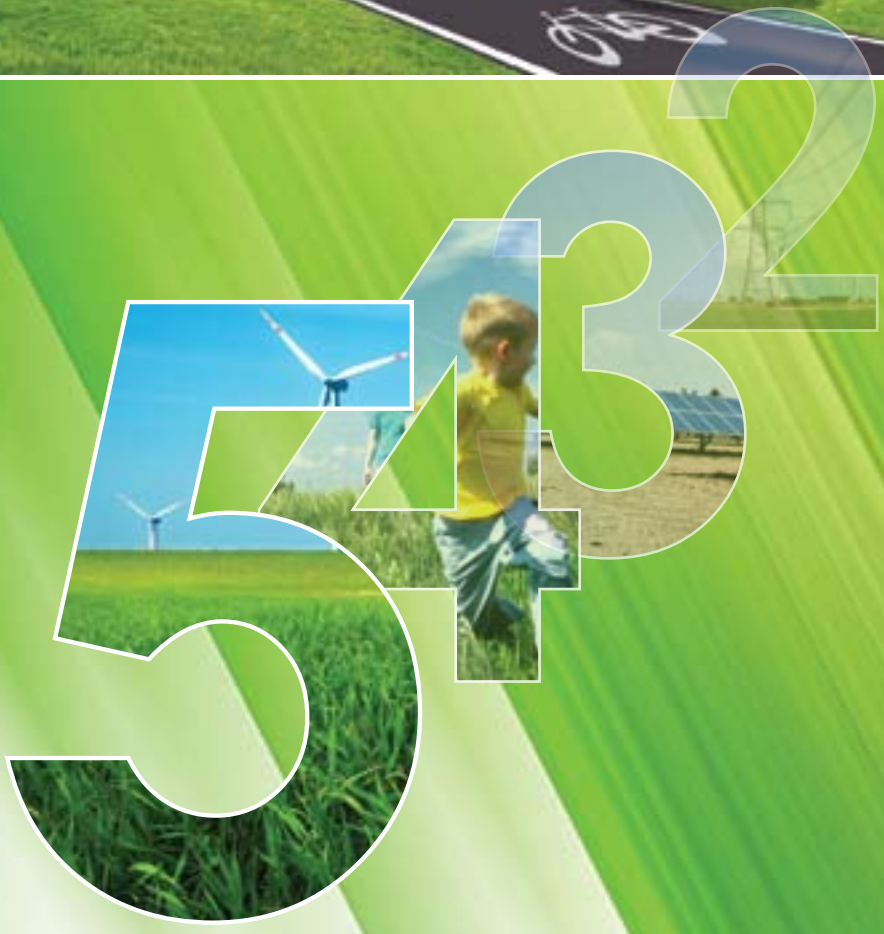
Turkey's Fifth National Communication under UNFCCC



Turkey's Fifth National Communication Under the UNFCCC

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FOREWORD

Environment and Climate have an impact on all aspects of our lives including urbanization, economy and development, technology, food and agriculture, water resources, human rights, health and tourism. Global strategies set in this area shape the global policies of 21st century in terms of economy, development and energy. It is out of question to think Turkey will not be affected by this global change or will not take the change into consideration. Nonetheless, Turkey emphasises that policies and measures implemented with an aim to protect the environment and tackle the climate change on a scale of international responsibilities should be in line with each country's own responsibilities and possibilities.

Turkey has taken many steps in the fight against climate change and is continuing to do so. Considering the environmental, economic and social factors through a holistic approach, the climate change action plan, based on tackling the climate change and prepared on the focus of sustainable and stable development sets forth the year 2023 in many sectors including energy, industry, transportation, agriculture and forestry and involves concrete technical objectives set to this end.

What Turkey aims to have achieved by the year 2023 is integrating her climate change policies into her development policies; disseminating her energy efficiency; increasing use of clean and renewable energy resources and providing all citizens with high living standards and welfare with low carbon intensity.

We aspire to build our Environment and Urbanization insight not only considering the social and economic need of people but also next-generation projects saving on energy and natural resources to constitute basis for the development of our cities, constructing environment-friendly technologies and highlighting use of renewable energy resources. We believe that Turkey will be able to embark upon a new period of sustainable urbanization through large scale and long term urban transformation plans to be implemented side by side with environment protection activities.

On the basis of the environmental, social and economic development of the new world order should be a win-win vision for all which covers all humanity, turns poverty into prosperity, is able to replace the old with the new in a way to put natural resources into all humans' disposal through a joint cooperation rather than exploitation.

Because we believe that for countries dealing with poverty and countries enjoying high levels of prosperity to come together around "environmentalist" discourses will be of no use unless the vision of "keep human beings alive so that the state lives" becomes the ground for the development all over the world.

In this sense, as I believe the 5th National Communication of Turkey, prepared with great commitment will have a visionary contribution to the future of our country, I would like to extent my sincere thanks first to the staff of our Ministry and to that of all related institutions and organisations who contributed.

Erdoğan BAYRAKTAR
Minister of Environment and Urbanization

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ABBREVIATIONS

AFD	French Development Agency
BAT	Best Available Technology
CBCC	Coordination Board on Climate Change
CDP	Carbon Disclosure Project
CFC	Chlorofluorocarbon
CFCU	Central Finance and Contracts Unit
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2 eq	CO_2 equivalent
ÇATAK	Protection of Agricultural Lands Considering Environment
ÇEVKO	Environmental Protection and Packaging Waste Recovery and Recycling Trust
DEMP	Disaster and Emergency Management Presidency
DOB	State Opera and Ballet
EBRD	European Bank for Reconstructuring and Development
ECO	Economic Cooperation Organization
EEA	European Environment Agency
EHCIP	Environmental Heavy Cost Investment Planning
EIB	European Investment Bank
EIE	General Directorate of Electrical Power Resources Survey and Development Administration
EMEP	Co-operative Programme for Monitoring and Evaluation of the Long-term Transmissions of Air Pollutants in Europe
EMRA	Energy Market Regulatory Authority
ESEAS	European Sea Level Service
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FIT	Feed-in tariff
FNC	Fifth National Communication
FSC	Forest Stewardship Council
GAP	Southeastern Anatolia Project
GAW	Global Atmospheric Watch
GCM	General Command of Mapping
GCOS	Global Climate Observing System
GDA	General Directorate of Afforestation
GDAR	General Directorate of Agricultural Reform
GDDW	General Directorate of Disaster Works
GDF	General Directorate of Forestry
GDP	Gross Domestic Product
GEF	Global Environment Facility
GLOSS	Global Sea Level Observing System
GOOS	Global Ocean Observing System
GOS	Global Observing System
GSN	Global Surface Network
GUAN	Global Upper Air Network
ICAO	International Civil Aviation Organization
ICCAP	Impact of Climate Change on Agricultural Production Systems in the Arid Areas
ICHET	International Center for Hydrogen Energy Technologies

