides, the tourists that come to Turkey from the northern countries may not need to go abroad in the case that the regions in which they live become suitable for mass tourism.

In the light of all of these information, it can be predicted that the effect of climate change on the mass tourism of Turkey will be positive at first and then it will cause loss on a serious scale (Sevim and Zeydan, 2007).

Winter tourism, which depends on snowing, is also experiencing loss because of the negative effects of climate change, besides the mass tourism with sea-sand-sun axis. Because winter tourism centers are generally on mountains and high altitudes, investment, transportation, and raw material obtaining are under very difficult conditions. However, the real difficulty is that the economic activities of these centers depend completely on the presence of snow. For this reason, the changes that will occur on the climate conditions as a result of climate change are one of the biggest risks in front of winter tourism (Zeydan and Sevim, 2008).

Turkey is a country on Alpine-Himalayan mountain range, approximately 55% of whose surface area is covered with mountains of 1500-3000 m height. Beydağları, Toroslar, Balkanlar, Aladağlar, Munzurlar, Cilo and Sat mountains and Kaçkarlar, which are the extensions of these mountain chains on our country, have formed in the same time interval with the Alpines in Europe. For this reason, they have the same altitude and the same flora. However, they are 2-3 times the Alpines in size. In addition, there are volcanoes such as Nemrut, Süphan, Ağrı, Erciyes and Hasan Mountain in Turkey. Besides, these mountains, where snowing occurs during the whole winter season, are covered with snow for 4-6 months. This time period is approximately equal to the mass tourism season, which is based on the sea-sand-sun trio (İncekara, 1998).

In Palandöken, Sarıkamış, Erciyes, Ilgaz, Kartalkaya, and Uludağ, which are of the most important skiing and winter tourism centers, tourism activities, which have primarily started

with the local demand, have swiftly developed. Uludağ, Kartalkaya, and Erciyes are the centers, in which the first lay-by sites were built and touristic infrastructure elements such as chairlifts and draglifts were put into operation. Keltepe, Kartepe, Davraz, Saklıkent, Elmadağ, Bitlis Sapgör and Zigan are also important skiing centers (Zeydan ve Sevim, 2008).

Whereas 2.7 million visitors were hosted in skiing centers in December-January-February months 10 years before, this number is more than 4.8 million in 2014. The number of the skiing centers that are registered to Ministry of Culture and Tourism in Turkey, which makes important investments in winter tourism, is 28. When we look at the bed capacity, whereas there is a capacity of 9,549 in 28 sites that are certified by Ministry of Culture and Tourism, it is aimed to increase this number to 78,645 (TURSAB, 2014). More than 400 million US Dollars investment is made on Palandöken, which hosts 2011 Winter University Games (Universiade), for this organization and Palandöken has reached a capacity in which 32 thousand people can ski and 6 thousand people can be employed.

The present cable lifts in Uludağ have been renewed approximately for 35 million dollars. With Hotels Station Site project, whose building on a 10 thousand m<sup>2</sup> area is ongoing, it is aimed to meet the needs of the region such as the congress center, shopping center, sports fields, spa center, cafe-restaurant, open car park.

The size of the investments mentioned above also show the size of the negativities that can be faced in the case that the possible effects of climate change are observed.

### Adaptation Measures

In the scope of sustainable tourism in Turkey, various applications are done with the purpose of protecting the environment, improving the environmental consciousness, and encouraging the positive contributions of the touristic sites to the environment.

In this scope, the Announcement Paper with the number 2008/3 About Giving Environment-Sensitive Lay-By Site Document to the Lay-By Sites with tourism Establishment Document, in which classification for environment-sensitive lay-by sites is done, has come into effect in 2008.

The stars that indicate the class of the sites, whose symbols are stars, of the sites that pass the minimum point, which is determined according to the type and class, will be designed with green color and the expression of Environment-Sensitive Site will be on the plaquettes these sites.

The number of the sites with Ministry of Culture and Tourism establishment site document that have Green Star document, which was 126 on 31.08.2014 and 205 on 28.02.2015, has increased to 223 on 30.06.2015. These numbers clearly show the interest of the lay-by sites to the Green Star (MCT, 2015). It is also seen in the last years that the cogeneration and trigeneration energy systems are generalized especially in lay-by sites with Green Star document.







## 7. FINANCIAL RESOURCES and TECHNOLOGY TRANSFER



## 7. FINANCIAL RESOURCES AND TECHNOLOGY TRANSFER

As referred in its 1<sup>st</sup> and 5<sup>th</sup> National Communication, Turkey, as a non-Annex II country, is not responsible for providing support to developing countries according to Articles 4.3, 4.4, 4.5 of the UNFCCC, and Article 11 of the Kyoto Protocol. Turkey, although listed in Annex I to the Convention, is a developing country according to both the World Bank and International Monetary Foundation classifications. Indeed, while Turkey is an OECD member, it is recognized by the OECD Development Assistance Committee as among the countries that may benefit from Official Development Assistance (ODA).

As a developing country Turkey could have accessed resources from bilateral and multilateral development banks and international funds to combat climate change. Turkey has been the first country to benefit from the Climate Investment Funds managed by the World Bank, and has also received bilateral and multilateral financing for renewable energy and energy efficiency investments. Turkey is eligible to receive finance from the main mechanism of the UNFCCC - Global Environment Mechanism (GEF) - and has been one of the best users of the GEF grants. Additionally, Turkey was also eligible to short-term financing facility of \$30 billion that was committed by developed countries under Copenhagen Accord with an aim to provide support to developing countries in their investments to combat with climate change. This position, as agreed by Cancun Agreements (Decision 2/CP.17), also highlights the special circumstances of Turkey among other Annex I countries of the UNFCCC.

The COP decision 26/CP.7 agreed to amend the list in Annex II to the Convention by deleting the name of Turkey and invited Parties to recognize the special circumstances of Turkey, which place Turkey, after becoming a Party, in a situation different from that of other Parties included in Annex I to the Convention. Decision 1/CP.16 recognized the special circumstances of Turkey and placed Turkey in a different situation than the other Parties included in Annex I. The Decision requested the Ad Hoc Working Group on Long-term Cooperative Action under the Convention to continue consideration of these issues with a view to promoting access by Turkey to finance, technology and capacity-building in order to enhance its ability to better implement the Convention. Decision 1/CP.18 reaffirmed the importance of the financial, techno-

logical and capacity-building supports to Turkey as an Annex I Party special circumstances of which is recognized by the COP so that it becomes able to implement the Convention more efficiently and encouraged the Annex II countries with appropriate conditions to provide financial, technological, technical and capacity-building supports to the Annex I countries with special position through multilateral agencies. Decision 21/CP.20 encouraged Parties included in Annex I to the Convention whose special circumstances are recognized by the COP to fully utilize the opportunities to benefit, at least until 2020, from support from relevant bodies established under the Convention and other relevant bodies and institutions to enhance mitigation, adaptation, technology, capacity-building and access to finance. Consequently, Turkey is a developing and emerging country, accomplished an average 5% GDP growth per annum for the last decade which is one of the greatest in the world. In order to implement its nationally determined contribution and to achieve ambitious national targets such as increasing share of renewable energy in national mix and mobilize its huge mitigation potential, Turkey needs to access financial resources in addition to existing funds that Turkey can access. For the continuation of efforts of Turkey to combat with global climate change within the perspective of common but differentiated responsibilities of countries, it is critical for Turkey to access financial resources and mechanisms under UNFCCC in particular Green Climate Fund.







## 8. RESEARCH and SYSTEMATIC OBSERVATION

## 8. RESEARCH AND SYSTEMATIC OBSERVATION

Supreme Council for Science and Technology plays the most important role in the generation of the science and technology policies of Turkey. The duties of the Council are; support the government in determining the long term science and technology policies, determining the objectives, determining the areas with priority, preparing plans and programs, charging public institutions and organizations, maintaining cooperation with special corporations, preparing the necessary law designs and legislations, taking precautions for founding private sector research centers, maintaining coordination between sectors and organizations. The Council has made 18 meetings during 2004-2014, regularly two times a year. The 27th Meeting of Supreme Council for Science and Technology took place on 18 June 2014:

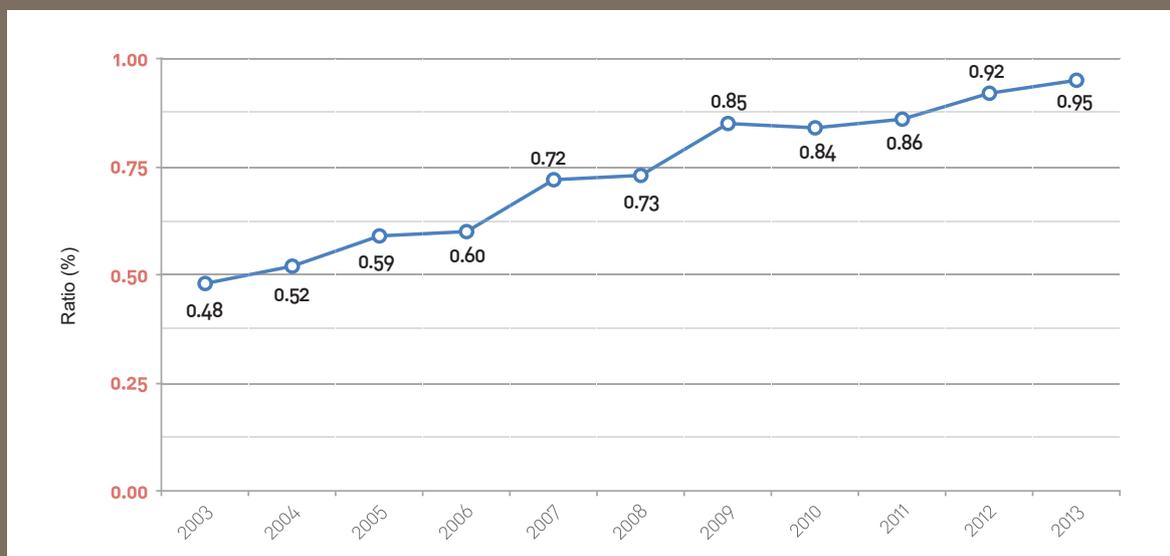
- Decisions about Generating Supports Towards Decreasing Foreign Trade Gap in the Area of Health and Biotechnology and Increasing our Technological Competence
- Developing Supports Towards Purchasing High Technology Companies
- Generating Supports Towards Founding R&D Laboratories of International Companies
- Founding, Developing, and Supporting Research Infra-

structures in the Areas of Health and Biotechnology

- Charging of Horizon 2020 Program National Communication Institution
- Policies to be Followed in the Usage of Public R&D and Innovation Funds in 2014-2016 (TUBITAK\_c, 2014).

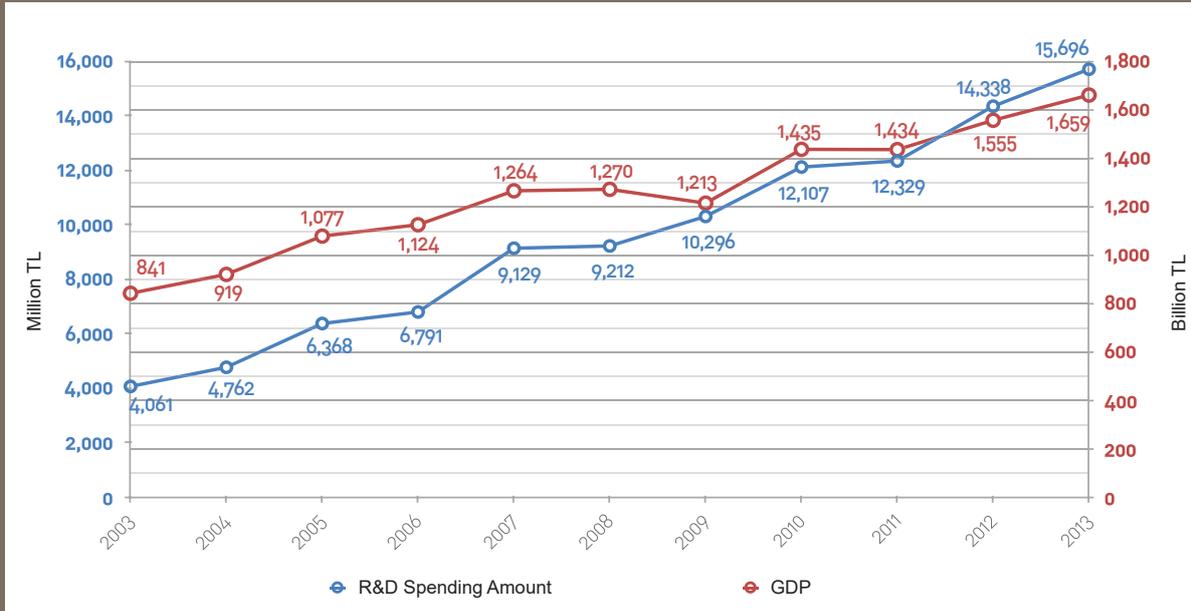
According to the calculations done in the scope of R&D Activities Research, whereas the ratio of R&D spendings of Turkey in GDP was 0.48% in 2003 in Figure 8.1, this ratio has increased to 0.95% in 2013. The increase here shows that the financing support reserved for R&D has increased. Whereas R&D spendings were 4.01 billion TL in 2003 in Figure 8.2, this amount has reached 15.7 billion TL in 2013 (TUBITAK\_d, 2014).

In 2013, while the private sector had the biggest portion in Gross Domestic R&D spendings with 47.5%, the higher education sector and public sector received 42.1% and 10.4% of Gross Domestic R&D spendings respectively. In 2012, while the private sector was in the first place with 45.1%, the higher education sector and public sector with 43.9% and 11% respectively. Whereas 48.9% of R&D spendings were being financed by private sector in 2013, this was followed by the public sector with 26.6%, the higher education sector with 20.4%, other domestic resources with 3.3%, and foreign resources with 0.8%. (TUBITAK\_e, 2014).



Source: TUBITAK\_d, 2014

Figure 8.1 The ratio of R&D spendings to GDP for 2003-2013



TUBITAK\_d

Figure 8.2 R&amp;D spending amount and GDP for 2003-2013

## 8.1. Research

Various studies are being carried out both in research institutions and universities in Turkey, in general about the subjects of climate process and climate system studies including paleoclimate studies, modeling and prediction including general circulation models, research on the impacts of climate change, socio-economical analyses including the analysis of both the impacts of climate change and response options, and research and development on mitigation and adaptation technologies.

Research about forestry in Turkey is being carried out by 12 forest faculties in total and forestry research institutes related to GDF, 9 of which work at the level of region and 3 of which work at the level of the country. Besides, various department heads in GDF and Regional Directorates of Forestry are preparing projects with national and international cooperations. General Directorates of CDE and NCNP also provide support to various research projects.

Research Master Plan towards the studies of forestry research institutes in GDF was prepared in 2001 and studies towards preparing a new master plan are started in 2013. In the new research master plan, which is being prepared, the research subjects about climate change with priority are determining the effects of the forests to the carbon deposit, afforestation, and drought-tolerance of the plants.

The vast majority of the projects that are carried out by universities and forestry research institutes are towards determining the amount of biomass in forests and calculating

the amount of carbon stocks of forests. Universities' research studies are usually supported with the budget of their own Scientific Research Projects. Besides, in 2010-2014, five projects regarding determining the amount of carbon stocks in forests were supported by TUBITAK.

Projects by Directorates of Forestry Research Institutes are supported from GDF budget. There are no projects towards adaptation to climate change or mitigation of greenhouse gases among the projects carried out in these institutes. However, numerous research studies, which can be considered about adaptation to climate change indirectly, in which species, origin, and progeny trials are being carried out in order to determine the species, ecotypes, or origins of forest trees with a high capacity of living and growing and resistant to various stresses (such as drought, saltiness, and frost) are being carried out (Semerci, Başsüllü, Özdemir, Semerci ve İpek, 2014). In addition, various research projects regarding determining carbon stocks in forests are either completed or ongoing.

R&D studies about climate change and agriculture have been implemented mainly by Ministry of Food, Agriculture, and Livestock and international institutions, universities, municipalities, and non-governmental organizations. Studies of developing growing techniques suitable for dry agriculture conditions and seed types are implemented by Ministry of Food, Agriculture, and Livestock General Directorate of Agricultural Research and Policies (MEU, 2013).

About land degradation and keeping land empty;

- "Updating of soil maps traditional water erosion units with

YETKE-K and putting forward the uncertainties in mapping units with geostatic”, “MDG-F 1680 development of adaptation capacity of Turkey to climate change”, “Erosion sensitivity because of land use and topography in Asartepo reservoir basin and the determination of its locational change by some physical soil properties” in 2009;

- “National pasture improvement and development project, determination and modeling of rice cultivation areas in Kızılırmak and Yeşilırmak deltas with the help of CBS” in 2010;
- “Generating the geographical database of some productivity properties and organic carbon content of the soils of Turkey”, “Generating territorial geographical soil database”, “Ankara-Kalecik sample field study and determination of the locational and chronic change in soil erodibility values in Mogan lake river basin” in 2011;
- Soil erosion sensitivity because of land use and topography in Asartepo reservoir basin and the determination of the locational changes of some physical soil properties in 2012
- In 2013, prediction of land losses in Haymana-Çatalkaya river basin with MUSLE and RUSLE methods, determination of national pasture property and pasture situation classes, determination of land and water loss in yellow pine stances with different closeness levels (Çamlıdere example), and the

usage of radar images in soil etude and mapping studies have been carried out.

In 2013, about irrigation, “Investigation of the effects of humic acid to the productivity of the plants that are watered with salty and sodic irrigation waters and some soil properties” and “Investigation of the effects of humic acid derivatives to the usability off low quality waters in irrigation” studies have been carried out.

About extending the use of fertilizer;

- Socio-economical investigation of the effect of humic acid and fertilizer applications to the soil which is formed on limestone and marl main materials on the forms of nutrients and the productivity of the soil, and the support for chemical fertilizer and soil analysis (Ankara example) in 2012;
- Determination of the plant food material and potential toxic element scopes of the agricultural soils of Ankara, Kirikkale, Kirsehir, Kastamonu, Karabuk, Duzce, Cankırı, and Bolu, generation of database, and mapping studies were done in 2013.

There are five projects related to climate change, in which the institutions and organizations in Turkey participates under European Union (EU) 7<sup>th</sup> Framework Program.

Project Name	Project Short Name	Period	Explanation
Mechanism, Modeling and Forecasting of Landslide Displacements	FOLADIS	2010/2013	It is aimed to to reduce damage caused by landslides, by increasing our understanding of the mechanism of slow-moving landslides.
A modular phase change material thermal store that enables optimal performance of renewable energy systems	PIPESTORE	2010/2011	It is planned to develop a modular and low cost thermal storage technology as an alternative energy resource because of the EU energy security approach and increasing energy prices due to climate change.
Investigation of the effects of Thermal Stratification on Hydrodynamics of a Reservoir	RESTRAT	2006/2007	The structure of the thermal stratification, its relation to wind and flow conditions, and its effects on vertical velocity profiles, suspended sediment concentrations and water quality parameters are investigated.
Eastern Mediterranean Centre for oceanography and limnology	EMCOL	2005/2008	It is aimed to establish state-of-the-art laboratory and field infrastructure that will be used extensively in marine and lake studies, including natural hazards and environmental changes, to develop highly qualified first- and second-generation researchers in interdisciplinary marine and lake studies at Istanbul Technical University (ITU), covering a wide range the fields such as underwater earthquake geology, tsunamis, submarine landslides, floods, climate change and environmental pollution and to enhance interactions in projects and idea exchanges between ITU researchers and those in the EU countries
Facilitation of the Participation of the Turkish Research and Development Community to EU Framework Programmes	TR-ACCESS	2004/2007	Network of information multipliers covering the country was set up to encourage and facilitate the widespread participation of Turkish institutions to Sixth Framework Program (FP6) projects, industrial participation was supported and distributed resources of research was brought together.

Table 8.1 EU 7. Projects Under Framework Program

### 8.1.1 Climate System Studies

Studies about climate process and climate system studies including paleoclimate studies have been carried out since the mid-1980s in Turkey. These studies, which are done predominantly done in universities, have also started to be carried out as projects supported by TUBITAK in 2000s. 30 projects have been carried out with the support of TUBITAK until today. There are 99 thesis studies done about the climate system of our country in the universities in Turkey until today.

Apart from these, there are climate system studies of the Ministry of Energy and Natural Resources General Directorate of Mineral Research and Exploration in Turkey. In this scope, "Investigation and Modeling of Paleoclimate Records from Pleistocene until Today for Eymir and Mogan Lakes (Ankara) and Surrounding Area " and "Investigation of the Development of Egirdir Lake and Beysehir Lake in Holocene Period with Geological and Geophysical Methods" studies were carried out by MTA General Management.

#### Investigation and Modeling of Paleoclimate Records from Pleistocene until Today for Eymir and Mogan Lakes (Ankara) and Surrounding Area Around from Pleistocene until Today

In the project, in which the public, universities, scientific institutions and organizations were determined as target audience, geological, mineralogical, geochemical, and isotropic findings were investigated on the paleo-soil and caliches around Eymir and Mogan Lakes and in the light of the data obtained, information about the climate conditions of the region in Pleistocene-Holocene terms were produced. The project was completed in 2012-2013 period.

#### Investigation of the Development of Egirdir Lake and Beysehir Lake in Holocene Period with Geological and Geophysical Methods

In Investigation of the Development of Egirdir Lake and Beysehir Lake in Holocene Period with Geological and Geophysical Methods project, in which the public, universities, scientific institutions and organizations were determined as target audience, limnological properties of the lakes were investigated together with the geological and geophysical studies in the lakes. Distribution and properties of lake sediments were investigated in the samples taken from both the base surface of the lake and towards the deeper from the base of the lake (drilling core). The investigation of paleoclimate data of Holocene period was carried out

in consequence of oxygen and carbon isotope analyses and radiocarbon age specification studies on the samples taken from the drilling cores.

"Climate Monitoring and Evaluation" activities about climate systems are being carried out in SMS, which is in Ministry of Forestry and Water Affairs. The studies in these activities are listed below:

#### Monthly, seasonal, and yearly climate evaluations

Public awareness is being provided by comparing the data of temperature, rainfall, etc. values of the last month, season, and year with the same kind of previous and the long-term annual data. Mapping processes are done by using ArcGIS software. The study has been carried out since 2001. The results of the study can be found under "<http://www.mgm.gov.tr/veridegerlendirme/sicaklik-analizi.aspx>" address.

#### Heating-Cooling day-degree analyses

Heating and cooling day-degrees, which are necessary for energy sector, are being estimated by using the formula of Directorate-General Europe Statistics, Eurostat. The mapping is done by calculating heating requirements for winter months and cooling requirements for summer months in the study. The study has been carried out since 2007. The data obtained in the study can be reached under "<http://www.mgm.gov.tr/veridegerlendirme/gun-derece.aspx>" address.

#### Turkey Climate Indexes study

27 climate indexes were produced for 1960-2010 for Turkey by using World Meteorology Organization Climate index calculation program, RClimDex. The study was presented in ITU 6. Atmosphere Sciences Symposium (ATMOS). The articles presented in the relevant symposium can be reached under "[www.mgm.gov.tr/FILES/iklim/Klimatoloji\\_Makaleler\\_2013.pdf](http://www.mgm.gov.tr/FILES/iklim/Klimatoloji_Makaleler_2013.pdf)" address.

#### Climate Classification Studies

The results of the climate classification study, which is prepared according to various methods have started to be published under "[www.mgm.gov.tr/iklim/iklim-siniflandirmalari.aspx](http://www.mgm.gov.tr/iklim/iklim-siniflandirmalari.aspx)" link as a web-based application.

#### East Mediterranean Climate Center Studies

Turkey is providing climate imaging, seasonal prediction, and data services to 10 countries (Greece, Turkey, Turkish republic of Northern Cyprus, South Cyprus, Syria, Lebanon, Israel, Palestine, Jordan, Egypt) in WMO 6th Region (Europe) East Mediterranean in Regional Climate Center Network. The studies can be accessed from "[www.emcc.mgm.gov.tr](http://www.emcc.mgm.gov.tr)" address.

### Ozone and UV monitoring studies

GDM is monitoring the ozone and UV in the atmosphere with Brewer Spectrophotometer situated in Ankara and UV sensors that are situated in about 20 AWOS.

### Studies and articles about climate

GDM is publishing tens of books, brochures, reports, and articles that it produces about climate and climate change under "<http://www.mgm.gov.tr/iklim/dokuman.aspx>" link.

### Investigation of the Climate Status of GAP Region Today and in the Near Future

In the project, which is carried out by Ankara University Agriculture Faculty Foundation of Education, Research, and Development and supported by the Ministry of Development (former State Planning Organization), climatological database, average value charts, and climatological distribution maps of GAP Region were prepared, general climatological properties of the region were investigated, and the statistical and graphical time series analyses of long term climatological observation series were done.

### National Water Information System

In the decree about the founding of Ministry of Forestry and Water Affairs, the setting up and operation of National Water Information System are ensured by GDWM. In this scope, it is aimed to develop a database and application based on geographical information system, in which all of the institutions and organizations that are active about water will be considered. Besides, it is aimed to collect data from and present data to the relevant institutions/organizations online by maintaining the integration of the current information about water.

## 8.1.2 Modeling and Prediction Studies

Modeling and prediction studies that include general circulation models have become prominent since the mid-1990s in Turkey. 11 projects have been carried out with the support of TUBITAK until today. There are 35 thesis studies done about the modeling and prediction studies of Turkey in Turkish universities until today.

Also, modeling and prediction studies that include general circulation models are being carried out in the Ministry of Forestry and Water Affairs GDM; and climate projection studies are done in GDWM, under the Ministry, with the purpose of

determining how the water resources will be affected by climate change.

### Climate Change and Model Studies

GDM is using RegCM4 Regional Climate Model in order to monitor climate change. Studies about the projections produced by using new generation Representative Concentration Routes (RCP) scenarios and 3 global model data are published under "<http://www.mgm.gov.tr/iklim/iklim-degisikligi.aspx>" address.

### Climate Change Projections for Turkey with New Scenarios

The study, with an acronym of "TR2013-CC", has started in 2011. The project, with a budget of 291,394 TL in order to be used in the development of electronic infrastructure for model studies, model application and projection development educations, and consulting areas, is proceeding under the coordination of GDM. In the study, it is aimed to produce current and high resolution regional climate projections, which are based on RCP scenarios in parallel to IPCC 5 Evaluation Report and which researchers, appliers, and decision makers can facilitate from the adaptation measures for the negative impacts of climate change and share these information with the stakeholders.

Climate projections are very long-term studies. For this reason, the completion of the study was not waited for the final result report and the first results obtained from the study (RCP4.5 and RCP8.5 scenarios by using Hadgem2-ES global model outputs and RegCM4 regional model with dynamic downscaling method) and the details of the study are shared in the Climate Change Projections Report for Turkey with New Scenarios with stakeholders and decision makers. The study is done with the outputs of the other two global models. New results are obtained with these models. It is planned to publish the developed versions of the report and share with the stakeholders.

### River Basin Monitoring and Evaluation System Setup Project

River Basin Monitoring and Evaluation System, which will be installed in the scope of the project that is carried out by the Ministry of Forestry and Water Affairs together with TUBITAK and General Directorate of Combating Desertification and Erosion, is a river basin monitoring and evaluation system that concerns numerous institutions and organizations working in river basins in our country, with the purpose of maintaining sustainable river basin management and monitoring desertification, which is a result of climate change with the other river basin components. Feasibility studies are completed in the project and according to

the applicable results that have emerged project studies are started in Gediz river basin. Desertification, soil erosion and mass movements, flood-overflow, land use and sustainable forest management themes can be monitored in terms of the activities in the river basin with numerous senior consultants. The other determined river basin components will be brought into the system as the data are provided.

### 8.1.3 Research on the Impacts of Climate Change

Research about the effects of climate change are being carried out since the mid-1980s in Turkey. These studies, which are done predominantly done in universities, have also started to be carried out as projects supported by TUBITAK in 2000s. 18 projects have been carried out with the support of TUBITAK until today.

Various projects about the effects of climate change are being carried out in Governmental Institutions in our country. These projects and their details are given in Figure 8.2.

In "Determination of Air Pollution Originating from Highway Traffic in Metropolitan Centers" project, which was carried out by Izmir Metropolitan Municipality and Dokuz Eylül University and supported by TUBITAK between 2006 and 2008, air pollution levels that originate from the highway in Izmir, which is one of the important metropolises of our country, were investigated. In this study, detailed vehicle counting is done, an emission inventory is prepared, air quality was monitored, and mathematical modeling was done.

In "Determination of the Levels, Sources, and Health Effects of Organic and Inorganic Polluters in Izmir Aliağa Industrial Zone" project, which was carried out by Izmir Metropolitan Municipality with the support of TUBITAK between May 2005 and January 2008, air quality and its effects on human health are determined in Aliağa and surrounding area. The results of the project were presented to the public opinion with a meeting in which the local people, non-governmental organizations and etc. participated.

### 8.1.4 Socio-Economic Analysis Studies

Socio-economic analyses including analysis of both the impacts of climate change and response options are being done since the beginning of the 2000s in Turkey. In the scope of these studies, which are done especially in universities, there are 34 thesis studies that are done until today.

Apart from these, "Economical analysis of the effects of climate changes on agricultural production systems in Çukurova and Central Anatolia Regions and determination of the necessary policies and institutional measures" project, which was done in Çukurova University with the support of TUBITAK, has ended in 2007. In the project, the ways how the farmers perceive global warming are investigated, their behaviors about this are put forward, and institutional measures and policies necessary for the combating global warming are determined.

Some of the studies that were done recently about socio-economic analyses including analysis of both the impacts of climate change and response options are explained below.

#### Revision of the present "Notification About the Entity, Duties, Working Methods and Principles of River Basin Management Committees", to include the duties about flood management

This study done by the Ministry of Forestry and Water Affairs is revised and published with the aims of maintaining the coordination between the institutions in order to prepare and apply the river basin protection and management plans and flood management plans towards the protection and planning of the surface and underground waters, excluding the seas and including the coastal waters, with an integrated approach and regulate the necessary methods and principles necessary for the follow-up of the applications.

Project name	Owner	With Whom It is Made	Starting Year	End Year	Explanation
Climate Change Impacts on Water Resources	Ministry of Forestry and Water Affairs.	GDWM-Flood and Drought Management Department	2013	2016	The studies of the project have started on 18.12.2013 and the purpose of the project is to determine the effect of current and higher sensitivity climate change scenarios on surface and underground waters on the basis of river basin and adaptation activities. There are 5 outputs of the project, which is going to be carried out in all of the river basins of our country: 1-Preparation of climate change projections in all of the river basins, 2-Determination of underground water potential and the change in the levels of surface waters special to the river basins, 3-Calculation of the change of water budget with the effect of climate change in all of the river basins, 4-Studies of sectoral effect analysis (for drinking water, agriculture, industry, and ecosystem main sectors) of climate change in Büyük Menderes, Ceyhan and Meriç-Ergene River Basins in terms of water resources and generating adaptation activity proposals 5-Generating Climate Database. Project results can be found under <a href="http://iklim.ormansu.gov.tr">http://iklim.ormansu.gov.tr</a> address.
Capacity Building to Implement Flood Directive In Turkey	Ministry of Forestry and Water Affairs	GDWM-Flood and Drought Management Department	2012	2014	In the scope of this project, determining the alternatives about the transferring of the Flood Directive to the legislation of our country, implementation of the essentials of the directive in West Black Sea River Basin (Evaluation Preliminary Flood Risk Assessment, Preparation of flood hazard and risk maps, Preparation of flood risk management plans), Preparation of National Implementation Plan, which shows the necessary road map for the implementation of the directive to all of the river basins in our country in general and which includes a specific calendar.
Development of Climate Change Action Plan in Turkey	Ministry of Environment and Urbanisation	UNDP-England Ministry of Foreign Affairs	2009	2011	In order to ensure the application of "National Climate Change Strategy", NCCAP is prepared in the scope of the project that includes strategical principles and aims for 2010-2020 years for the relevant sectors about greenhouse gas emission control and adaptation to climate change. NCCAP is accepted in CBCC, which was done on 2 May 2011, with the technical support of all of the stakeholders in the framework of their responsibilities and areas of interest and the other stakeholders, especially relevant ministries and governmental institutions.
Projects of Preparing Drought Management Plans	Ministry of Forestry and Water Affairs	GDWM			Project studies were first started for Konya and Akarçay river basins and they will include all of the river basins of our country until 2023. With Drought Management Plans, the measures to be taken before, during and after drought will be determined for the solution of drought problems as soon as possible with the purpose of reducing the negative effects to be seen when the possible drought risks are faced. Drought indicator and threshold values of the river basins will be determined, drought analyses will be done, and the necessary precautions will be determined by doing the sectoral vulnerability analyses.