ICP-Forest	International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests
ICZM	Integrated Coastal Zone Management
IEA	International Energy Agency
IKV	Economic Development Foundation
IMO	International Maritime Organization
INC	Initial National Communication
IPA	Instrument for Pre-Accession Assistance
IPCC	Intergovernmental Panel on Climate Change
ISE	Istanbul Stock Exchange
ITU	Istanbul Technical University
IUCN	International Union for Conservation of Nature
IZAYDAS	Izmit Waste and Residue Treatment, Burning and Reuse Co.
KENTGES	The Integrated Urban Development Strategy and Action Plan
KfW	German Development Bank
KOSGEB	Small and Medium Size Enterprises Development Organization
LULUCF	Land Use, Land Use Change and Forestry
MAM	Marmara Research Center
MDGF	Millennium Development Goals Fund
MEF	Ministry of Environment and Forestry
MENR	Ministry of Energy and Natural Resources
METCAP	Meteorological Communication and Application Package
MEU	Ministry of Environment and Urbanization
MFAL	Ministry of Food, Agriculture and Livestock
MFWW	Ministry of Forestry and Water Works
MLF	Multilateral Fund
MNE	Ministry of National Education
MSIT	The Ministry of Science, Industry and Technology
MTMAC	Ministry of Transport, Maritime Affairs and Communication
MURCIR	Marmara University Research Center for International Relations
NCCAP	National Climate Change Action Plan
NCCSD	National Climate Change Strategy Document
NGO	Non Governmental Organization
ODS	Ozone Depleting Substances
OECD	Organization for Economic Co-operation and Development
PSMSL	Permanent Service for Mean Sea Level
REC	Regional Environment Center
REL	Law on The Use of Renewable Energy Resources for Electricity Production
SCST	Supreme Council for Science and Technology
SCT	Special Consumption Tax
SEI	Support Activities to Strengthen the European Integration Process
SHW	State Hydraulic Works
SME	Small and Medium-sized Enterprise
SMS	Turkish State Meteorological Service
SPC	Supreme Planning Council
SPO	State Planning Organization
SRN	Surface Radiation Network

SWCR	Solid Waste Control Regulation
TAGEM	General Directorate of Agricultural Research and Policies
TARSIM	Agricultural Insurance Pool
TÇMB	Turkish Cement Manufacturers` Association
TEIAS	Turkish Electricity Transmission Company
TEMA	Turkish Foundation for Combating Soil Erosion, for Restoration and Protection of Natural Habitats
TEYDEB	Technology and Innovation Funding Programs Directorate
TINA	Transport Infrastructure Needs Assessment
TİGEM	General Directorate of Agricultural Enterprises
TOBB	Union of Chamber and Commodity Exchanges of Turkey
TOE	Tonne of Oil Equivalent
TARAL	Turkish Research Area
TRNC	Turkish Republic of Northern Cyprus
TSE	Turkish Standards Institute
TSKB	Industrial Development Bank of Turkey
TTGV	Technology Development Foundation of Turkey
TUBITAK	Scientific and Technological Research Council of Turkey
TUDES	Turkish National Sea Level Monitoring System
TurkStat	Turkish Statistical Institute
TURMEPA	Clean Seas Association
TUSIAD	Turkish Industry and Business Association
TUBA	The Turkish Academy of Sciences
TURCEV	Turkish Environmental Education Foundation
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
WHO	World Health Organization
WMO	World Meteorological Organization
WPP	Wind Power Plant
WWF	World Wildlife Fund

EXECUTIVE SUMMARY

1. INTRODUCTION

Turkey recognizes that climate change represents a pressing and complex problem that can lead to serious environmental and socio-economic consequences and that it has become one of the most significant threats to the lives of future generations due to its long-term and cross-sectoral effects. Efforts are necessary to limit emissions of greenhouse gases, the main cause of anthropogenic climate change, and to pursue multilateral international cooperation as nations seek to reduce impacts from and adapt to climate change.

As a result of decision 26/CP.7 of the United Nations Framework Convention on Climate Change (UNFCCC) adopted in 7th Conference of Parties held in Marrakech in 2001, Turkey was removed from Annex II of the UNFCCC and State Parties were invited to recognize the special conditions which place Turkey in a different position from other Annex I countries. After this decision, Turkey became a party to UNFCCC on 24 May 2004. Then, it became an official party to the Kyoto Protocol on 26 August 2009.

Within the context of the Kyoto Protocol, Turkey does not have emission reduction targets. Nevertheless, Turkey undertakes many activities toward decreasing emissions on issues like energy efficiency, promotion of renewable energy, transportation and waste management. In addition, Turkey makes active efforts to participate in voluntary markets for emission credits through emission reduction projects.

This is the Fifth National Communication (FNC) of Turkey since becoming a Party to the UNFCCC and it is the first one since becoming a Party to the Kyoto Protocol. This report was commissioned taking into consideration the situation in 2011.

2. NATIONAL CIRCUMSTANCES

The population growth rate of Turkey in 2007 was 1.24%, which was higher than the average (0.68%) for other Organization for Economic Co-operation and Development (OECD) countries. On the United Nations Development Program (UNDP) Human Development Index (HDI), which includes national indicators related to health, education, and environment, Turkey is 91st among 187 countries (2011). Based on Gross Domestic Product (GDP) per capita, Turkey has a relatively low level of per capita income, when compared with many non-Annex I countries and is behind all Annex I countries that have quantitative emission reduction targets under the Kyoto Protocol. In terms of industrialization, Turkey is much less industrialized than other OECD countries, as well as many UNFCCC Annex I countries and some non-Annex I countries.

According to data from the International Energy Agency (IEA), in 2008 the world average for primary energy consumption per capita was 1.83 tonnes equivalent petroleum (TEP/person), while the OECD average was 4.56 TEP/person. Primary energy consumption of Turkey was 1.39 TEP/person, which is below both the world and OECD averages.