**Table 8.2** Projects about the effects of climate change that were carried out in Governmental Institutions

## 8.2. Systematic Observation

The only institution, which is authorized about doing atmospheric measurements in Turkey, is Meteorology General Management (SMS). In the last years, SMS has shown important developments by integrating modern techniques to its system in its measurement and model activities with national and international cooperations. Oceanographical observations are done by General Map Commander (HGK) and terrestrial observations are done with ICP Forests project, which is carried out by Government Water Works (SHW) and General Directorate of Forestry (GDF).

SMS, which is a member of WMO (World Meteorological Organization), works in cooperation with WMO in our country. With the help of this international partnership, SMS actively participates in all of the programs of WMO. Some of these programs can be listed as Global Observation System-GOS, Global Climate Observation System-GCOS, Surface Radiation Network-SRN, and Global Atmospheric Watch-GAW. Global Observation System consists of the union of surface observations, sea observations, high altitude observations, and observations done with satellites and radars.

### 8.2.1 Global Observation System (GOS)

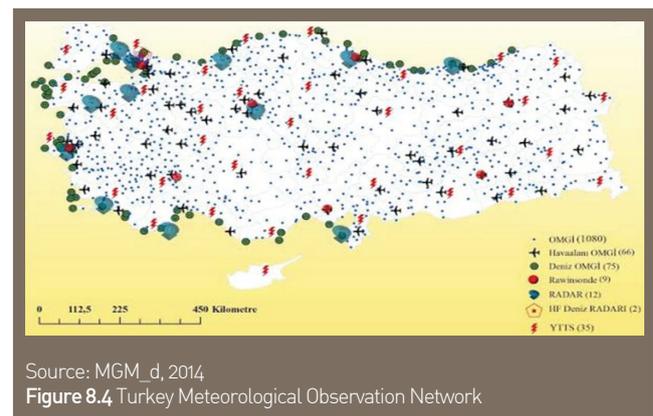
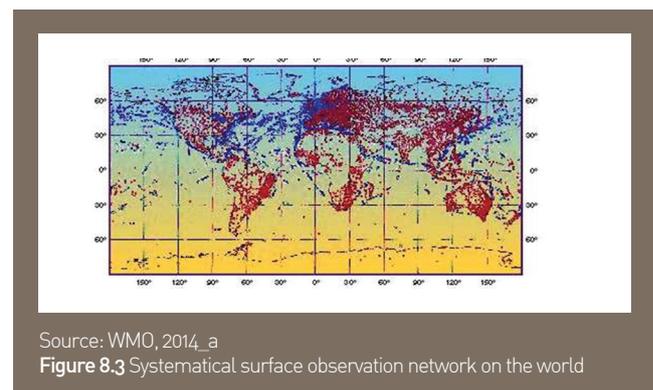
#### 8.2.1.1 Surface Observations

Surface observations is an observation system, which is generated in the framework of the data obtained from the meteorological measurement results in all of the countries. The measurements in this system are obtained from approximately 11,000 stations and points on land surface or close to land surface, in which meteorological parameters such as atmospheric pressure, wind velocity and direction, air temperature, and humidity are measured usually with 3-hour intervals (WMO, 2014\_a). Approximately 4,000 of these stations are in Regional Synoptical Network system and approximately 3,000 of them are in Regional Climate network. Data coming from the both networks are being evaluated after coming to 6 data collection units of WMO on the world (WMO\_a, 2014). The surface observation network on the world is given in Figure 8.3. Red stations represent terrestrial stations and blue ones represent the stations built on the seas.

Measurements are being taken by SMS in 1,280 points in total in Turkey. 1,080 of these are Automatical Meteorology Observation Stations (OMGI). Besides, 235 of these stations are synoptical measurement stations, 67 of them prepare METAR (Meteorological Terminal Air Report), SPECI (Special Weather

Reports), and TAF (Terminal Aerodrome Forecast) codes with aviation purposes, 69 of them are sea OMGI, 6 of them are buoy, 14 of them are radar, 35 of them are thunderbolt detection and following systems, 9 of them do (8 stationary, 1 mobile) Ravind-some measurements twice daily (00 GMT and 12 GMT) as the result of scanning the atmosphere vertically by using atmospheric balloon, and besides there are 11 stations in General Directorate of Agricultural Research and Policies (TAGEM) and 14 stations in General Directorate of Agricultural Enterprises (TIGEM) (SMS\_e, 2014). Turkey provides data for GOS system through SMS with 362 stations in total, 227 of which are climatological, 135 of which are synoptical and besides SMS, there are Meteorology Offices that are in service for 24 hours a day in the Tactic Forces Commander and all of the Main Jet Station and Aerodrome Commander of Air Forces Commander (SMS\_e, 2014) (Figure 8.4).

Turkey provides data for GOS system through SMS with 359 stations in total, 227 of which are climatological, 132 of which are synoptical (MEU, 2013). Besides SMS, there are Meteorology Offices that are in service for 24 hours a day in the Tactic Forces Commander and all of the Main Jet Station and Aerodrome Commander of Air Forces Commander.



### 8.2.1.2 Sea Observations

Sea observation is done by volunteer observation ships related to WMO, platforms, and satellites. There are approximately 4,000 observation ships and approximately 1,000 of them provide data daily. With 1,200 buoys, 27,000 sea surface temperature measurements and 14,000 sea level pressure measurements are taken a day. These ships and buoys are operating in the scope of WMO Sea Program (WMO\_a, 2014). SMS has taken 69 automatic sea meteorology observation systems, 2 sea radars, and 6 Stationary Buoys with Meteorological Purposes (MAS) into operation with the purpose of sea observation (SMS\_e, 2014).

### 8.2.1.3 High Altitude Observations

There are approximately 1,300 high altitude stations and radiosondes in the global network. High altitude observations include pressure, wind velocity, temperature, dew point temperature, and humidity measurements from sea level up to 30 km altitude. More than two third of the stations do their observations at 00 UTC and 12 UTC (WMO\_a, 2014). High altitude measurements are done with radiosonde balloons in our country. In our country, measurements are done twice daily in 8 cities, which are Ankara, Adana, Samsun, İstanbul, İzmir, Isparta, Diyarbakır, and Erzurum (SMS\_f, 2014). Ankara station is Global Upper Altitude Atmosphere Network (GUAN) station. There is one Mobile high altitude measurement station in SMS.

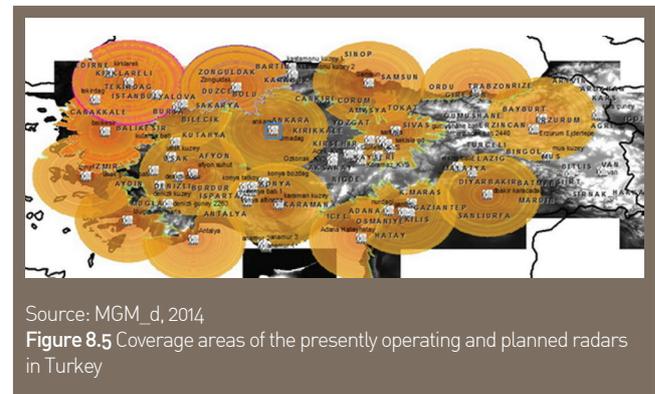
### 8.2.1.4 Observations Done With Air Vehicles

Measurements done with air vehicles are done with the cooperations with ICAO (International Civil Aviation Organization) and the commercial airlines. Pressure, wind, temperature, humidity, turbulence, and the other parameters, which are important for flight are measured with over 3,000 air vehicles. Over 300,000 measurements are taken daily in 2012 and the number of these measurements is increasing (WMO\_a, 2014).

### 8.2.1.5 Observations Done With Radars

Radars are being used in the detection of the droplets in Cumulonimbus and Nimbostratus clouds that can transfer to raining and the amount of water that can transfer to rain since 1950s. Doppler Radar networks are increasing fast and they are actively used in raining predictions today (WMO\_a, 2014). The first meteorology radar has come into service in Ankara,

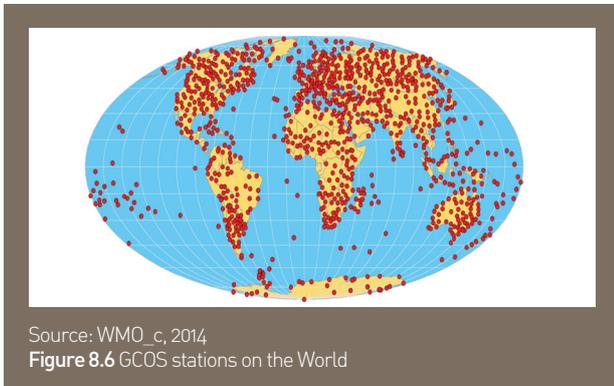
Elmadağ in 2000 in our country. There are 11 presently operating radars, which are set in İstanbul, Zonguldak, and Balıkesir in 2003, in İzmir, Muğla, Antalya, Adana, Samsun, and Trabzon in 2007, and in Ataturk Airport in 2014. Studies of setting radars to Bursa, Karaman, Afyon, Erzurum, Sivas, Gaziantep, and Diyarbakır have started in 2013. These radars will be made operational between 2014 and 2016 (SMS\_g, 2014). The coverage ranges of the presently operational radars and the ones to be brought into operation until the end of 2016 in our country are shown in Figure 8.5. In addition to these, there are one Mobile X-Band and two sea radars in SMS.



## 8.2.2 Global Climate Observation System (GCOS)

Global Climate System (GCOS), is formed with the cooperation of WMO, International Oceanography Commission (IOC) related to UNESCO, and United Nations Environment Program. The purpose of GCOS is to provide comprehensive information about the global climate system and maintaining the carrying out of various studies about climate change and climate modeling, and interdisciplinary studies (WMO\_b, 2014). There are 1,017 GCOS observation stations on the world. The places of these stations are seen in Figure 8.6.

Global Climate Observation System (GCOS) consists of surface network and upper atmosphere network. Stations in GCOS are similar to those in GOS. There are approximately 1,000 stations in the surface network and 150 stations in the upper atmosphere network (WMO\_e, 2014; NOAA, 2014). 7 stations from Turkey (Rize, İstanbul, Kastamonu, Sivas, Van, Isparta, Finike) are GCOS stations.



### 8.2.3 Global Atmosphere Watching Program (GAW)

Global Atmosphere Watching Program is made in order to investigate how the atmosphere is affected by the human activities and maintain the control and the understanding of this change (WMO\_d, 2014). The places of 29 GAW stations present in the global system are given in Figure 8.7. There are 400 regional stations besides the global network (WMO\_c, 2014).

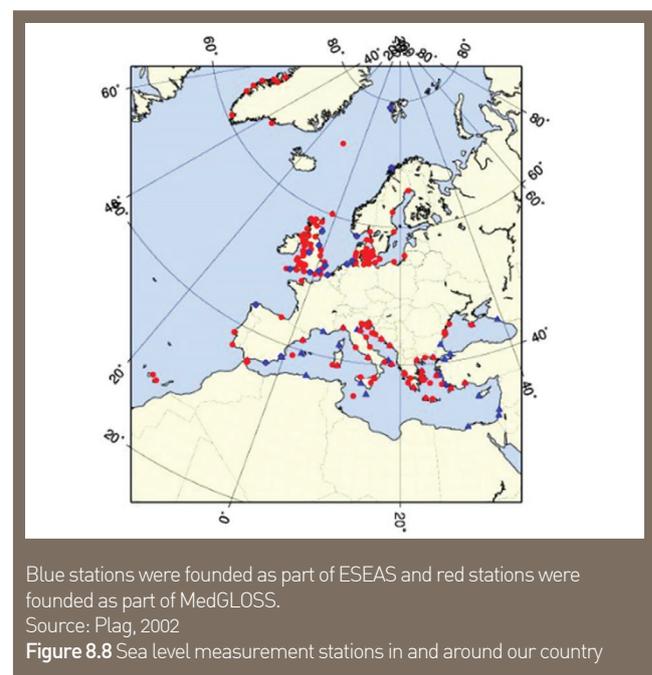
SMS is also included in Global Atmosphere Monitoring Program (GAW). This program is directed to the investigation of the structure of the atmosphere by focusing on six parameters, which are UV radiation, ozone, greenhouse gases, aerosols, reactive gases, and rain chemistry. SMS is doing the measurements with an ozonesonde tool in Ankara. SMS monitors the total ozone and ultraviolet radiation from the surface of the earth by using ozonesonde and Brewer Spectrophotometer. SMS is doing UV-A measurements since 1997 and UV-B measurements since 2009 (SMS\_h, 2014). Besides, ozone measurements are done in a lot of points in our country in the scope of Ministry of Environment and Urbanization, some municipalities, and TUBITAK projects.



Ministry of Environment and Urbanization provides air quality data for European Monitoring and Evaluation Program (EMEP), which is a scientific part of long-range cross-boundary air pollution contract related to United Nations, besides SMS. In this program, the chemical compositions of atmospheric aerosols and rain water and some pollutants. The only EMEP station in our country is the station, which is in Ankara, Cubuk and which was operated by Ministry of Health between 2003 and 2010, and which was later passed on to Ministry of Environment and Urbanization (MEU\_a, 2014).

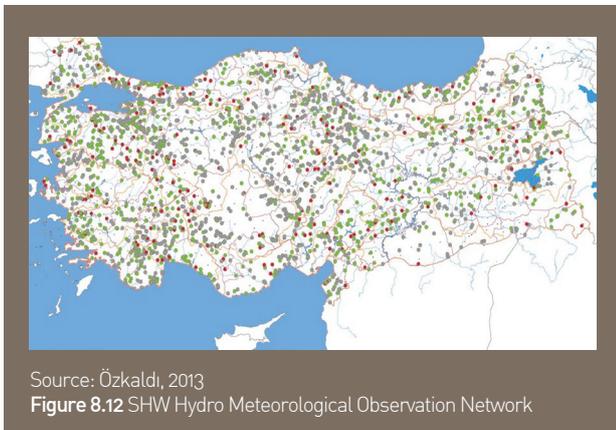
### 8.2.3.1 Oceanographic Climate Observation Systems

Oceanographic observations are being done by HGK in our country. HGK is a member of Permanent Service for Mean Sea Level-PSMSL, which determines and analyses the average sea level with the help of its global network in 1993 and reveals the publications about these (PSMSL, 2014; Akyol, Simav, Sezen, Kurt, Türkezer, and Kurt, 2011). Our country is a member of European Sea Level Service-ESEAS at the same time. In the scope of ESEAS membership, there are tide turn systems at 5 points and sea level measurement stations, which are in the scope of MedGLOSS (Mediterranean Network for Systematic Sea-level Monitoring in the Mediterranean and Black Seas-regional subsystem of Global Sea Level Observing System), at 5 points (Plag, 2002; IOC, 2000). The red points in Figure show the stations in the scope of ESEAS and the blue points show the stations in the scope of MedGLOSS.





SHW, which does terrestrial observation and which is the biggest institution responsible for the inspections at the same time, carries out the observations done in rivers and lakes. There are 3,713 current observation stations (AGI) in the hydrometeorological observation network of SHW. 338 of these are serving as lake observation stations (GGI), 721 of these are serving as meteorology observation stations (MGI), and 330 of these are serving as snow observation stations (KGI). Hydrometeorological observation network of SHW is shown in Figure 8.12 (SHW, 2014).

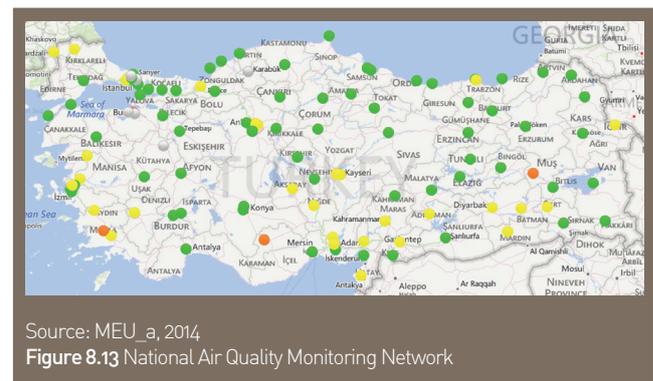


Up-to-date agricultural information on the basis of product and place is obtained by evaluating the data taken from satellite images and ground measurement networks in high speed computers with the Agricultural Monitoring and Information System (TARBİL), which is carried out with the partnership of Ministry of Food, Agriculture, and Livestock, SMS, and TurkStat in the field of meteorology (TARBİL, 2014). The building of the infrastructure will be completed with the increasing of the number of ground measurement stations until the end of 2014 and the integration of the satellite images that ITU-CSCRS (ITU-Research and Application Center for Satellite Communications and Remote Sensing) has provided completely to the system (TARBİL, 2014).

### 8.2.3.3 Air Quality Observation Systems

Air pollution has started to be a problem for the world with the beginning of the industrial revolution. Industrial revolution has brought urbanization and the increase of the usage of fuels that cause the increase of carbon emission together with itself. The increase in emission has caused some results that are harmful for human and environment. Air quality monitoring networks are built in our country and a lot of other countries in order to decrease these harmful results and follow the emission ratios. For this purpose, air quality measurement stations are built by Ministry of Environment and Urbanization in 81 cities in our country between 2005 and 2007. Measurements are done in 39 stations of

Marmara Clean Air Center in addition to 125 stations related to the ministry. Besides the ministry, there are 14 air quality measurement stations of Istanbul Metropolitan Municipality, 6 of İzmir Metropolitan Municipality, 8 built by Ministry of Health Sanitation Center Head Office in Ankara, 1 of Konya Karatay Municipality, 1 of Zonguldak Black Sea Ereğli Municipality, 1 in Çanakkale Biga IÇDAŞ sites, 2 in Karabük Kardemir sites, and 1 of Kocaeli Dilovası Organized Industry Region. These stations operate integrated to National Air Quality monitoring network. In the stations, Sulphur Dioxide (SO<sub>2</sub>) and Particle Material (PM<sub>10</sub>) parameters and Nitrous Oxides (NO, NO<sub>2</sub>, NO<sub>x</sub>), Carbon Monoxide (CO), and Ozone (O<sub>3</sub>) are also measured in addition to these. All of the collected data is sent to Environment Reference Laboratory Data Processing Center, which is related to the ministry and are collected there. The places of air quality monitoring stations and the air quality situations of the stations on 22.08.2014 at 10:00 are given in Figure 8.13 (MEU\_a, 2014).



The colors given on the map are determined according to EPA (Environmental Protection Agency) air quality index. The detail information about the index is given at Table 8.3.

### 8.2.3.4 Space-Based Observation Systems

Environmental Observation Satellite Network includes 3 operational polar-orbit satellites and 6 operational geostationary-orbit satellites. Whereas the vertical profile of the humidity and temperature data is drawn with polar-orbit satellites, measurements of wind velocity, cloud water capacity, and water vapor are done with the geostationary-orbit satellites (WMO\_a, 2014).

SMS is in EUMETSAT (European Organization for the Exploitation of Meteorological Satellites) Satellite Program in our country since 1984. This program does the operation of geostationary- and polar-orbit satellites for Europe and does the ground services and the distribution of safe data, image, and products. The program in question supports weather prediction and climate studies of the meteorology organizations of 30 member countries (Schulz, 2012).

Air Quality Index (AQI) Values	Health Concern Levels	Colors	Meaning
0 - 50	Good	Green	Air quality is satisfying and the air pollution risk is low or there is no risk.
51 - 100	Middle	Yellow	Air quality is appropriate, but medium level health concern may arise for very few people who are unusually sensitive to air pollution in terms of some polluters.
101 - 150	Sensitive	Orange	Health effects may arise for sensitive groups. It is not probable that the public will be affected in general.
151 - 200	Unhealthy	Red	Everyone may start to experience health effects and serious health effects may be in question for sensitive groups.
201 - 300	Bad	Purple	May cause emergency in terms of health. The possibility that all of the population will be affected is high.
301 - 500	Dangerous	Brown	Health alarm: Everyone may face more serious health effects.

Source: MEU\_a, 2014

**Table 8.3** EPA air quality index

### 8.3. Assistance to Developing Countries

Turkey, which is not in UNFCCC Annex II list, does not have a direct obligation to provide financial and technological help to developing countries. However, Turkey participates in a lot of projects with dual and multilateral contracts and continues to support developing countries.

International Meteorological Radar Education has begun in Muğla on 8 October 2012. A lot of trainees from Tunisia, Kuwait, Romania, Senegal, Congo Democratic Republic, Burkina Faso, Hungary, Moldova Republic, Kazakhstan, Bahama, Saudi Arabia, and Ethiopia have participated to the program. In an one-week training, courses such as Turkish Meteorology observation systems and meteorology radar network, spreading of electromagnetic waves and radar types, air radar, receiver, transmitter, antenna unit, radome and its types, radar products and their applications, and Muğla radar field are given by Turkish State Meteorological Service (SMS) experts (SMS, 2012).

The Third International Workshop about "Meteorology, Dust Carrying, Desertification, and Campaign Against Erosion" was taken place in Istanbul on October 28-31 2013. 32 experts from 15 countries have participated in total (including one from Serbia and Spain each) and 30 participants from 13 countries which are Saudi Arabia, Oman, Lebanon, Iran, Libya, Algeria, Morocco, Sudan, Yemen, Palestine, The Unit-

ed Arab Emirates, Tunisia, and Jordan (SMS, 2013).

SADCA (Satellite Data Access for Central Asia) project, planned by SMS and Europe Meteorology Satellites Operation Organization (EUMETSAT) and the first steps of which were taken in 2011, was completed in the year of 2014. As the part of the project, the access of the national meteorology organizations of five countries (Turkmenistan, Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan Hydrometeorology Services) to their meteorological satellite data and their operational usage are facilitated (SMS\_a, 2014).

Upon the request of Azerbaijan Hydrometeorology Institute, SMS has provided support for the studies of Message Switching System (MSS) and Database Generation and also the setup of the prediction centers of MetcapPlus (Imaging Meteorological Data-Automation Program) Software (SMS\_b, 2014).

"METCAPPLUS Meteorological Imaging Software", which was developed by SMS, has been set up in three units of the center of Georgia Hydrometeorology Institute in Tiflis, as Telecommunication, Predictions, and Long Term Predictions between 8 and 14 June 2014 (SMS\_c, 2014).

"Increasing and Evaluating Performance about Meteorology" and "Quality management Systems, Documentation, and Internal Control" educations were given in World Meteorology Organization Regional Education Center Ankara Site for Yemen Meteorology Organization employees in 2014 (SMS\_d, 2014).

SMS and TIKA have been organizing education programs and trainings for Palestine Meteorology Works experts about various subjects since 2006. In 2013, investigations have been done in meteorology stations in different cities of Palestine and problem and solution consultations were done for capacity and situation evaluation (TIKA\_a, 2013).

According to the Turkey Development Helps Report of 2013 of TIKA, 6 expert personnel were charged for 1080 days in Afghanistan Kabil Airport under the cooperation of TIKA and SMS. Besides, The Basics of International Calibration Training is given to 13 participants coming from 12 countries (TIKA\_b, 2013).





## **9. EDUCATION, TRAINING and PUBLIC AWARENESS**

## 9. EDUCATION, TRAINING AND PUBLIC AWARENESS

### 9.1. General Policy

As a requirement of Article 4.1(i) of UNFCCC, the Parties must provide education and training about climate change, raise public awareness and do the cooperations that encourage the widest participation in this process, including non-governmental institutions. While carrying out these commitments; it is necessary to develop educational and public awareness programmes on climate change and its effects, ensure public access to information, facilitate the participation in the strategy development process and support the training of scientific, technical, and managerial personnel as specified in the Article 6 of the Convention. It is also highlighted in Article 10(e) of Kyoto Protocol that the proper methods should be developed in order to apply the activities in the Convention.

Within the scope of commitments, Turkey completed 1st National Communication in 2007 and 5th National Communication in 2013. In Turkey, Ministry of Environment and Urbanization, which acts as National Focal Point for climate change, carries out the national coordination duty for all subjects related to climate change. CBCCAB was built in 2013 under Directorate General of Environmental Management in order to carry out studies in coordination with the Directorate of Education and Publication of the Ministry. One of the working groups formed under CBCCAM is Education, Raising Awareness, and Capacity Building Working Group.

Education, Raising Awareness, and Capacity Building Working Group, coordinated by the Ministry of Environment and Urbanization, is responsible for providing the necessary contribution to the preparation of national reports submitted to the UNFCCC, developing policy in the field of education, training, and informing the public, conducting the studies towards raising awareness by maintaining the cooperation between institutions, reporting of the studies done in the whole country about primary school, secondary school, and high school education, education materials, training programs, source and information centers, public informing campaigns, participation of public and non-governmental organizations in climate change campaign studies, and reporting of the studies done about participation in international activities (DGEM\_a, 2014). With the expression, "Everyone has the right to live in a healthy and balanced environment. It is the duty of the Government and the citizens to improve the environment, protect the environmental health, and prevent environmental pollution" in

the Article 56 of the Constitution, the importance of protecting the environment is highlighted.

Environment Law with the number 2872 has come into effect with the purpose of protecting the environment, which is the common property of all of the living creatures, in accordance with sustainable environment and sustainable development principles on 11/08/1983 and the notion of environment has become the subject of a law for the first time. In Article 9(i) of the Law, which was changed for the last time on 24 April 2006, there are the following expressions;

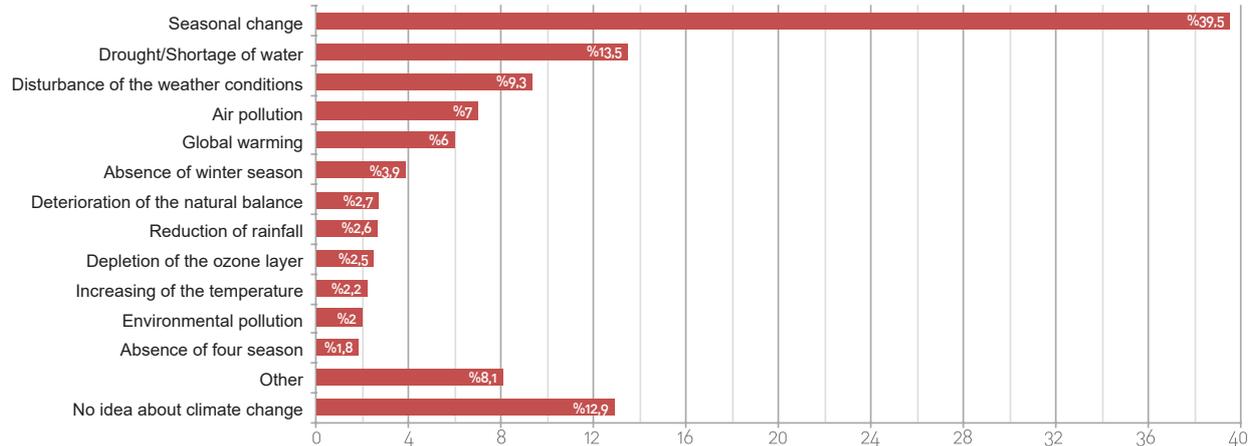
- It is essential to include subjects about environment in the education programs of formal education institutions of Ministry of National Education, starting from pre-primary education, with the purpose of protection of the environment and raising environmental public awareness.
- For non-formal education, it is essential to include programs about the importance of the environment and for the development of the environmental consciousness should be included in radio and television programs. It is obligatory to do educational broadcasting at least for two hours a month in the television programs of Turkish Radio and Television Corporation and private television channels and at least for half an hour in the programs of the private radio channels. It is essential to do 20% of these broadcastings in the hours in which watching and listening rates are the highest.

### 9.2. The Awareness of Turkey About Climate Change

Different researches were done in order to determine the awareness level of Turkey about climate change. In 2012, a research completed by Ministry of Environment and Urbanization, Directorate General of Environmental Management. The research aims the determination of the awareness level of the public about climate change, the greenhouse gas mitigation and adaptation activities done by the public, and the willingness of the public to pay more for the decrease of greenhouse gas release. The results that were found are as follows (MEU\_b, 2012):

#### What is Climate Change?

Whereas 87.1% of the society could comment about climate change, 12.9% of it declared that they did not have an idea. The answers given to the question are shown in Figure 9.1 in detail.



Source: MEU\_b, 2012

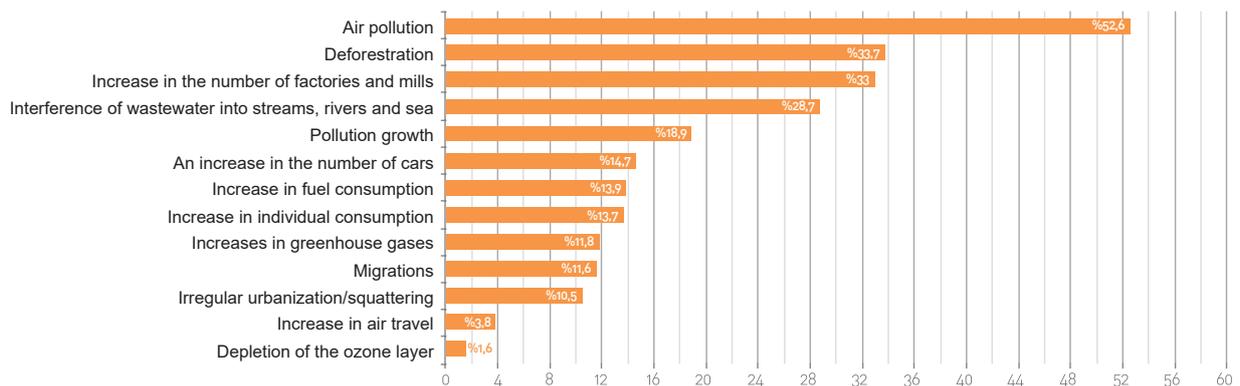
Figure 9.1 Answers given to the "What is climate change?" question

Climate change was largely considered as seasonal change. It is detected that the number of people having no idea increases as the education level decreases and university graduates have given answers that are ozone layer depletion and global warming. 52.6% of the society thinks that air pollution is causing climate change and 33.7% of the society thinks that deforestation is causing climate change. Opinions about the causes of climate change are shown in Figure 9.2.

15.2% of the interviewed people has evaluated climate change as "very worrying", 50.8% of them evaluated it as "worrying", 12.8% of them evaluated it as "neither worrying nor not worrying", 6.9% of them evaluated it as "not worrying", 1.5% of them evaluated it as "not worrying at all".

Applications done individually in order to reduce the effects of climate change consist of saving energy (17.4%), saving water (8.7%), keeping the environment clean (7.5%), using energy-saver light bulbs (5.7%), separating the wastes (5.4%), preferring public transportation more (4.8%), afforestation (3.7%), making thermal insulation (2.7%), using natural gas (2%), using aerosol products (1.4%), protecting the nature (1.4%), buying environment-friendly products (1.2%), and using high quality coal (1.1%).

53.9% of the people who said that they have knowledge about climate change also said that they would not pay a higher price for the products, which they know that harmed the



Source: MEU\_b, 2012

Figure 9.2 Opinions about the causes of climate change

environment less during production phase, whereas 33.2% of them said that they would. The average amount that is agreed to be paid in order to buy a 100 TL-product is 12.05 TL (MEU\_b, 2012).

In another study, which was done for private sector with the cooperation of Regional Environmental Center (REC Turkey) and Turkish Industry and Business Association (TUSIAD) in 2014, was carried out with the participation of big and leading companies in the sectors directly related to climate change, with the purposes of determining the awareness level of Turkish business world about "Climate Change and Low Carbon Economy" and determining the point on which it is about the campaign against climate change. Results obtained from the study were collected under three topics:

- Awareness and Strategy
- Measurement
- The Role of Private Sector in the Campaign Against Climate Change

According to the results obtained from the study, some findings were determined as follows;

- Awareness is raised about climate change in private sector (100%) and this problem affects the institutions (84%),
- Strategy towards campaign is developed (96%) and certain budgets are reserved for this issue (80%),
- The process is managed in a top-level and the communication of climate change strategy is done at every level of the institution (72%),
- The institutions approach to the subject with institutional social responsibility consciousness first while developing their strategies and the main elements in the basis of their strategies are 'the management of environmental effects originating from the operations' and 'reducing water and energy consumption and waste materials',
- Institutions usually publish the outputs of their climate change enterprises in the scope of sustainability reports (56%),
- It is believed that private sector has a role in managing the effect of climate change on Turkish business world (96%),
- It is believed that private sector has a role in managing the effect of climate change on Turkish business world in the subjects of raising awareness (40%), cooperation (36%), setting an example (28%), carbon reduction (20%), innovation (8%), and supply chain (8%),
- It is believed that public sector has a role in managing the effect of climate change on Turkish business world in the subjects of encouraging in management (44%), regulation (36%), management (20%), sanction (8%), and funding (4%) (Sayman, Akpulat, and Baş, 2014).