Among OECD and UNFCCC Annex I countries, Turkey's greenhouse gases emissions per capita are the lowest in terms of historical responsibility and primary energy consumption per capita values. Energy related greenhouse gas emissions per capita in 2009 were 3.7 tonnes of carbon dioxide equivalent (CO_2 eq). In the same period, OECD emissions per capita were 10.6 tonnes of CO_2 eq and the world average was 4.4 tonnes of CO_2 eq/person.

While the total greenhouse gas emissions from Turkey in 1990 were about 187 million tonnes of CO_2 eq (when Land Use, Land Use Change and Forestry (LULUCF) was not taken into attention), this amount more than doubled to 370 million tonnes of CO_2 eq in 2009. While sinks absorbed

about 44 million tonnes of CO_2 eq of greenhouse gases emission in 1990, this value increased to about 82 million tonnes of CO_2 eq in sinks in 2009.

Turkey, is located in the Mediterranean Basin, which, according to the Intergovernmental Panel on Climate Change (IPCC) 4th Assessment Report, is one of the regions most negatively affected by climate change globally.

Due to its climatological features, Turkey does not have an abundance of water resources. For this reason, there is a need to take into consideration the on-going desertification trend in the Mediterranean Basin and Turkey since the early 1970s. In order to prevent serious water problems in the future, an integrated basin management approach and water policies should be pursued.

One of the most important effects of climate change is the recent and possible future increase in the intensity, duration and extent of forest fires in Turkey. As a natural result of the Mediterranean climate, hot and dry summers are dominant across Turkey, except for the Black Sea Region and Northeast Anatolia. When decreasing trends of precipitation since the early 1970s are taken into account, like hot and dry summers in 2007 and 2008 in many regions, the increased probability and severity of forest fires in Turkey is likely to be an increasingly important problem.

In addition to stresses from anthropogenic climate change, other human activities like increasing natural resource use and deforestation are leading to the collapse of ecosystems, weakening of biological diversity and strengthening of desertification, by weakening water resources and increasing the frequency and intensity of drought in Turkey.

3. GREENHOUSE GAS EMISSION AND REMOVAL INVENTORY

Total greenhouse gas emissions of Turkey in 2009 were 369.6 Megatonnes of CO_2 eq (without considering LULUCF). Sectoral distribution of total emissions was as follows: energy had 278.3 Mton CO_2 eq (75.3%), waste had 33.9 Mton CO_2 eq (9.2%), industrial activities represented 31.6 Mton CO_2 eq (8.6%), and agriculture represented 25.7 Mton CO_2 eq (7.0%).

The predominant greenhouse gases type were: CO_2 emissions representing 299.11 Mton CO_2 eq (80.92%), methane (CH_4) emissions contributing 54.37 Mton CO_2 eq (14.71%), nitrous oxide (N_2O) emissions providing 12.53 Mton CO_2 eq (3.39 %) and F-gases emissions representing 3.64 Mton CO_2 eq (0.99%).

There was a consistent increase in emissions between 1990 and 2009, except for 1994, 1999, 2001 and 2008 when reductions were observed. While greenhouse gas emissions per capita were 3.39 tonnes CO_2 eq in 1990, it increased to 5.13 tonnes CO_2 eq in 2009 (except for LULUCF). This value is below the 9.83 tonnes CO_2 eq/person OECD average and close to the 4.29 tonnes CO_2 eq/person world average.

While GDP increased by 33.9% between 2000 and 2009 in Turkey, total greenhouse gas emissions increased by 24.5%. This shows a positive trend in terms of decoupling economic growth from growth in emissions.

Energy

With increases in emissions from fossil fuel combustion for electricity and industrial production due to economic development and population growth trends, the energy sector is the main source of greenhouse gas emissions in Turkey. According to 2009 data, total greenhouse gas emissions from the sector constitute 75.3% of total emissions based on 278.33 Mton CO_2 eq. From 1990 to 2009, there was an increase by 110.65% in greenhouse gas emissions from the energy sector. Most of the energy sector emissions originated from fossil fuel combustion. 36.94% originated from the electricity industry, 20.39% originated from housing and services, 19.91% originated from industrial production, 17.04% originated from transportation and 5% originated from fuel combustion in the agriculture sub-sector. CO_2 emissions constituted 97.4% of energy sector emissions in 2009. The contribution of methane emissions was 2.1% and the contribution of N_2O emissions was only 0.5%.

Industrial Treatments

Total greenhouse gas emissions originating from the industrial processes was 31.7 Mton CO_2 eq, constituting 8.57% of Turkey's total emissions. Compared with 1990, greenhouse gas emissions from industrial processes increased by 105% in 2009. The most important activity causing greenhouse gas emissions in this sector is cement and lime production constituting 89% of the sector emissions. According to the 2009 inventory, CO_2 constitutes 88% of process-based greenhouse gas emissions from the industrial sector and F-gases (HFC, PFC and SF_6) represent 12% of it.

Agriculture

According to the greenhouse gas emission inventory data of Turkey from 2009, agricultural activities contribute to approximately 7% of total greenhouse gas emission representing 25.69 Mton CO_2 eq. In the 1990-2009 period, while greenhouse gas emissions from other sectors increased considerably, only greenhouse gas emissions originating from the agricultural sector decreased (by 14%) due to the decrease of stock farming and agriculture activities. According to the 2009 inventory, 58% of greenhouse gas emissions from agricultural activities originated from enteric fermentation of animals, 27% from agricultural lands, 13% from fertilizer management and 2% from rice production and the combustion of agricultural wastes. 64% of total CO_2 eq emissions originated from the agriculture sector are from CH_4 and 36% is from N_2O.

Land Use and Land Use Change and Forestry (LULUCF)

According to Turkey's 2009 greenhouse gas emissions inventory data, the LULUCF sector constitutes a net sink, equal to nearly 22.33% of anthropogenic greenhouse gas emissions. From 1990 to 2009, emissions from the LULUCF sector increased by 83.93%. The most important emission sinks for 2009 were forests sequestering 15.5% of Turkey's total emissions, agricultural areas with 5%, and grassland and pasture areas with 1.8%. All emissions from the LULUCF sector in 2009 were from CO_2.