## 9.3. Education and Training

### 9.3.1 Education Syllabus and Teaching Programs

The basic structure of the education system of Turkey was determined with National Education Basic Law with number 1739. According to the law, National Education System consists of two main parts as formal and non-formal education. Formal education includes pre-primary education, primary education, secondary education, and higher education and non-formal education includes all of the education activities organized besides or out of formal education.

#### 9.3.1.1 Pre-Primary Education

The aims and duties of pre-primary education consist of ensuring the physical, mental, and emotional development and acquiring good habits of children, preparation for primary education, creating a common environment of upbringing for children coming from environment and families with disadvantaged conditions, and ensuring the correct and proper speaking of Turkish of the children (MNE\_a, 2013). According to 2014-2015 National Education Formal Statistics, the number of schools is 26,972 and the number of students receiving pre-primary education is 1,156,661 (MNE\_a, 2015). There are a lot of activities related to climate change and environmental issues in pre-primary education program, in which the importance of recycling is taught and the negative results of climate change are told (MNE\_b, 2013).

#### 9.3.1.2 Primary Education

The 4-year primary school and the 4-year lower-secondary school programs of the 12-year compulsory education that is given after pre-primary education constitute primary education. According to 2014-2015 National Education Formal Statistics, there are 27,554 primary schools and 5,434,150 primary school students, 16,969 lower-secondary schools and 5,278,107 lower-secondary school students (MNE\_a, 2015). Examples to the courses in which climate change and environment subjects are included and the educational attainments and explanations of these courses in the training programs are given in Table 9.1.

CLASS	UNIT/SUBJECT AREA	EDUCATIONAL ATTAINMENTS/EXPLANATION/ACTIVITY EXAMPLES
<b>Life Information</b>		
1	Yesterday, Today, Tomorrow Theme	<ul style="list-style-type: none"> <li>• Realizes the changes related to seasonal changes in the lives of living creatures.</li> <li>• Observes the changes in the weather conditions during the day and shows the observation results on the table.</li> </ul>
<b>Sciences</b>		
5	The Mystery of the Earth Crust/The World and The Universe/Air, Soil, and Water Pollution	<ul style="list-style-type: none"> <li>• Discusses the reasons of, negative results of, and precautions to be taken against air, soil, and water pollution</li> </ul>
8	The Structure and Properties of the Matter / Matter and Change / Acids and Bases	<ul style="list-style-type: none"> <li>• Investigates the reasons and results of acid rains and produces and presents proposals for the solution of the problem</li> </ul>
8	Matter Cycles	<ul style="list-style-type: none"> <li>• Investigates the reasons for the thinning of ozone layer and its possible effects on living creatures and produces and presents proposals for the solution of the problem</li> </ul>
<b>Social Studies</b>		
6	Resources of Our Country	<ul style="list-style-type: none"> <li>• Discusses the effects of the unconscious consumption of natural resources on human life. (Our Natural Resources are Committed to Us: Projects are designed about the conscious usage of natural resources.)</li> </ul>
<b>Science Applications</b>		
6	-	<ul style="list-style-type: none"> <li>• Creates a model towards the usage of renewable energy resources</li> </ul>
7	-	<ul style="list-style-type: none"> <li>• Discusses the factors that will negatively effect ecosystems and the possible results of these.</li> <li>• Presents proposals towards the protection of ecosystems</li> </ul>
<b>Turkish</b>		
6-8	Selective Themes	<ul style="list-style-type: none"> <li>• It is proposed to include the "climate, natural events, physical changes in the nature" subjects in the "Sub-Themes" of "Nature and the Universe" theme, which is among the "Selective Themes" of Primary Education Turkish Course Teaching Program</li> </ul>
<b>English</b>		
8	Natural Disasters	<ul style="list-style-type: none"> <li>• <b>Listening Skill Gains:</b> Students can recognize the main idea of television news and reports broadcasted about natural disasters. Students can understand structures and expressions related to natural disasters in a clear and understandably expressed talk.</li> </ul>

**Table 9.1** Examples to the courses related to climate change and environment subjects in primary education syllabus

### 9.3.1.3 Upper Secondary Education

Upper secondary education, which comes after primary education, constitutes the last 4 years of the 12-year compulsory education. Upper secondary education includes all the teaching institutes, general, vocational and technical education institutions with at least four year compulsory formal or non-formal education.

**General Secondary Education:** It is a four year compulsory educational process that prepares students for higher education or future according to their interests, expectations, and abilities in addition to equipping them with world knowledge with an education based on primary education.

**Vocational and Technical Secondary Education:** It is a four year compulsory educational process that prepares students for higher education, education, or future and job fields according to their interests, expectations, and abilities in addition to equipping them with work knowledge with an education based on primary education.

**Open Upper Secondary High School:** Education is given to the students, who cannot continue formal education institutions that give face to face education, whose formal education age have passed, and who wants to open upper secondary high school while continuing high school, with a pass or fail and credit system in open upper secondary high schools.

According to 2014-2015 National Education Formal Statistics, there are 9,061 high schools and 5,691,071 students (MNE, 2014). Examples to the courses in secondary education in which climate change and environment subjects are included and the educational attainments and explanations of these courses in the training programs are given in Table 9.2.

CLASS	UNIT/ SUBJECT AREA	EDUCATIONAL ATTAINMENTS	EXPLANATIONS/ACTIVITY EXAMPLES
<b>Geography</b>			
9	Natural Systems	<ul style="list-style-type: none"> <li>• Makes deductions about the properties and distributions of different climate types</li> </ul>	<ul style="list-style-type: none"> <li>• “World Climate Regions” distribution map is generated by facilitating the climate prosperity of the world and the properties of different climate types.</li> </ul>
11	Environment and Society	<ul style="list-style-type: none"> <li>• Classifies environment problems according to different criteria.</li> <li>• Questions the generation and dispersion processes of environment problems in terms of their global effects.</li> <li>• Gives examples to the effects of human activities on carbon, nitrogen, oxygen, and water cycles.</li> <li>• Develops strategies towards the prevention of environment problems.</li> </ul>	<ul style="list-style-type: none"> <li>• Human Interventions to Ecological Cycles: Can make deductions about example situations related to the human activities intervening carbon, nitrogen, oxygen, and water cycles by facilitating the figures of these cycles.</li> <li>• Our Planet is Giving Alarm: A class newspaper, which scrutinizes Global Environment problems with all of their aspects can be issued.</li> <li>• Problems With No Boundaries: Striking slogans about global environment problems can be found, posters and flyers can be prepared and various campaigns can be organized.</li> <li>• Possible Developments in Environment Problems: A short role play about environment problems and their effects is presented. At the end of the play, the subject is brought up for discussion. By playing “If I was...” game, it can be requested that they say what they would do if they were the people who were affected by environment problems, who are causing environment problems, and who are trying to prevent environment problems.</li> </ul>
2	Natural Systems	<ul style="list-style-type: none"> <li>• Evaluated the extreme situations and effects of natural events.</li> <li>• Makes deductions about the changes directed towards the future in natural systems.</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluated the extreme situations and effects of natural events.</li> <li>• Makes deductions about the changes directed towards the future in natural systems.</li> </ul>
<b>Biology</b>			
9	Current Environment Problems	<ul style="list-style-type: none"> <li>• Questions his/her roles in the emerging of current environment problems.</li> <li>• Questions the reasons and the possible results of the current environment problems.</li> </ul>	<ul style="list-style-type: none"> <li>• Applications about ecological footprint and carbon footprint are made done.</li> <li>• Discussions are made in the framework of current environment problems, air pollution, water pollution, soil pollution, food pollution, radioactive pollution, noise pollution, acid rains, global climate change, erosion, deterioration of natural habitats, and forest fires etc.</li> <li>• Possible effects of global climate change and biological diversity on daily life are questioned.</li> </ul>

**Table 9.2** Examples to the courses related to climate change and environment subjects in secondary education syllabus



### 9.3.1.4 Higher Education

Higher education is all of the educational institutions that give education of at least two years, based on secondary education, including universities, faculties, institutes, colleges, conservatories, vocational colleges, and center for practice and research (MNE\_a, 2015). According to the 2014-2015 statistics that Council of Higher Education has published, the total number of students taking associate programme, undergraduate programme, and master education is 6,062,886 (state+foundation) (CoHE, 2015).

A lot of studies about climate change are being done in different departments of higher education institutions such as environmental engineering, meteorology engineering, chemical engineering, agriculture, civil engineering, biology, marine sciences, landscaping architecture, urban and regional planning, medical ecology and climatology, geography, international relationships, finance, public administration, political sciences, and econometry.

There are also master and doctorate programs including courses such as "climate change and modeling", "sustainable development", "environmental economy", "energy policies and finance", "ground system sciences", and "plant-climate models" with the purposes of raising awareness about the adaptation and campaign processes related to global climate change, which is one of the most important problems of today, and meeting the need of the country for educated employee/academician.

### 9.3.2 Education and Training Projects

Education and training studies in the scope of the activities developed about climate change are listed below.

#### I am Learning Safe Life with Turkish Red Crescent Project

I am Learning Safe Life with Turkish Red Crescent Project, which was conducted in collaboration with Turkish Red Crescent and Ministry of National Education, General Directorate of Basic Education, was carried out with the purposes of introducing natural disasters and the ways of protection from these, and introducing Turkish Red Crescent. The target audience of the project was class 4 and above for the books and 2., 3., 4., 5., 6., 7., 8., and 9. class students, families, and teachers for class calendars.



Source: Kızılay, 2014

It was aimed to raise the levels of consciousness of students, families, and teachers about disasters, preparation for disasters, safety, social responsibility, volunteering, and human values under the topics of safe life, public responsibility, volunteering, disaster, emergency, first aid, earthquake, tsunami, fire, wind and wind storms, tornadoes, snow storm, snowslide, thunderstorm rains, floods, landslides, mud currents, insolation times, hot waves, forest fires, and global climate change. In the teacher's book, which is generated separately, there are guide information about the usage of the student's book as a source book and evaluation forms reserved to be filled by teachers. In the framework of I am Learning Safe Life with Turkish Red Crescent Project, 753,563 student's books, 46,926 teacher's books, and 234,000 classroom calendars were published and distributed in Turkey.

#### Programme for International Student Assessment- PISA

Programme for International Student Assessment (PISA), which is carried out by Organization for Economic Cooperation and Development, is one of the biggest education research of the world, in which students of the 15 age group are evaluated in terms of their reading skills; Moreover, information and skills in the fields of mathematics and science. Our country has been participating in PISA research, which is carried out by Ministry of National Education, General Directorate of Innovation and Education Technologies since 2003.

PISA research is collecting data about the motivations of the students of 15 age group, who continue formal education, their ideas about themselves, learning fashions, school environments, and their families apart from their mathematical literacies, life sciences literacies, and reading skills. Different question types such as multiple choice, complicated multiple choice, open end,

and close end are used in PISA Project. Facts about environmental subjects are also included in these questionnaires. Some of the subjects in question are greenhouse gases that cause climate change, factors damaging the environment, and environmental pollution sources. Awareness of the students about environment is raised with the research (MNE\_b, 2015; PISA, 2015).

#### 9.4. Public Awareness

Some of the sample awareness raising activities carried out about climate change are given below.

##### Increasing Awareness of Climate Change Impacts and Adaptation to Climate Change Project

"Increasing Awareness of Climate Change Impacts and Adaptation to Climate Change" project, which is supported by Ministry of Environment and Urbanization and carried out with the cooperation of TUBITAK and Turkish Institute of Management Science (TUSSIDE), is done with the purposes of attracting attention to climate change and raising awareness about the precautions to be taken. In the scope of the project;

- Climate change seminars were organized for 120 secondary school teachers from 8 pilot cities (Trabzon, Samsun, Konya, Kayseri, Muğla, İzmir, Bursa, and Edirne) of 4 geographical regions of Turkey (Black Sea, Central Anatolia, Aegean, and Marmara Regions).
- Public spot film is prepared in the scope of the project for transferring the effects of climate change to public.



- Picture and composition competition about climate change is organized.
- Climate Change Camps are organized for 120 secondary school students and 60 university students, who are teacher candidates.

##### EU - Turkey Chambers Forum II Project (ETCF II)

The target audience of "EU-Turkey Chambers Forum" Project, which was started with the cooperation of the Union of Chambers and Commodity Exchanges of Turkey in June 2011, consists of industry and/or trade chambers, chamber employees, and private companies. In the framework of the project, a survey is organized with the purpose of measuring the level of adaptation to EU Environmental Acquis. Comprehensive surveys were done about EU Environmental Acquis by visiting the 242 companies which were selected for the application of survey studies, one by one.

At the end of the project, which was completed in June 2014, with the help of EU acquis inspection, the awareness of Turkish chambers and companies about EU Environmental Acquis and legislation is raised. The capacity of the chambers to do these inspections independent of the project even after the project is maintained. Besides, 242 Turkish companies were inspected in terms of their levels of adapting to EU legal regulations about environment and a report was prepared based on the results of the inspections of acquis.



##### Agricultural Extension Services Project

In the scope of the project and adaptation to climate change, it is aimed to educate irrigation publisher to work in farmer education and publication activities for conscious and economical water usage. The target audience of the project, which is under the operation of Ministry of Food, Agriculture and Livestock, Department of Training, Extension, and Publications, consists of ministry personnel and irrigation publishers.

When we think about the irrigated area in our country, there is a need for 3,853 irrigation publishers in Ministry of Food, Agriculture, and Livestock. The number of technical staff, who were certified as irrigation publishers between 1996 and 2013 in the Ministry, is 1,465 and this number is 38% of the needed number. Agricultural Extension Services Project is ongoing.

### Farmer Training and Extension

In the scope of the activity, education programs of one week or two weeks are being carried out about agricultural irrigation, canal project design, pressurized irrigation systems, modern irrigation, and hydraulic design upon the requests of farmers who are members of Water User Organizations, and Provincial Special Administration. Besides, farmer meetings are planned about the protection of water resources, natural resources and biological diversity, global warming, surface irrigation, and drip irrigation. In the education activities that were carried out, 151 technical personnel and 155 farmers were educated between 2008 and 2011. Besides, 2,070 farmers have participated in 160 farmer meetings in total.

### Woman Farmer Training Cooperation Protocol

It is aimed to educate women who live in rural areas and do farming and to develop the cooperation between institutions, with the Woman Farmer Training Cooperation Protocol, which was signed between Ministry of Food, Agriculture, and Livestock, Ministry of Family and Social Policies and Turkey Union of Chambers of Agriculture in 2012. The education program, which includes "climate change, cooperativity, entrepreneurship-leadership, social security, social gender equality, violence against women, personal rights and freedoms" subjects that are determined in the scope of the protocol for woman farmers and subjects determined in the direction of the needs of woman farmers, is applied mutually with protocol parties.

In the study that was started in 5 pilot cities, trainer education is given to 35 technical personnel from provincial directorate and a total number of 771 woman farmers were educated in the 5 pilot cities in 2012. 25 technical personnel have participated in trainer education in 2013 and 27 technical personnel have participated in trainer education in 2014. Protocol study was generalized in our 81 cities in 2014.

### Adaptation to Climate Change Workshop in Transportation Sector

In the scope of European Union Technical Assistance and Information Exchange (TAIEX) program, "Adaptation to Climate Change in Transportation Sector" workshop was organized in Ankara in 20-21 March 2014, with the purpose of

raising the awareness of transportation sector about adaptation to the present and future effects of climate change. The target audience consisted of ministries, institutions and organizations, metropolitan municipalities, universities, private sector, unions, and chambers.

A broad participation was maintained and information exchange was done in the workshop, which was carried out with the purposes of meeting the information need for the adaptation of transportation sector in our country to climate change, increasing the awareness and capacity about this subject in public and private sector, and providing a basis for the projects that are planned to be carried out in the next terms. In the light of the presentations and information given by foreign experts about the subject, precautions to be taken about the adaptation of transportation infrastructure to climate change and the needs in the sector were tried to be determined.