Waste Sector

In 2009, the waste sector in Turkey contributed 33.93 Mton CO_2 eq (9.18%), representing the second largest contribution to GHG emissions after the energy sector. 88.9% of waste sector greenhouse gas emissions in Turkey originated from regular and irregular solid waste storage areas and the remainder originated from domestic wastewater treatment facilities. It was observed that waste sector emissions increased by 250% between 1990 and 2009. In 2009, 95% of greenhouse gas emissions from the waste sector were CH_4 and 5% were N_2O. While methane gas originate from solid waste storage units and wastewater treatment plants, nitrous oxide emissions originate from only wastewater treatment plants.

4. POLICIES AND MEASURES

CLIMATE CHANGE POLICY

Turkey established a Coordination Board on Climate Change (CBCC) in 2001 to coordinate activities on mitigation and adaptation to climate change. The board was re-structured in 2004, 2010 and 2012 and representatives of public and private sector have been included, in addition to representatives from public institutions.

The most central policy document for climate change in Turkey is the National Climate Change Strategy Document (NCCSD), which was prepared with the active participation of public institutions, private sector representatives, non-governmental organizations (NGOs) and universities, in addition to institutions and association members of the CBCC under the coordination of the former Ministry of Environment and Forestry (MEF). The Strategy Document, covering 2010-2020, was approved by the Higher Planning Council in May 2010.

The Strategy Document acts as a guide for mitigating and adapting to climate change, and includes emission reduction strategies, adaptation, financing and technology policies within the limits of national facilities and international financing and grants, under the principle of "common but differentiated responsibilities," which is central to the implementation of the UNFCCC.

National Climate Change Action Plan (NCCAP), was proposed under the NCCSD and 9th Development Plan, and was prepared with a wide range of stakeholders and CBCC members under the coordination of the Ministry of Environment and Urbanization (MEU). It was published in July 2011. The NCCAP presents sectoral sub-actions under the main titles of greenhouse gas emissions control and climate change adaptation, and defines timing and responsible institutions/ associations for subsequent actions.

CONCURRENT POLICIES AND MEASURES

Issues such as renewable energy support, state support for investment, the European Union (EU) candidacy processes, carbon markets, research and development (R&D) and awareness increase are approaches to mitigating and adapting to climate change that are likely to result in co-benefits for many sectors.

Although Turkey cannot participate in the flexibility mechanisms under Kyoto Protocol for emissions trading, projects are able to participate in voluntary carbon markets. As of the end of 2011, annual greenhouse gas reductions have been pursued through 178 projects under the voluntary market, resulting in approximately 12 million tonnes CO_2 eq reductions. The regulation prepared by the MEU and put into force in 2010, on registering GHG reduction activities, aimed to register projects developed towards voluntary carbon markets. There are a variety of targets and actions for activities that will establish greater participation in carbon markets in the NCCAP, as well as a proposed Istanbul International Finance Center Strategy and Action Plan, which was started in 2009.

The dissemination and application of national climate policies are also important and they will make critical contributions to reducing greenhouse gas emissions in many sectors like energy, transportation and waste.

ENERGY

According to the National Greenhouse Gas Inventory of Turkey, in 2009 the share of emissions in the energy sector originating from fuel combustion was 75.3%. Of this, 17% came from transportation, 19.9% from the industrial production and construction sectors, 26.2% from other sectors, and 36.9% from the recycling and energy sectors. Leading policies towards controlling emissions focused on increasing the share of renewable energy resources in electricity production. Targets stated in Electricity Energy Market and Supply Security Strategy Document from 2009 aim to increase the share of renewable resources in electricity production to 30% in 2023. To achieve this goal: i) wind energy capacity should be increased to 20,000 MW by 2023, ii) all hydroelectricity potential that is technically and economically practical should be developed for electricity energy production by 2023, iii) the 600 MW geothermal potential that has been determined to be eligible for electricity production should be brought into operation, and iv) the use of solar energy in electricity production should be increased.

In order to meet these targets, various legal amendments have been made. For example, in order to increase the share of renewable resources, the Law on The Use of Renewable Energy Resources for Electricity Production (REL) was put into force and enabled important support for producers. With the REL, support for land allocation was given, in addition to providing purchase guarantees and tariff support for electricity produced from renewable resources.

With the REL, the power capacity established for electricity production from renewable energy resources increased substantially. Except for hydroelectric power plants with dams, the share of the renewable energy installed capacity in total installed capacity increased from 2.7% in 2000 to 4.8% in 2009. While electricity production from renewable resources was 34.0 billion kWh in 2002, it rose to 55.8 billion kWh, representing a 64% increase by the end of 2010.

In the Electricity Energy Market and Supply Security Strategy Documents, issues related to energy

efficiency and saving were also highlighted. Besides decreasing emissions from energy production, the strategy targets reducing the costs of electricity and decreasing environmental impacts. In the Energy Efficiency Law of 2007, there are important measures toward increasing energy efficiency in the industry, transportation, building and services and electricity sectors. Many legal amendments have been adopted related to these measures so far.

In accordance with the Energy Efficiency Law, projects to increase energy efficiency have been supported since 2009 including 32 projects representing total investments of 10.5 million TL in 25 industrial enterprises. These projects are expected to enable energy efficiency of about 13,141 TEP in total. In addition, 22 industrial enterprises are voluntarily decreasing their energy intensities by at least 10 percent over 2010-2013. If these industrial enterprises meet their obligations, they are expected to enable about 44,500 TEP/year energy saving each year, although the maximum support provided is only 2.2 million TL.

Within the scope of education programs, more than 4,500 people have been certified as "Energy Managers." Moreover, the Energy Managers Training Programs organized for Asian, Middle Eastern and Balkan countries started in 2002 and has continued.

In order to support renewable energy investments and implement projects that increase energy efficiency, there will be a need for financing. Climate funds, clean energy funds and NAMA support in the future will make important contributions to such projects.

INDUSTRY

Industrial production is responsible for 24% of GDP and 32% of energy consumption. Greenhouse gas emissions from the industrial sector are composed of fuel combustion and process-based emissions. Policies and measures towards fuel combustion are discussed under the energy section. One of the leading policies and measures towards reducing process-based emissions is to develop and disseminate clean production technologies.

In the Industry Strategy Document covering 2011-2014, in addition to the importance given to environmental policies, supporting the transition to a low carbon economy and clear production processes in industry and information activities, the spread of eco-efficiency programs throughout the country are strong focal areas for support. Legal amendments on eco-design and eco-labeling have been partially completed.