### Ministry of National Education-Ministry of Forestry and Water Affairs Protocol

The cooperation protocol about the introduction of meteorological activities and products in schools and informal education institutions between Ministry of National Education and Ministry of Forestry and Water Affairs is signed and came into effect on 04.03.2014. The protocol aims that meteorological activities and products are introduced in schools and informal education institutions and seminars are organized about the accessibility of these and the awareness of the public opinion is raised.

The experts charged by provincial directorates of meteorology have started to go to the determined schools and giving seminars from April 2014. In the scope of the educations, the awareness of the students was raised about subjects such as the interaction between the science of meteorology and daily life, methods of protection from meteorological disasters, the benefits of planings to be made with the following of the weather predictions in terms of timing and economy, the consumption rate of our natural resources and the importance of renewable energy.

### Pilot Climate Change Adaptation Market Research: Turkey Project

"Turkey Adaptation to Climate Change Study" was started to be applied since September 2011 in our country and completed at the end of 2013 under the cooperation of European Bank for Reconstruction and Development (EBRD), International Finance Corporation (IFC) related to World Bank, and Ministry of Environment and Urbanization. The Union of Chambers and Commodity Exchanges of Turkey has provided intensive support to the project. The purpose of the project is to determine the role of Turkish business world in adapting the new conditions that

climate change has created and determine the precautions to be taken in order for the private sector not to be fragile against climate change. The project in question is very important about raising the awareness of Turkish companies about the precautions to be taken against Kyoto Protocol, climate change, carbon trade, and sanctions to be faced in the next terms.

In the scope of the project, 1 workshop and 2 informing meetings in Ankara, 1 workshop and 1 informing meeting in Istanbul, and one workshop in Bursa, Gaziantep, and Antalya each were carried out under the leadership of The Union of Chambers and Commodity Exchanges of Turkey. It is aimed to raise the awareness of the sector about climate change and environment in the workshops. Besides, in the scope of the project, a survey study was carried about climate change via the website of The Union of Chambers and Commodity Exchanges of Turkey. At the end of all of the studies, a comprehensive guide is prepared for the private sector to be able to manage the risks about climate change, and to be able to find out the opportunities in this field.

### Gender Equality National Action Plan (2009-2013)

It is very important that women are educated and especially their awareness is raised about environment. One of the studies done in this scope consists of "Gender Equality National Action Plan (2008-2013)".

One of the eight topics in the Action Plan, which was prepared based on the critical areas determined in Pekin Action Platform with the contribution and participation of all of the related parties under the coordination of Ministry of Family and Social Policies, Directorate General for Status of Woman is "Woman and Environment".

Under the topic of Woman and Environment;

- Diversifying environmental data on the basis of gender and maintaining the increase of the research and scientific studies about woman and environment,
- Maintaining the activity of women in the decisions to be made about environment,
- Reinforcing the role of women in the active application of environmental policies,
- Protecting women, especially women of rural areas, against inadequate rural and urban environmental conditions, making them stronger, and increasing their life standards aims take place. Action Plan was followed with 6-month termly meetings and reports with the institutions and corporations responsible for the carrying out of the strategies determined under each aim. (DGSW, 2014).

### Green Airport Project

Studies are started for systematically decreasing or, if possible, completely extinguishing the harm done or that can be

done by corporations in the airports to environment and human health in the framework of Green Airport Project, which is carried out by Directorate General of Civil Aviation. Two educations were organized in the scope of the project for the airports under the responsibility of General Directorate of State Airports Authority.

Greenhouse Gas Management, Carbon Footprint Report, and Climate Change Program Education has been carried out in Ankara Esenboğa Airport education sites in 20-24 May and 27-31 May 2013 as two groups.

Greenhouse Gas Calculation Expert Education has been carried out in Dalaman Airport education sites in 20-23 May and 27-30 May 2012 as two groups.

### Green School Project

Green School Project, which takes separation at the source system, which is the first and the most important step of the recovery of the wastes as principle, is being carried out with the cooperation of Ministry of National Education, Beykoz Municipality, Beykoz District Governorship, and Yön Cleaning. Project aims to contribute to the improvement of environmental awareness, environmental management, and waste management in this scope.

In the scope of the project, the recycling of the wastes collected from the schools is being done with the mediation of institutions and corporations approved by Republic of Turkey Ministry of Environment and Urbanization. With the help of compost machines provided for every school, it is made possible for the children to do the composting of the organic wastes in their schools themselves. The compost that is generated is used as soil improver in the gardens of the schools. For each school in the scope of the project, garden-type compost units, waste boxes special for each waste type, and other project equipment was provided. The reason for preferring the garden-type compost machine in the project is that the students will apply the composting process easily and in a healthy environment (Green\_School, 2015).

### Energy Kid Project

Energy Kid Project was started with the purpose of making 5., 6., 7. and 8. class children gain energy efficiency consciousness and perception. With the cooperation contract signed between Ministry of National Education, General Directorate of Basic Education and Energy Efficiency Association, it is aimed to raise the consciousness of the children with theater, cartoons, computer games, and other visual activities and decrease the energy consumption in the houses. In 21 pilot cities determined in Turkey in general -Trabzon, Adana, Ankara, Bursa, Denizli, Diyarbakır, Edirne, Gaziantep, Hakkari, İstanbul, İzmir, Kahramanmaraş, Kars, Kayseri, Kocaeli, Konya, Malatya, Mersin, Sinop, Şanlıurfa, and Van- application studies are being done.

In the scope of the project, 2014-2015 education/teaching year activity plan was done in the formal and private schools related to ministry of National Education. Theater show studies about energy efficiency were done in 21 pilot cities. Energy clubs were generated in the schools that were determined from each city. Materials such as clipboards, flyers, and posters were sent to the pilot schools by Energy Efficiency Association in order to be used in the clubs. A meeting was done in Istanbul with representative teachers and students coming from 21 pilot cities in January 2015.

### Earth Hour

Earth Hour has been carried out by World Wide Fund for Nature (WWF)-Turkey since 2008 in our country. In 2010, Bosphorus Bridge has also supported Earth Hour, in which over 230 institutions and approximately 5,000 people participated, by turning of its lights. In 2011, over 20,000 people and over 250 institutions have united their powers for the future of the world. Besides Bosphorus Bridge, Ankara Opera Building and Kastamonu Castle have also supported the application. In 2012, a record number of over 75,000 people and over 400 institutions have participated in Earth hour. Besides Bosphorus Bridge, Fatih Sultan Mehmet Bridge, Dolmabahçe Palace and Clock Tower, Beylerbeyi Palace, Küçüksu Pavilion, Galata Tower, and Hagia Sophia Museum have turned their lights off for Earth Hour for the first time. In 2013, over 70,000 people have supported the campaign and the lights of tens of symbolic buildings in different cities of Turkey were turned off with #dominoetkisi (#dominoeffect) campaign (Earth Hour, 2014).

### Raising Awareness in energy Efficiency of Household Appliances and Climate Change Project

Raising Awareness in energy Efficiency of Household Appliances and Climate Change Project, which is carried out by Ministry of Energy and Natural Resources, General Directorate of Renewable Energy with United Nations Development Programme (UNDP) with the financial support of GEF, which is supported in the scope of Market Transformation of Energy Efficient Appliances in Turkey Project (EVUDP) Grant Programme, and which was completed in September 2014 by carrying out by Kadir Has University, aims that the relationship between climate change and energy efficiency is understood. The project aims to educate the mothers and children about the risks of climate change.

In the scope of the project, "Practical Information Book for Saving Energy At Home" and "Electrical Home Devices Book for Children" are prepared with the purpose of raising awareness. With "Energy Efficiency in Electrical Home Devices Game", the raising of the consciousness of the children about considering energy efficiency while using electrical home de-

vices. Besides, survey study has been carried out via Internet. (Energy Awareness, 2014).

## 9.5. Public Access to Information

Access to information about climate change is maintained via television programs and news, Internet, newspapers, and journals in Turkey. According to a study done by Directorate General of Environmental Management Ministry of Environment and Urbanization in 2012, the sources of access to information about climate change and environment consist of television programs (46.7%), television news (43.9%), family members (28.6%), close people such as friends and neighbors (24.2%), newspaper news (19.5%), universities and scientists (17%), teachers (11.4%), religious commissaries (8%), advertisements (7.6%), Internet news and sites (5.7%), explanations done by political authorities (4.4%), non-governmental organizations and foundations (3.9%), headmen (3.5%), and journals (0.5%) (MEU\_b, 2012).

According to the statistics of 2014, 73%, 67.1%, and 52% of people in 16-24, 25-34, and 35-44 age intervals use internet respectively. Whereas the rate of Internet usage of people of and above 45 years of age decreases, their television watching rates increases. In 2013, television is watched for 4.81 hours daily on average (TurkStat\_s, 2014; SBT, 2014). When we think about these rates, it is especially important to transmit television programs of appropriate quality to the target audience in appropriate hours, besides, increasing the percentage of access to information about environment and climate change via websites.

Public service broadcastings and short films that are broadcasted on the televisions about environment and campaign against climate change are important in terms of raising awareness of public. Different public service broadcastings, documentaries, programs, and short films are made about environmental issues such as arbor, recycling, global warming, and energy efficiency in our country. Some written and visual examples to the publications prepared about climate change are given below.

### Climate Change

Climate Change public service broadcasting, which was prepared by the Ministry of Environment and Urbanization, attracts attention to the subject that climate change can be fought personally and raises the awareness of the public opinion about the things that can be done in order to fight climate change.

### Listen to the Voice of Climate

The 5-minute film, which was prepared by Ministry of Environment and Urbanization, Directorate General of Environmental Management, highlights the subject of adaptation to climate

change. Turning to climate-resistant and productive species, taking precautions against pests, good agricultural practices and transferring to organic fertilizer, the importance of renewable energy, and increasing energy efficiency constitutes the contents of the film (MEU\_b, 2014).

### Agriculture TV

With Agriculture TV application, which is carried out by Ministry of Food, Agriculture, and Livestock, Department of Training, Extension and Publications, education and publication activities are done for farmers since 2010. Besides, it is aimed to transmit 27 educational films that were prepared between 2007 and 2009 to the target audience by sending them to local and national channels.



### Assessment of Technological Needs and Determination of Greenhouse Gas Reduction Potential for Industry in scope of Climate Change

In the scope of the Assessment of Technological Needs and Determination of Greenhouse Gas Reduction Potential for Industry in scope of Climate Change, is a guide book about campaign against climate change, which all of the industry (big-scale plants and SMEs) can facilitate and seven different sectoral books, in which there are sectoral information about adaptation to climate change, emission mitigation, and technological applications and which are special for the seven selected sectors (Iron-Steel, Sugar, Cement, Lime, Glass, Ceramic, and Petrochemistry) were prepared and published.

## 9.6. Public Participation

The participation of local managements, private sector, and non-governmental organizations is also important besides the relevant units of ministries in the activities of education, training and public awareness about climate change.

### 9.6.1 Participation of Local Governments

#### Istanbul Metropolitan Municipality

Istanbul Metropolitan Municipality, Directorate of Environmental Protection has started an awareness raising study for children. The awareness of the children is being raised with musical and visual informing with "Child and Entertainment Portal", which is generated about subjects such as recycling, decreasing the consumption and the ways to do it, and reuse.

There are Determining Ecology-Sensitive Sustainable Campus Criteria Project, Gray Water Decision, Central Building Solar Collector Project, Bahriye Üçok - Green Kindergarten Project, City Managers Contract & Sustainable Energy Action Plan, Changing Kadıköy Municipality Service Vehicles with Electrical Vehicles with Less Emission, Bicycle Roads, and Obtaining Irrigation Water from Domestic Sewage Project among the studies done by Istanbul Kadıköy Municipality in the scope of campaign against climate change and energy efficiency activities since 2012 (Kadıköy Municipality, 2014).

#### Sakarya Metropolitan Municipality

In the scope of "How Will the Weather Be Tomorrow" climate change educations, which are carried out by Sakarya Metropolitan Municipality and Regional Environmental Center (REC) Turkey, Sky Tent is built and educations about climate change are given to students. Besides, Planetarium Tent is built in the activity, in which 500 students were educated, and the three dimensional presentations of magic globe and planet and atmosphere events were done.

Sakarya has been included in Gold Standard Cities Program with "Sustainable City Protocol", which was signed between Sakarya Metropolitan Municipality and Gold Standard Foundation on 27 March 2013. In the scope of the protocol, educations were given about renewable energy, waste management, biogas, transportation, city illumination systems, arbor, energy efficiency, urban regeneration, and eco-cities.

"Sustainable Sakarya Climate-Friendly Illumination Project" was applied by Sakarya Metropolitan Municipality and Sakarya Chamber of Commerce with the support of United Nations

Development Programme (UNDP) and GEF Small Grant Programme (SGP), in the stakeholdership of Gold Standard Foundation with the purposes of encouraging and generalizing active energy applications in public buildings and raising awareness in public opinion. Two educations and one workshop were carried out in the scope of the project. In the project, which was planned in four steps, after developing greenhouse gas emission inventory draft on the basis of the city firstly, the biggest possible participation was maintained at the local level with the workshop made and Sakarya climate change strategy and actions with priority are determined. And later, transfer to LED technology in Metropolitan Municipality buildings in the area of public illumination was carried out as the first application and a 7-minute short documentary that tells about the project is prepared.

Education is organized in 2014 in the scope of "Developing Institutional Capacity About the Effects of Climate Change and Adaptation to Climate Change Project" in 2014 under the cooperation of Sakarya Metropolitan Municipality and East Marmara Development Agency (MARKA) Technical Support Program.

The education that was given has increased the knowledge and awareness of the participants about campaign against climate change, sustainable energy action plans and EU Presidents Convention, environment- and climate-friendly innovation, international organization in campaign against global warming, responsibilities of the local managements in urban decarbonization, and the integration of urban and energy planning to local managements.

Training about Calculation of Greenhouse Gas Emissions According to IPCC Methods is one of the education activities that was organized by Sakarya Metropolitan Municipality besides the education that was given about generating greenhouse gas emission inventory and calculation.

### Antalya Metropolitan Municipality

Antalya Metropolitan Municipality Sustainable Energy Action Plan was prepared by considering the interaction of cities with climate change and the threats that it causes with the purpose of explaining the intervention attempts of the local managements to the processes related to the problems caused by climate change and the activities that cause climate change. The meetings that were first organized in the process of preparing the action plan are like below:

- Education, informing, and team determining meeting: Education and informing meeting, in which higher management has also participated and in which presentations about different subjects related to climate change such as climate negotiations, cities and climate change, and the importance

of greenhouse gas inventory, was carried out.

- In the second meeting, which was carried out under "Climate is Changing, Antalya is Planning its Future" topic, group studies about "Physical Development of the City-Structured Environment, Industry and Services, Renewable Energy, Transportation, Waste and Wastewater Management, Agriculture-Animal and Forestry" main themes were done with the participation of public institutions, non-governmental organizations, local government units, and all of the relevant people and groups.

Energy efficiency awareness raising campaigns were determined with the purposes such as raising the consciousness of saving about the consumption of energy, encouraging the purchase of electrical devices that consume less energy, and maintaining fuel saving with economical driving methods. In this scope, actions were aimed about generating municipality informing points, organizing activities about energy saving in the whole city, and giving economical driving techniques educations.

700,000 TL was spent on awareness raising campaigns in total and 148,571 MWh decrease in energy consumption and 78,985 CO<sub>2</sub>-eq. reduction were maintained in return (Antalya Metropolitan Municipality, 2013).

### Gaziantep Metropolitan Municipality

Gaziantep Climate Action Plan, which is carried out by Gaziantep Metropolitan Municipality, directorate of Environmental Protection and Control and financed by French Development Agency, has started in 2010. Climate Action Plan includes the applications to be done about determining and reducing the present greenhouse gas emission amounts of the city and aims to make Gaziantep a leading sustainable city. The studies are being carried out on big scales and the present greenhouse gas emissions of the city are determined. In the direction of the data obtained from these analyses, applications that would decrease possible future greenhouse gas emissions were determined. "Gaziantep Ecological City Project" and "Gaziantep Ecological Building Project" are of the other projects that were carried out.

### Eskişehir Tepebaşı Municipality

Environmental educations are given to primary school students in Eskişehir Tepebaşı Municipality in order to create a consciousness about sustainable environment. Informing studies about environmental problems, packaging wastes, municipal hazardous wastes and the recycling of the waste vegetable oils, energy efficiency, and global climate change constitute the scope of the educations. 3094 students and 224 parents have taken education about recycling and waste management subjects since December 2010. Competitions and technical trips are also being organized for the schools with the purpose of raising awareness in children.