Activities to establish a National Clean Production and Eco-efficiency Center in Turkey started between 2008-2011 under the coordination of the MEU as one of the targets under the MDG-F 1680 UN Joint Programme on Enhancing the Capacity of Turkey to Adapt to Climate Change, which was implemented by United Nations Industrial Development Organization (UNIDO), Turkey Technology Development Foundation (TTGV) and the Ministry of Science, Industry and Technology. The establishment of this center was led by the General Directorate of Efficiency under the Ministry of Science, Industry and Technology.

The Technology Need Assessment Project, which aims to identify technology needs in the industrial sector, was established by the Ministry of Science, Industry and Technology in 2012.

Nearly 88% of industrial emissions originate from mineral products. Mineral products include cement, lime, asphalt road, roofing and glass production. Some of the activities undertaken within the sector to improve sustainability include: coprocessing activities (although these projects have different features, they are mainly based on the use of different emission resources like wastes in cement production) and activities to decrease clinker rate in cement.

Activities by industrial facilities to reduce emissions have included: carbon management; calculation of carbon footprint; activities toward enhancing environmental performances standards of facilities like ISO 14000 and EMAS; waste reduction; decrease of energy consumption in production; energy efficiency; use of waste heat; and application of Best Available Technologies (BATs).

TRANSPORTATION

According to the 2009 emissions inventory, greenhouse gas emissions from the transportation sector represented 17% of total emissions in Turkey. Transport on highways is responsible for 85% of CO2 emissions originating from the sector.

In order to control greenhouse gases emissions from the transportation sector, the Turkey Transportation and Communication Strategy Document (2011-2023) and National Climate Change Strategy Document (2010-2020) have established targets. Some of these targets, as stated in the National Climate Change Action Plan (NCCAP) include:

- as of 2023, the share of railroad use (5% in 2009) should increase to 15% and the share of railroads for passenger transportation (2% in 2009) should increase to 10%;
- as of 2023, the share of the use of highways for freight transportation (80% as tonne-km in 2009) should decrease to 60%, and the share of passenger transportation on highways (89% as passenger-km in 2009) should decrease to 72%;
- emission increases from the use of individual vehicles should be limited in urban transportation;
- necessary legislation, institutional structures and guideline documents should be prepared to develop sustainable transportation planning approaches across all cities; and
- legal amendments should be made and capacity developed to increase alternative fuels and clean vehicle use through 2023.

There are important ongoing studies on vehicle technologies for alternative fuels in the transportation sector based on partnerships between the public and private sectors and universities.

AGRICULTURE

Greenhouse gas emissions from agricultural activities represent 7% of total greenhouse gas emissions in Turkey. This rate was 16% in 1990 and is decreasing. Greenhouse gas emissions originating from agricultural activities were mainly based on enteric fermentation. However, due to the decrease in the number of animals in Turkey, methane emissions in this sector have decreased substantially since 1990.

The Ministry of Food, Agriculture and Livestock (MFAL), which is responsible for policy development in the agriculture sector, prepared the Agriculture Strategy (2006-2010), the Strategy for Struggling with Drought (2008-2012) and the Organic Agriculture Strategy (2006-2020) documents. These documents include targets related to the control of greenhouse gas emissions and adaptation to climate change. In order to reach these targets, many legal regulations have been established. Some of these include the Law on Land Protection and Land Use, the Law on Agriculture Reform, the Pasture Law, the Regulation on Good Agriculture Activities and the Regulation on Principles and Application of Organic Agriculture.

Under the Environmentally Based Agricultural Land Protection Program (ÇATAK), many projects were supported to improve the sustainable use of natural resources, the spread of best practices related to fertilizing, irrigation, the prevention of erosion and raising awareness of producers in terms of agriculture – environment.

In many research institutions, R&D activities directly or indirectly related to climate change have focused on decreasing energy use in agriculture, increasing the use of sustainable resources, renewing irrigation methods and tools, developing land processing methods and tools, using fertilizer more consciously, animal breeding, managing animal fertilizer, and preventing stubble burning.

FORESTRY

According to the General Directorate of Forestry (GDF), the Ministry of Forestry and Water Works (MFWW) data, as of 2011, total forest area of Turkey was 21.6 million hectares and the forest asset was determined to be 1.4 billion m^3.

Annual carbon absorption potential of forests in Turkey is increasing annually (Figure 4.8). In 1990, the net carbon inventory increase was 12.02 Mtonne/year and it increased to 15.64 Mtonne/year in 2009. Forest areas constitute the most important sink of greenhouse gas, absorbing an average of 25% of CO_2 emissions.

In order to maximize sink capacity in the forestry sector, the NCCAP prioritizes the following goals: increasing carbon sequestered in forested areas by 15% until 2020 compared with 2007 (14,500 Gg in 2007 rising to 16,700 Gg in 2020), decreasing deforestation and forest degradation by 20% by 2020 compared based on 2007 data, and limiting the negative effects of climate change on land uses like forests, pastures, agricultural lands and settlements.

With many projects conducted to date, important contributions have been made in protecting and increasing forests. For example, within the scope of the Project on Strengthening Forest Protection Areas Management, in the Küre Mountains National Park and buffer zone, one of nine forest hotspots in Turkey, many activities on natural protection and sustainable resource management were completed.

WASTE

The waste sector has had the second largest share of greenhouse gas emissions in Turkey since 1995. According to the 2009 national emission inventory, the waste sector constitutes 9.2% of total emissions. In Turkey, 89% of waste sector emissions originated from regular and irregular solid waste storage areas, with the remaining originating from domestic wastewater treatment facilities. For this reason, the Waste Management Action Plan (2008-2012) prepared by the former MEF in 2008, has a very important impact on emissions in this sector.

Through Waste Management Action Plan, besides estimating the current situation in waste management, future projections and targets have also been established for both central government and provincial needs.

In addition, under the NCCAP, many activities in the waste sector have been emphasized. Some of these actions include:

- decreasing biodegradable waste in regular storage facilities based on 2005 should be decreased to 75% by 2015, 50% by 2018 and 35% by 2025; disposing of 100% of municipal wastes in solid waste disposal plants throughout the country by 2023; and
- closing 100% of irregular storage areas by 2023.

The number of regular storage areas has increased significantly since INC. As of 2011, there are 59 regular storage facilities functioning in Turkey, which provide services to 41 million people in 756 municipalities. In 13 of the current regular storage areas, there are solid waste infiltration water treatment facilities. To improve and close about 1400 irregular storage areas, investment will be needed of Euro 350,000,000. Emission reduction efforts to decrease methane emissions from regular and irregular storage areas have also been started by the MEU through two projects in 2010.

INTERNATIONAL AIR AND MARINE TRANSPORTATION

Within the scope of the EU Emission Trade Directive, all Turkish planes are included in the emission regulations. However, within the context of UNFCCC, international airline and marine transportation sector became subjected to the emission trade and control.

Turkey participates regularly and systematically in the meetings and discussions of international airline and marine transportation sub sectors in the context of UNFCCC. It closely follows the activities of the International Civil Aviation Organization (ICAO) and International Maritime Organization (IMO).

TOTAL EFFECT OF POLICIES AND MEASURES

The estimated greenhouse gas reductions from policies and measures in the above-mentioned sectors is provided in Table 4.6.

5. GREENHOUSE GAS EMISSION PROJECTIONS

Turkey, as a country included in Annex I list of UNFCCC, yet excluded from the Kyoto Protocol's Annex B list, has no greenhouse gas reduction commitment. In addition, Decisions 26/CP.7 and 1/CP.16 of the Conference of the Parties indicate that Turkey has a different status from other Annex I countries and underline its "special circumstances." Although Turkey has no GHG reduction commitment, it decreased its emissions by 20% and achieved 1.4 billion tonnes of reduction against the business as usual scenario (BAU) in the policies and projects it implemented at the national level between 1990 and 2007. Within this period, Turkey increased its GDP by 171% and dropped its emission intensity to 0.36. This is an indicator that Turkey will maintain its contribution to combating climate change by continuing to reduce emissions from business as usual.

6. CLIMATE CHANGE IMPACT, VULNERABILITY AND ADAPTATION

Climate Variables Tendency Analysis

When examining meteorological data between 1950-2010, statistically significant warming tendencies in general have been observed in Mediterranean Region of Turkey. Only some statistically significant cooling tendencies have been detected in the Black Sea Region and in the central and western regions of Turkey. The average spring temperature has shown a tendency to rise across most of Turkey. The average spring temperature has shown a tendency to rise across most of Turkey. Regarding precipitation, the Mediterranean precipitation regime remains dominant across Turkey in terms of winter and spring precipitation total; but there has been a significant decrease in precipitation (aridification) in Marmara, Aegean, Mediterranean and Southeast Anatolia, and in the inner and southern part of the Central and Eastern Anatolia regions. During the winter season, the tendency for reduced precipitation observed especially in western, southern and continental central southern regions still continues despite the more humid conditions, compared to the averages that have been experienced over the past two years in these regions.

Climate Projections

Climate change projections have been conducted by using three different global climate system models (GCM), ECHAM5, CCSM3 and HadCM3. Despite some differences in the sizes of change, all model simulations project similar tendencies. All simulations agree on the increase in temperatures in Turkey in the 21st century. Furthermore, the simulations suggest larger increases in the central and eastern parts of Turkey. Almost all simulations project decreases in winter precipitation in the Mediterranean Region of Turkey while projecting increases in the Black Sea Region. All simulations project a decrease in spring flows and an increase in winter flows in Eastern Anatolia.

Expected Impacts, Vulnerability and Adaptation Measures

Water Resources

Evaluations of likely climate change impacts on water resources of Turkey indicate regional differences. Based on precipitation, heat, evaporation and surface flow values across the 25 basins in Turkey, it is expected that in some basins, surface flows may decrease and take on an irregular regime in comparison to average flows.

Projections of water stress levels in Turkey and the EU for 2030 suggest that Turkey will experience particularly strong water stress in the Central and Western Regions, as well as significant stress in Southeastern and Eastern regions by 2030.

Climate change is projected to affect a variety of different social and bio-physical water related processes in Turkey, including: possible regional differences in surface water resources; possible flood and drought conditions; reservoir/storing and hydroelectricity production potential; irrigation rehabilitation and modernization; and groundwater recharge.

Agriculture and Food Security

Agriculture and food security in Turkey are particularly vulnerable to climate change given the country's location in the Mediterranean basin, and due to the importance of the agriculture sector both economically and socially. There have been an increased number of studies on climate change and agriculture in Turkey since 2007. It is widely estimated that Turkey will experience a decrease in the efficiency of the agricultural production due to decreasing precipitation in semi-arid regions, increasing temperatures, and constraints on water resources in irrigated areas. There are a variety of research projects conducted by MFAL on adaptation, agriculture insurance activities, improvement of irrigation systems, as well as studies within the scope of MDGF-1680 United Nations Joint Programme on Enhancing the Capacity of Turkey to Adapt to Climate Change.

The issues coming to the forefront in the relationship between agriculture and climate change include: the efficiency of agricultural production, possible changes in soil and water resources; and socio-economic/environmental effects in agriculture sector.

Natural Disasters

A variety of natural disasters are predicted to increase due to climate change including: extreme weather events, forest fires, storms, floods, hail, heat waves, avalanches and landslides. According to a study performed by the European Environment Agency (EEA), climate change due to higher temperature and reduced precipitation projections in Southern Europe and Turkey might make the region more vulnerable to meteorological disasters.

The issues at the forefront of natural disasters and climate change are: increases in the frequency of, intensity of and period of exposure to hydro-meteorological disasters; increases in exposure of social and economic assets in communities with few adaptation options; increases in urban floods due to severe precipitation; increases in climate induced migration due to desertification; increases in the number of forest pests and fires; increases in the exposure of agricultural production to damage from hail and other meteorological events; and adverse effects of disasters across the sectors such as agriculture, forest, insurance, energy and water.

Ecosystem Services

Among the impacts to ecosystem services that might occur due to the climate change include: salinization; eutrophication (increase of phytoplankton and especially cyanobacteria stimulated by nutrient salt and heat increase); and loss of biodiversity. Adverse effects are expected depending on the changes in heat and precipitation regimes in terrestrial ecosystems. It is also possible to see some positive effects from climate change on forest ecosystems.

Coastal Areas

Turkey is a country with 8,333 km of coastline and surrounded on three sides by the sea. The coastline, where the population density is double the rest of the country, is an important area mainly for agriculture and tourism. Particularly vulnerable assets in the area include coastal communities, and a large amount of transportation and industrial infrastructure.