### Bursa Metropolitan Municipality

In the scope of "Increasing Institutional and Technical Capacity for Developing Climate Adaptation Strategies Project", which was supported by Ministry of Environment and Urbanization and of which Bursa Metropolitan Municipality is the main beneficiary, adaptation to climate change on local level is aimed in Turkey. In the scope of the project, which is aimed at increasing the capacity actively applying Turkey's National Climate Change Adaptation Strategy and Action Plan and helping the development of adaptation to climate change strategies on the level of cities, educations were given to Bursa Metropolitan Municipality in terms of expertise in the area of energy and climate change and global sustainability counseling. Institutional capacity of Bursa Metropolitan Municipality was developed and "City-Level climate Change Adaptation Plans" was prepared. City-Level climate Change Adaptation Plans is an example for the process of adaptation plan preparation process of municipalities in Turkey (DGEM\_b, 2014).

## 9.6.2 Participation of Private Sector

### Carbon Disclosure Project-2014

Carbon Disclosure Project (CDP) was brought into life in 2011 in Turkey. Carbon Disclosure Project operates in order to change the operating fashion of the business world with the purposes of reducing the effects of climate change and protecting natural resources. In the scope of CDP programs, reports including the detailed analysis of the institutional answers showing important trends and proceedings about climate change, environment, water, and forest management of countries are published every year. There are two types of leaderships such as CDP Climate Disclosure Leadership and CDP Climate Performance Leadership in the scope of CDP evaluation. Companies are evaluated and rewarded separately in both branches.

2014 report of CDP, which was carried out by Sabancı University Institutional Management Forum with the main sponsorship of Akbank and the report sponsorship of EY Turkey, was published on 3 November 2014. Whereas Garanti Bank, Coca-Cola Drink, Zorlu Energy Electric Production, Ekoten Textile Industry and Trade Inc., and Noor Hazelnut have won 2014 CDP Climate Disclosure Leaders Prizes, Tofaş Turk Automobile Factory Inc. has won CDP Climate Performance Leadership prize. (CDP, 2014).

### Standing United for Education

Arçelik Inc. aims to contribute to the preparation of children to life as a modern and self-confident generation by focusing on the personal development of the students with "Standing United for Education with Arçelik" social responsibility program. In the scope of the project, 200,000 students taking education in 299 regional primary boarding schools in 60 cities have been reached. In the scope of the program, which is carried out with the cooperation of Ministry of National Education, "Let's Protect Our Environment and Natural Resources" themed competitions were organized. In the scope of the competition, the pictures that the students have prepared for a more beautiful world are presented to the public opinion with the exhibition which was organized (Arçelik, 2010).

### Energy Efficiency Project

Energy Efficiency Project was started by Enerjisa in 2010 with the purpose of raising the awareness of the children in primary education age about energy efficiency and energy saving with the educations.

Educations were given by volunteer employees of Enerjisa with "It is in Your Hands to Protect the Energy of the World" slogan in 2011 by cooperating with Ankara Provincial Education Directorate. Energy Efficiency Theater has also started to be shown in the scope of the project, which has reached 173,000 students in 203 schools. Approximately 7,000 children have been reached in Ankara, Zonguldak, Bartın, Karabük, Çankırı, and Kastamonu with the play, which was shown by adapting Musicians of Bremen to the subject of energy efficiency (Enerjisa, 2014).



Source: Enerjisa, 2014

### Glass is Glass Again

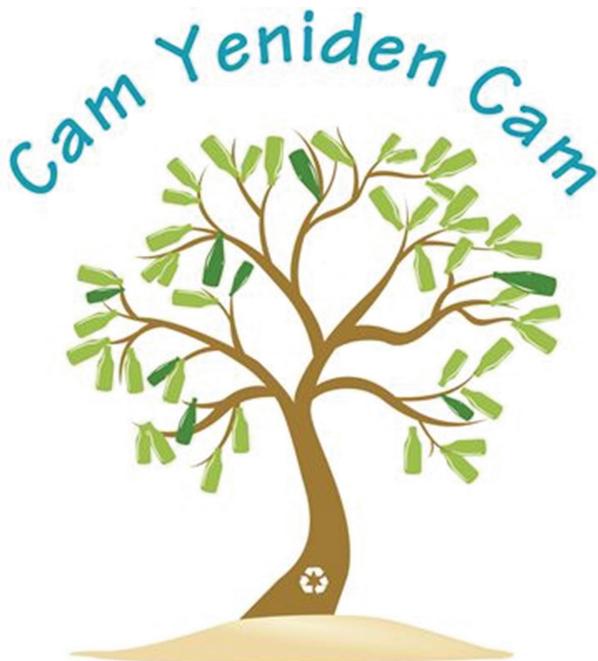
Glass is Glass Again Project is being carried out by Anadolu Glass Industry Inc., which is a Şişecam Group company. With the project, which was started in 2011, it is aimed to increase the glass recycling ratio to 60% until 2020 in Turkey. In the direction



of this aim, mutual studies are being done with municipalities, 'green point' organizations, National Education Directorates, universities, waste glass and package collecting and recycling companies, finance institutions, and sports clubs.

The main aims of "Glass is Glass Again" project, which is one of the most comprehensive sustainability and social responsibility projects in Turkey, are decreasing the effects on the environment, maximizing social and economical benefits, creating behavior change in the society, and supporting the transition to a society, which puts importance into recycling. In the scope of the project, education is given to 113,000 primary school students about the recycling of glass, campaigns of raising the awareness of the public were carried out, and 5,150 new glass boxes were installed between 2011 and 2013 by cooperating with 42 municipalities in eight cities. Glass breaking machines were provided for restaurants, hotels, and bars, in which glass-bottled drink consumption is frequent, and box collection trucks were donated to the municipalities with high potential of glass waste. Since the beginning of the project, 297,800 tons of glass waste was collected. In other words, with the help of the project;

- Release of carbon emission to the atmosphere is prevented equivalently with the withdrawal of 107,200 vehicles from the traffic
- The decrease maintained in carbon emission in the last 3 years is equivalent to the carbon emission absorbed by 6 million trees.
- Energy, which is enough to heat and provide hot water for 12,500 houses was saved.
- The amount of saved material is equivalent to a (sand) beach of 10 meter width and 31 kilometer length.



### Environment Children Theatre

Bosch Environment Children Theatre Project was brought into life by Bosch Home Devices in 2008 with the purpose of contributing to the growing up of the children as people who are conscious about environment. In the scope of the project, over 14,000 children were reached with "Environmentalist Nasreddin Hoca Puppet Show", which was shown between 2008 and 2010. With "La Fontaine is in Forest Court" play, which was prepared with the cooperation of Sadri Alışık Culture Center in 2010, activities directed towards raising the awareness of children about environment have continued. Bosch Environment Children Theater, which has gone on Turkey Tour for the first time in 2011-2012 education and teaching year, has contributed to the raising of the consciousness of over 40,000 children about environment until today.

Bosch Environment Club website, which was brought into application with the purpose of giving environmental awareness to the children in 2011, serves with two categories to children of 4-7 age group as "teeniest" and children of 8-13 age group as "stars" (Bosch, 2014).

### 9.6.3 Participation of Non-Governmental Organizations

In Turkey, the sensitivities of the Non-Governmental Organizations (NGOs) to climate change activities has increased in the last years. The NGOs in Turkey have developed Climate Network in order to talk about their mutual concerns about climate change and solution suggestions. Participants who have come together to fight against human-sourced climate change have accepted to carry out their activities based on scientificity, equality, globality, locality, participation, transparency, and organizational continuity principles.

Climate Network consists of Buğday Association for Supporting Ecological Living, Nature Association, Nature Conservation Center, Turkey Association for Renewable Energy (Eurosolar Turkey), Greenpeace Mediterranean, Kadıköy Science, Culture, and Art Friends Foundation (KADOS), TEMA The Turkish Foundation for Combating Soil Erosion, for Reforestation and the Protection of Natural Habitats, WWF-Turkey (World Wide Fund for Nature), Earth Foundation, Green Thought Association, Yeşilist, and 350 Ankara (Climate Network, 2014).

Some of the non-governmental organizations that are active in the subject of climate change in Turkey are given in Table 9.3.

## Non-Governmental Organizations in Turkey

Ankara Chamber of Industry  
 Ankara Office of the Regional Environmental Center (REC)  
 National Policy Research Foundation (UPAV)  
 Turkish Green Building Council Foundation  
 Foundation for Environmental Protection and Research (CEVKOR)  
 Nature Association  
 World Wide Fund for Nature (WWF)  
 Nature Conservation Center  
 Buğday Association for Supporting Ecological Living  
 Ecological Research Society  
 Center for Economics and Foreign Policy Studies  
 Energy and Climate Change Foundation (ENIVA)  
 Greenpeace Turkey  
 Support to Life Foundation  
 Business World and Sustainable Development Association  
 Rural Environment and Forestry Problems Research Association (KIRCEV)  
 Coastal Area Management in Turkey National Committee  
 Pankobirlik

Water Foundation  
 Underwater Research Society  
 Sustainable Rural and Urban Development Association (SURKAL)  
 Clean Energy Foundation  
 TMMOB Chamber of Environmental Engineers  
 TMMOB Chamber of Forestry Engineers  
 TMMOB Chamber of Agricultural Engineers  
 TMMOB Union of Chambers Turkish Engineer and Architects  
 Technology Development Foundation of Turkey (TTGV)  
 Economic Policy Research Foundation of Turkey (TEPAV)  
 TEMA Foundation  
 Corporate social Responsibility Association of Turkey  
 The Foresters' Association of Turkey  
 The Central Union of Turkish Agricultural Credit Cooperatives  
 Turkish Seed Industry Association  
 Union of Turkish Chambers of Agriculture  
 Foundation for Environmental Education (TURCEV)  
 Turkish Environmental and Woodlands Protection Society (TURCEK)  
 Turkey Association for Renewable Energy (Eurosolar Turkey)

Source: Climate Network, 2014

**Table 9.3** NGOs active about climate change

Some of the studies done by NGOs are shortly explained.

### The Turkish Foundation for Combating Soil Erosion, for Reforestation and the Protection of Natural Habitats (TEMA)

The Turkish Foundation for Combating Soil Erosion, for Reforestation and the Protection of Natural Habitats consist of areas directed towards arbor, rural development, protection of biological diversity, campaign against desertification, and climate. Its studies about education are as follows:

**Ecological Literacy Teacher Training:** The training is being done with the purposes of creating environmental consciousness, teaching the principles of the nature, and ensuring the communication with the nature. As a requirement of the protocol signed between Ministry of National Education and TEMA Foundation in 2011, 64 teachers from 30 different cities have participated in the education applied in 18-30 September 2011. 72 teachers from 38 cities and Cyprus have participated in Ecological Literacy Teacher Training between 06 and 17 August 2012. The program that takes 77 hours consists of Powerpoint presentations, field studies, workshops, and group studies.

**Mini TEMA Program:** The purposes of Mini TEMA Program, which is a Pre-School Environmental Education Program that is applied since 2010, are reinforcing the bonds of the children in early childhood term with the nature, ensuring that they have a high quality time in the nature, supporting their physical, cognitive, and social developments, and supporting these activities with various materials by presenting an activity pool about nature to the teachers. 69,000 students were reached in the scope of the program until now.

**Secondary School TEMA Program:** Is the environmental education program for secondary school students, which is applied since 1996, but is being renewed and developed since 2013-2014 educational year. The purpose of the education program, which has reached approximately 50 thousand children in 1,100 schools in 55 cities since 1996 until today, is to support the children's being ecologically literate.

**High School TEMA Program:** High School TEMA is a one-year environmental education program that consists of activities that will support the ecological literacy of the young people in high school age. In the scope of the program, it is aimed to contribute to the young people's being ecologically literate people who are sensitive to environmental problems and who can act towards finding solutions (TEMA, 2014).

### Turkish Environmental and Woodlands Protection Society (TURCEK)

It is aimed to raise the awareness of the students with the 35-minute play named "Environment Inspector Karagöz!", which is prepared for 1th, 2th, and 3th class primary school students. The scenario of Karagöz play consists of keeping the environment and the nature clean, saving energy and water, loving forests, and separating packaging wastes. The play, which is going to be shown in different cities and countries of Turkey besides Istanbul in 2014-2015 educational year, aims to raise the young generations as people who are sensitive to the environment and the nature with the power of the universal language of art, humor (TURCEK, 2014).

### Turkish Foundation for Environmental Education (TURCEV)

Eco-Schools Program, whose national coordination is done by TÜRÇEV, is a program that is applied in pre-primary education institutions and primary schools in order to give environmental awareness, environmental management and sustainable development education. With its participating approach, the students in the schools not only are informed about environmental subjects, but they are also playing active roles in the raising of the awareness of their families, local managements, and non-governmental organizations.

In the scope of Eco-Schools Program, Green Flag prize is given to the schools that have proved high success in the studies done in the program and the environmental educations that they have given besides presenting a program to the schools, which serves guidance about environmental education (TURCEV, 2015).



### Water Foundation

Water Foundation does studies about climate change besides especially showing activity in subjects related to water and wastewater. The publications of Water Foundation about climate change consist of "Climate Change, Fresh Water Resources, and Turkey", "Climate Change, Local Managements, and Sectors", "The Effects of Climate Change on Our Water and Energy Resources", and "Climate Change and its Effects on Water Resources of Turkey (Water Foundation, 2014).

### Energy and Climate Change Foundation (ENIVA)

"Climate Change and Sustainable Energy in Turkey" project, which was carried out by ENIVA in Kadir Has University is completed and published into a book. It is aimed to show the data special to Turkey in the project. "For this reason, climate change concept and specially climate changes seen during geological ages were handled generally first and the past, present, and the future of the climate in Turkey was evaluated. Climate changes observed today in Turkey and their possible extensions into future and the effects of the changes were handled in the light of scientific data. Later, comments were made about future trends by investigating the historical development of the greenhouse gas emissions that cause climate changes in the framework of energy consumption. And at the very end, the financing of the energy projects that will reduce the greenhouse gas emissions and carbon trade were handled in detail. At the end of each chapter, results and suggestions are given place." (ENIVA, 2014).



## Turkey Association for Renewable Energy (Eurosolar Turkey)

Turkey Association for Renewable Energy is planning activities towards education, informing, and capacity development with the purpose of improving the knowledge and expertise levels of people who work, make investment, plan career, are in decision making position, and are interested in renewable energy types, energy efficiency, sustainability, and climate change.

The planned educations, whose target audience consists of investors, architects, engineers, building companies, municipalities, planners, energy managers, technical staff, and counselors are in the direction of

- Renewable energy solutions
- Solar energy technologies and applications
- Wind energy technologies and applications
- Bioenergy technologies and applications
- Effective use of energy
- Climate change, global, national risks and solutions
- Sustainable development, green transformation subjects.

## 9.7. International Cooperations

### Capacity Development of Least Developed Countries in Africa on Desertification/Land Degradation and Combating with Drought Project

General Directorate of Combating Desertification and Erosion carries out dual relationships with countries towards reducing the effects of climate change, in which campaign against desertification and erosion are included, with its awareness of the importance of international cooperations towards adaptation to climate change and reducing the effects of climate change on the global scale. In the scope of technical cooperation projects carried out with Turkish Cooperation and Coordination Agency, technical visits were paid to Bosnia and Herzegovina, Austria, Azerbaijan, Turkmenistan, Kyrgyzstan, Czech Republic, Tanzania, Niger, Senegal, Djibouti, Tajikistan, and Mozambique in 2013, 2014, and 2015. Besides, the bases of technical studies are being formed by staying in touch with Burkina Faso, Kenya, Morocco, Tunisia, Palestine, and Gabon committees.

With the project, whose target audience is the least developed countries in Africa, it is aimed to transfer the experiences of our country to the experts of the least developed countries

in Africa, which is the continent that is affected the most by the effects of climate change. In the first step of the project, a friendship forest was generated in Niger, Niamey, and recreation areas and water wells were formed. It is aimed to give education to 800 people from 40 countries in Turkey, making workshops in 10 countries, and giving consultation to the countries which request between 2012 and 2022.