Sea level and water temperature - the parameters of climate change that will affect the coastlines - are expected to rise significantly. Sea level rise is expected to increase coastal erosion and land loss due to floods, as well as result in salinization of groundwater.

The issues at the forefront of coastal vulnerability to climate change are: land loss and coastal erosion; differences in the frequency of the storms; salinization of river deltas; salinization of groundwater; and negative impacts on tourism.

Health

Diarrheal illnesses, malaria and other viral diseases, which are a principal cause of death globally, are expected to increase with a changing climate. Turkey is expected to experience effects like decrease in water resources and increases in forest fires, erosion, changes in agricultural

productivity, aridity, deaths due to the heat waves, as well as in vector induced diseases. Specific health impacts are expected related to: a decrease in populations with access to healthy, clean and sufficient potable water; an increase in the frequency of diseases that are spread via vectors; an increase in the diseases/deaths related to floods and standing water; and an increase in chronic respiratory system diseases due to urban air pollution. In order to protect populations from these negative health impacts of climate change, sustainable adaptation and prevention efforts are required.

Settlements and Tourism

Settlements and tourism are vulnerable to climate change based on: water shortages and water quality challenges in urban areas with increasing heat; the difficulty of life in urban areas as extreme heat days increase; damage to infrastructure in settlements from natural disasters; adverse impacts on the economic structure of the tourism sector; and the possibility of evacuation of communities due to climate impacts.

Improving Adaptation Capacity

The United Nations Joint Program on Enhancing the Capacity of Turkey to Adapt to Climate Change (Millenium Development Goals Fund (MDGF) 1680) was launched in 2008 to form strategies and strengthen the institutional capacity of Turkey to adapt to climate change. The Joint Programme aims to integrate national, regional and local policies within the scope of the Turkey's development objectives in a sustainable way. The National Climate Change Adaptation Strategy has been developed under the joint programme and some activities have been realized to improve capacities within national and regional institutions for the prediction and management of risks. Some of these activities include: studies to define institutional capacity needs for adaptation in the agriculture and forestry sectors; studies to establish a Flood and Drought Information Sharing Portal; climate projections produced using different scenarios in order to increase the reliability of climate projections in Turkey; pilot activities of eco-efficiency in water use in industries; and supporting projects under the Community-Based Climate Change Adaptation Grant Program in the Seyhan River Basin.

Adaptation Policy

The National Climate Change Adaptation Strategy and Action Plan were prepared in coordination and in line with the National Climate Change Strategy and National Climate Change Action Plan process. The Adaptation Strategy and Action Plan were prepared by the Ministry of Environment and Urbanization within the MDGF-1680 UN Joint Program.

7. FINANCE AND TECHNOLOGY

Turkey is not an Annex II country under the UNFCCC and thus is not required to provide financial support to any developing country within the scope of Articles 4.3, 4.4 and 4.5 of the UNFCCC and Article 11 of the Kyoto Protocol.

Turkey is not acknowledged as a developed country according to the country classifications made by the World Bank and the IMF. As a country with middle-high income level, Turkey is in the same category with many non-Annex I countries, and it has access to climate financing resources from bilateral and multilateral development banks and international funds.

Turkey is also eligible to benefit from the short-term financing facility of $30 billion that is committed by developed countries under Copenhagen Accord" and officially recognized under Cancun Agreements, with an aim to provide support to developing countries in their investments to combat with climate change.

In order for Turkey to reach its objectives, such as increasing the share of renewable energy to at least 30% by 2023, and to implement the National Climate Change Strategy and Action Plan,

financing is necessary from international banks and funds. As a result, Turkey should continue to receive financing and accesses to new funds should be given to the country. This role as a recipient country is inline with the "common but differentiated responsibilities" principle and Turkey should have access to the financial resources that will be provided by official financing mechanisms, such as the Green Climate Fund. Studies continue to define the technology needs of Turkey for more effective adaptation and greenhouse gas mitigation activities.

8. RESEARCH AND SYSTEMATIC OBSERVATION

The highest structure in Turkey for establishing science and technology policies is the Supreme Council for Science and Technology (SCST). The Turkish Research Area (TARAL) was established to facilitate cooperation between the national R&D and broader stakeholders, and to keep research focused in line with national objectives.

A significant increase in the expenditures of R&D has occurred over recent years, reaching almost 1% of GDP. Research budgets also increased in 2009 reaching to 8.5 billion Turkish lira in 2009. The contribution of the private sector in national R&D has also risen notably.

Since 2007 there has been a substantial rise in the amount of research, and number of projects and publications on climate change. This research has been implemented through either national or international cooperation. The main areas of research have been in renewable energy, energy efficiency, alternative energy resources, and fuel cells.

There is a need to continue research in mitigation technologies, but also to scale-up research in adaptation and adaptation technologies. Additionally there is a strong need for more research on the socio-economic impacts of climate change and response measures in Turkey. Turkey should increase its contributions to international observation systems and Turkey should be increasing its systematic observations at a national scale, as well as supporting other developing countries in enhancing their observation systems through bilateral or multilateral agreements.

9. EDUCATION, TRAINING AND PUBLIC AWARENESS

Since 2007, many activities have been undertaken in Turkey on education, training, raising awareness of the public, public participation and access of the public to information and international cooperation within the scope of the New Delhi Working Program. There are numerous NGOs organizing training, education and public awareness on climate change, and there is an increased interest of the media in knowledge acquisition and raising awareness. Cooperation is also being developed between public institutions and NGOs, and between public institutions and the private sector.

Since 2009, climate change adaptation projects have targeted: municipalities, farmers, women, female farmers, primary school and university students and the private sector. Although there is still no research center working on climate change broadly, research centers have been established to focus on renewable energy. Climate change is also becoming widespread in art activities. Some of the most prominent examples have been children's ballet with the title, Global Warming, and photography and caricature competitions with climate change themes.

Almost 15 million people have been reached through the training, education and awareness raising activities on climate change since 2007. One another significant experience that Turkey has gained from this process is promoting the dissemination of this work and increasing the quality and financing of studies conducted through public sector-NGO-private sector partnerships. This has led to successful results from these studies.

1. INTRODUCTION

Turkey recognizes that climate change is a multifaceted and complex issue that is leading to serious environmental and socio-economic impacts. Based on this understanding that climate change represents one of the most substantial challenges facing future generations, Turkey supports international cooperation to combat climate change and efforts to decrease greenhouse gas emissions.