The other international education activities of General Directorate of Combating Desertification and Erosion are as follows:

- In 26-28 November 2012 in Ankara, "II. Meteorology, Dust Carrying, Desertification, and Campaign Against Erosion Workshop" was carried out and "Results Report" was prepared.
- The international workshop with the subject "The Third International Meteorology, Dust Carrying, Desertification, and Campaign Against Erosion", which was organized with the hosting of Republic of Turkey (General Directorate of Combating Desertification and Erosion, GDF, and Turkish State Meteorological Service), was carried out in 28-31 October 2013 in Istanbul.
- The International Education with the Subject "Seed, Nursery, and Dry Area Arbor Techniques" was carried out in 7-11 April 2014 in Eskisehir.
- II. International Drought and Desertification Symposium has been carried out between 16-18 September.

### International Activities Carried Out by Ministry of Forestry and Water Affairs

An activity with the topic "International Drought Management Study Meeting" was organized by Ministry of Forestry and Water Affairs in a partnership with Turkish State Meteorological Service and under the cooperation of General Directorate of Water Management in 4-5 March 2014 with the purposes of developing the principles, strategy, and policies related to drought management in our country, examining the examples of different countries, determining the strategy of drought management by bringing the institutions about drought and its effects together, and generating the framework, which is necessary for monitoring and predicting drought nationally. National Oceanic and Atmospheric Administration (NOAA), FAO, United Nations Convention to Combat Desertification (UNCCD), and France Ecology, Sustainable Development and Energy Ministry have contributed to the meeting, which was supported by World Meteorological Organization (WMO), and United States Agency for International Development (USAID).

Besides, again under the cooperation of Ministry of Forestry and Water Affairs, Turkish State Meteorological Service, World Meteorology Organization (WMO), USAID, and NOAA, "Sixth

International Training Workshop on Climate Variability and Prediction (6ITWCVP)” and “Climate Change Predictions and Services Symposium” were organized in 04/15 August 2014 in Istanbul. “Mediterranean Climate Outlook Forum (MEDCOF) Meeting”, “South East Europe Climate Outlook Forum (SEECOF) 12. Meeting”, and “South East Europe Regional Counseling Meeting” were organized under the cooperation of WMO in 17-22 November 2014 in Antalya.

### Energy Efficiency and Management in Industry Training Program

Energy Efficiency and Management Training Program was organized for a total number of 21 experts from Albania, Azerbaijan, Bosnia and Herzegovina, Georgia, Iran, Kazakhstan, Kyrgyzstan, Moldova, Uzbekistan, Pakistan, Ukraine, Tajikistan, and Turkmenistan under the cooperation of Turkish Cooperation and Coordination Agency (TIKA), General Directorate of Renewable Energy, and Japan International Cooperation Agency (JICA) in the scope of their activities towards supporting the capacity development programs of developing countries in the scope of third country education program. The education program, 14. of which is organized, has been carried out between 2 and 13 June 2014.

The education program that takes two weeks consists of two parts as theoretical and practical studies that include energy efficiency and energy management subjects. Besides, in the education, it is aimed to show energy management and energy-efficient applications by visiting industries (TIKA\_b, 2014).

### Adaptation of Forestry Policies to Climate Change in MENA Region Project

MENA Project, which is financed by The German Federal Ministry for Economic Cooperation and Development and which includes 6 countries such as Morocco, Algeria, Tunisia, Turkey, Syria, and Lebanon, is being carried out by German Technical Cooperation Agency and is supported by FAO and GDF (General Directorate of Forestry) as project partners. “The purpose of this project is to develop political frameworks for protecting the environmental services of countries that have a big volume of forest areas, which are in Mediterranean region, which is in the cycle of campaign against climate change for the sustainable management of forest ecosystems related to forests.”

The project that was carried out between 2010 and 2014 consists of increasing the socio-economical importance of forest based ecosystem services in the policies of forest sector and

the relevant sectors, increasing communication, information, and awareness about climate in the public, and mobilizing foreign supports and partnerships in the scope of adaptation to climate change (GDF\_b, 2014).

## 9.8. Planned Studies

### Studies planned in the scope of National Climate Change Strategy Document (2010-2020)

Medium and long term aims are given under Education, Capacity Building, and Institutional Infrastructure topic in National Climate Change Strategy Document (NCCSD) that was approved in May 2010. Medium term aims consist of raising awareness of public and institutional capacity, and increasing the consciousness of the public opinion for changing consumption patterns to be climate friendly with the mutual effort of public and private sector, universities, and non-governmental organizations by generating international cooperation mechanism and ensuring the participation in active negotiations and the long term aim consists of founding “Climate Change Research Institute” for doing scientific studies about climate change (MEU, 2010).

### Studies planned in the scope of the National Climate Change Action Plan (2011-2013)

National Climate Change Action Plan (NCCAP), which includes 2011-2023 years, aims to determine the actions that will ensure the reducing of greenhouse gas emissions and which are appropriate for national conditions, manage the effects of climate change, and encourage Turkey for campaign against and adaptation to climate change.

NCCAP includes climate change adaptation strategy and action plan of Turkey in the scope of mutual subjects in the context of water resources management, agriculture sector and food safety, ecosystem services, biodiversity and forestry, natural disaster risk management, human health, and adaptation to climate change (financing, economical tools, research-development, data and information systems, education, consciousness and capacity development, management, coordination, monitoring and evaluation and social gender equality). In the direction of the determined aims, some of the actions that were planned about education, training, and public awareness are as follows:

- Giving agricultural production techniques education to woman farmers with the purpose of adapting to the effects of climate change and/or including them in the present education activities.

- Developing application guides and procedures, distributing them and giving the relevant educations about reducing the disaster risks and post-disaster short and long term improvement approach and applications with urgent intervention.
- Preparing, and distributing guides that tell the things that the citizens or the institutions need to do during possible contagious diseases and extreme weather events and giving periodical educations.
- Giving the basic educations about adaptation to the effects of climate change and the situation in Turkey in in-service educations of all of the Ministries.
- Preparing programs towards ensuring the participation in the process of adaptation to climate change and raising the awareness of public opinion.
- Protecting underground waters in the river basins, preventing illegal usage of underground water, and raising the consciousness of the public about this subject.
- Raising the consciousness of Drought City/County Damage Detection Commissions, City Crisis Centers, and City Drought Investigation Commissions about adaptation to the effects of climate change.
- Carrying out awareness-raising activities towards all of the society (MEU\_a, 2012).

### Studies done in the scope of Program for Improving Energy Efficiency-Action Plan

One of the subjects that are important in terms of sustainable development is the reduction of energy intensity and making improvements in the area of energy efficiency. Program for Improving Energy Efficiency aims the carrying out of studies towards improving energy efficiency in some selected sectors and areas and raising the awareness of the public by announcing sample applications. The policies of the program about education, training, and public awareness and its actions related to these policies are as follows:

- Improving the mechanisms towards supporting the education, etude, and counseling services of the SMEs about energy efficiency
  - o The capacities of Energy Management Units (EMU) built in OSBs will be reinforced and the building of EMUs will be ensured in Organized Industrial Zones that do not have EMUs. Informing and awareness raising activities that will be done by EMUs will be supported.
- Generalizing of the technologies and good application examples in SMEs
  - o Studies for awareness raising and introduction will be done with the purpose of increasing the demand for energy efficient products and raising the consciousness of the last users (MD\_a, 2014).

### Studies planned in the scope of Action Plan of Combating Erosion, Upper Catchment Flood Control Action Plan, and Action Plan of Dam Catchments Green Belt Afforestation

“Action Plan of Combating Erosion”, “Upper Catchment Flood Control Action Plan”, and “Action Plan of Dam Catchments Green Belt Afforestation” are prepared for 2013-2017 years under the coordination of General Directorate of Combating Desertification and Erosion.

In the scope of the action plans, it is aimed to contribute to arbor, prevention of erosion and carrying of sediment, rehabilitation of deteriorated forest areas, pasture improvement, maintenance of the studies done in the last years, research and development activities, protection of dams and water river basins by taking administrative, mechanical, biological, and cultural precautions such as education, introduction, and capacity development, and reducing the effects of desertification and because climate change on our country.

### GEF 6 Project Proposal

Turkey has adopted an integrated approach on the scale of watersheds and has developed action plans for protecting 25 watershed in this direction. The main priority of National Basin Management Strategy is the maintenance of rehabilitation in big basins. It is aimed to maintain socio-economical and environmental improvement and increasing the productivity of fields and water and forest resources with the help of this. There are 7 basins in the west of Turkey. Gediz Basin is one of these. Reasons such as industrialization, fast population growth and demographical pressure, irregular urbanization, environmental pollution, wrong usage of natural resources, and climate change create a high pressure on basins and Gediz Basin is under a high risk.

In the scope of this project, it is aimed to rehabilitate the land under the effect of climate change, improve land usage methods, rehabilitate the deteriorated forests, raise awareness, maintain the integrated sustainable management of the river basin by raising awareness and improving local capacity, and share the experiences with international educations with UNCCDs of Land Degradation Neutrality (LDN) approach in Gediz River Basin.

### Capacity Building in the Field of Climate Change in Turkey

Capacity Building in the Field of Climate Change in Turkey, which is an IPA project that is planned to be started in Ministry of Environment and Urbanization in 2015, aims the reinforcement of national and local capacity for the determination of medium and long term climate change actions towards green growth, which will gradually be made compatible with European Union Climate policies and legislation.

The basic components of the project consist of developing analytical infrastructure with the purpose of determining strategies and activities towards green growth, carrying out of analytical studies towards LULUCF sector, improving the capacity about the subject of adapting EU acquis related to the protection of ozone layer, and reinforcing the institutional capacity and raising the awareness of the public about climate change and protection of ozone layer (MEU\_b, 2014).

### Technical Assistance for Support to Mechanism for Monitoring Turkey's Greenhouse Gas Emissions Project

Technical Assistance for Support to Mechanism for Monitoring Turkey's Greenhouse Gas Emissions Project, which was initiated in Ministry of Environment and Urbanization in April 2015, is being done with IPA 2011 application in the scope of adapting Europe Parliament and Commission Decision with date 11 February 2004 and number 280/2004/EC about generating a mechanism towards monitoring greenhouse gas emissions and applying Kyoto Protocol.

With the project, whose budget is 3,000,000 Euro, it is planned to eliminate the gaps detected about the monitoring and reporting of greenhouse gas emissions on the national scale and building the technical capacity about preparing greenhouse gas projections and climate change national conventions (MEU\_b, 2014).

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# ANNEX-A INVENTORY SUMMARY TABLES

	1990	2000	2010	2011	2012	2013	Change (%)		Sectoral Contribution (%)		
							1990-2013	2012-2013	1990	2000	2013
1. Energy	131.57	213.78	284.79	297.63	320.76	311.25	136.57	-2.97	69.99	78.38	75.82
A1 Energy Industry	33.94	68.19	102.61	110.21	120.67	113.90	235.63	-5.61	18.05	25.00	27.75
A2 Industry Sector	33.90	66.73	60.89	57.62	65.26	62.33	83.89	-4.48	18.03	24.47	15.19
A3 Transportation	26.84	36.14	45.49	48.25	62.71	69.04	157.22	10.09	14.28	13.25	16.82
A4 Other Sectors	33.56	36.14	45.49	48.25	62.71	69.04	105.69	10.09	17.85	13.25	16.82
B. Fugitive emissions originating from fuels	3.33	4.72	6.71	7.43	7.84	7.01	110.82	-10.53	1.77	1.73	1.71
C. CO <sub>2</sub> transportation and storage	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.00	0.00	0.00	0.00	0.00
2. Industrial Processes	31.08	36.25	59.98	65.59	69.57	72.03	131.76	3.53	16.53	13.29	17.55
3. Agriculture	41.60	40.10	39.80	41.59	46.34	49.81	19.73	7.49	22.13	14.70	12.13
4. Land Use, Land Use Change, and Forestry	-30.18	-36.18	-47.46	-49.61	-50.85	-58.70	94.52	15.43	-16.05	-13.26	-14.30
5. Waste	13.92	20.66	27.18	27.69	27.55	26.02	86.91	-5.55	7.41	7.58	6.34
Total (including LU-LUCF)	187.99	272.74	340.69	357.02	411.79	410.48	118.35	-0.32			
Total (excluding LU-LUCF)	218.16	310.78	411.74	432.50	464.22	459.10	110.44	-1.10			

Table A-1. The Change of Sectoral Emissions and Their Contribution Portions

GREENHOUSE GAS SOURCE AND SINK CATEGORY	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	HFCs	PFCs	SF <sub>6</sub>	HFCs ve PFCs	NF <sub>3</sub>	Total
	CO <sub>2</sub> equivalent (kt )								
Total (net emissions)	304,697.29	65,810.96	23,225.69	5,705.87	NE	963.49			400,403.30
1. Energy	298,698.70	10,606.60	1,941.67						311,246.97
A. Fuel combustion	298,553.26	3,742.64	1,941.14						304,237.04
1. Energy Industry	113,561.12	41.19	301.32						113,903.62
2. Industry Sector	62,014.08	86.45	232.35						62,332.89
3. Transportation	67,638.63	338.98	1,063.03						69,040.64
4. Other Sectors	55,339.43	3,276.02	344.44						58,959.89
5. Other									
B. Fugitive emissions originating from fuels	145.31	6,863.96	0.53						7,009.80
1. Solid Fuels	NE,IE	4,812.72	NO,IE						4,812.72
2. Petrol and natural gas	145.31	2,051.24	0.53						2,197.08
C. CO <sub>2</sub> transportation and storage	0.13								0.13
2. Industrial processes and product use	63,888.89	465.01	1,002.78	5,705.87	NE	963.49			72,026.05
A. Mineral products	41,323.25								41,323.25
B. Chemical industry	1,578.90	35.25	1,002.78						2,616.93
C. Metal production	20,458.35	429.75			NE				20,888.10
D. Non-energy products from fuels and solvent use	528.40	NA,NE	NA,NE						528.40
E. Electronic industry									
F. Product uses as ODS substitutes				5,705.87					5,705.87
G. Other product manufacture and use			NE			963.49			963.49
H. Other	IE	NA,NE	NA						NA,NE,IE
3. Agriculture	807.30	30,562.34	18,437.36						49,807.00
A. Enteric fermentation		27,195.62							27,195.62
B. Manure management		2,894.91	3,132.05						6,026.96
C. Rice cultivation		190.64							190.64
D. Agriculture soils		NO	15,218.42						15,218.42
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		281.17	86.89						368.07

SERA GAZI KAYNAĞI VE YUTAK KATEGORİSİ	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	HFCs	PFCs	SF <sub>6</sub>	HFCs ve PFCs	NF <sub>3</sub>	Toplam
CO <sub>2</sub> equivalent (kt )									
G. Liming	NE								NE
H. Urea Application	807.30								807.30
I. Other carbon containing fertilizers									
J. Other									
4. Land Use, Land Use Change and Forestry	-58,699.00	0.02	0.01						-58,698.97
A. Forest land	-51,095.13	0.02	0.01						-51,095.10
B. Croplands	-137.13		NO,NE						-137.13
C. Grasslands	-528.07		NE						-528.07
D. Wetlands	NO,NE		NE						NO,NE
E. Settlements	570.61		NE						570.61
F. Other lands	NO,NE		NE						NO,NE
G. Harvested wood products	-7,509.27								-7,509.27
H. Other									
5. Waste	1.40	24,176.99	1,843.86						26,022.25
A. Solid waste disposal	NA	21,529.02							21,529.02
B. Biological treatment of solid waste		16.00	14.30						30.30
C. Incineration and open burning of waste	1.40	10.65	1.89						13.94
D. Wastewater treatment and discharge		2,621.31	1,827.67						4,448.98
E. Other									
6. Other									
Memo items:									
International bunkers	11,531.30	8.04	94.43						11,633.78
Aviation	8,660.75	1.51	72.19						8,734.46
Navigation	2,870.55	6.53	22.24						2,899.32
Multilateral operations									
CO <sub>2</sub> emissions originating from biomass	20,660.58								20,660.58
CO <sub>2</sub> captured	NO								NO
Long term C storage in waste storage fields									
Indirect N <sub>2</sub> O			NE						
Indirect CO <sub>2</sub>	NE								
Total CO <sub>2</sub> equivalent emissions, excluding LULUCF									459,102.27
Total CO <sub>2</sub> equivalent emissions, including LULUCF									400,403.30

NA: Not Applicable; NE: Not Estimated; NO: Not Occurring; IE: Included Elsewhere  
Table A.2 2013 year Inventory Summary Table





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