Pursuant to decision 26/CP.7 of the United Nations Framework Convention on Climate Change (UNFCCC) at the 7th Session of the Conference of Parties held at Marrakesh, Morocco in 2001, Turkey's name was deleted from Annex II of the UNFCCC, and the Parties were invited to recognize the special circumstances of Turkey. These circumstances place Turkey in a situation different from that of other Parties included in Annex I to the UNFCCC. Subsequent to this decision Turkey became a Party to UNFCCC on 24 May 2004. Law No. 5836 regarding the participation of the Republic of Turkey in Kyoto Protocol was published in the Official Gazette #27144 (17 February 2009). After the relevant decision of the Council of Ministers was published in the Official Gazette, the "Instrument of Accession," declaring Turkey as a Party to Kyoto Protocol, was submitted to the United Nations Secretary General on 28 May 2009, and the Republic of Turkey became a Party to the Kyoto Protocol as of 26 August 2009.

Turkey does not have emission reduction targets under the Kyoto Protocol. However the country has been conducting intensive emission reduction activities in areas such as energy efficiency, promotion of renewable energy, transportation, and waste management. In addition to this, Turkey has demonstrated an active commitment to the development of markets for voluntary emission reductions and for integration of emission reductions into compliance markets. Furthermore, Turkey has conducted activities to better understand national mitigation opportunities.

The Communication has been prepared in accordance with the Guidelines for the Preparation of National FNC by Parties included in Annex I to the UNFCCC (FCCC/CP/1999/7) and is consistent with the reporting requirements stated in Article 7.2 of Kyoto Protocol.

Turkey's Initial National Communication (INC) was submitted to the UNFCCC Secretariat on 20 February 2007 and was reviewed by the Expert Review Team (ERT) between September 2008 and August 2009. The findings in the detailed review report issued by the ERT were taken into account in the preparation of the FNC. The FNC focuses on the changes that have occurred since the submission of the INC.

2. NATIONAL CIRCUMSTANCES

2. NATIONAL CIRCUMSTANCES

2.1. Government Structure

The Republic of Turkey is a parliamentary democracy. The 550 members of the parliament (Grand National Assembly of Turkey - GNAT) are elected for five year terms. The GNAT is the legislative authority. The President and Ministerial Cabinet hold executive power and lead the central administration. The President is elected by people for a five year term and is limited to a maximum of two terms. The Ministerial Cabinet is composed of the Prime Minister and the Ministers. The Prime Minister is selected by the President from among the members of the GNAT. The remaining Ministers are assigned by the Prime Minister.

There are 21 line ministries in the Ministerial Cabinet. The Ministries referred in Initial National Communication including the Ministry of Environment and Forestry (MEF); the Ministry of Public Works and Settlement; the Ministry of Agriculture and Rural Affairs; the Ministry of Industry and Commerce; the Undersecretariat of State Planning Organization (SPO); the Undersecretariat of Foreign Commerce; and the Ministry of Transportation have been reformed. In 2011 the following were established: the Ministry of Science, Industry and Technology (Decree No 635); the Ministry of Economy (Decree No 637); the Ministry of Food, Agriculture and Livestock (MFAL) (Decree No 639); the Ministry of Customs and Commerce (Decree No 640); the Ministry of Development (Decree No 641); the Ministry of Environment and Urbanization (MEU) (Decree No 644); the Ministry of Forest and Water Affairs (MFWW) (Decree No 645); and the Ministry of Transport, Maritime Affairs and Communications (MTMAC) (Decree No 655). As a result of the reformation of these public institutions in the Second National Communication, the new names of the institutions are generally used. However, where reference is made to published sources (such as the commissions, inter-institutional protocols, agreements, etc.) implemented prior to the publication of the Decrees, the previous names of the institutions are used.

The central government makes political decisions related to climate change such as the climate change strategy, as well as energy, transportation and waste policies. It also executes relevant legal regulations. There are 81 provinces in Turkey. The representatives of the central government in the provinces are the governorates under the Ministry of Interior. The governors who occupy the head of the provincial administrations are assigned by the central government. The representatives of the local administration in the provinces are determined through local elections.

Mayoral elections occur every five years. There are 16 metropolitan municipalities in Turkey. In addition to infrastructure services, such as transportation, potable water and drainage, the municipalities are responsible for energy efficiency, waste disposal and environmental planning. In this context, the municipalities have an important role in the development and implementation of climate change policies at the local scale.

The MEU is responsible for the formation and implementation of environmental policy in Turkey, and is also the focal point for the UNFCCC. In this context, climate change policies are determined and executed by Coordination Board on Climate Change (CBCC) under the coordination of the

MEU with the participation of relevant ministries and institutions the CBCC, which is composed of the senior representatives of the relevant institutions and organizations and is responsible for the determination and execution of the national climate policy. The CBCC is also responsible for the preparation of the national communications of the Republic of Turkey for UNFCCC and for the development of relevant studies, and execution of relevant obligations. Under the CBCC, eleven technical working groups have been established for the execution of the studies related to the sectors addressed in the FNC.

2.2. Population

While the population of Turkey was 56.47 million in year 1990, it reached 73.72 million in 2010, with an annual increase rate of approximately 1.5% during 2005-2010 period (Figure 3). It is anticipated that the population will reach 85.41 million in the year 2025 with an approximate annual increase rate of 1% during the period between 2011 and 2025. Despite the increase in population experienced since 1990, a significant decrease was observed in population growth rate for the 1990-2010 period, and this trend is estimated to continue (Table 2.1).

According to 2010 data, 76.3% of the population lived in urban areas, and 23.7% of the population inhabited rural areas. The median age was 29.2 years with a median age for men and women 28.7 and 29.8 years respectively. The working age population, between 15 and 64 years, comprised 67.2% of the population. 25.6% of the population was under 14 years and 7.2% was 65 years or older. Population density in 2010 was 96 person/km^2. This figure ranges between 10 person/km^2 and 2,551 person/km^2, depending on the province.[1]

An increase in greenhouse gas emissions is expected alongside the increase in population. Furthermore, since most of the population resides in urban areas, the policies and actions of local authorities is particularly important in influencing emission increase.

Table 2.1. Population Data of Turkey

	1990	2000	2007	2008	2009	2010	2015*	2020*	2025*
Population (millions)	56.47	67.80	70.59	71.52	72.56	73.72	77.60	81.78	85.41
Yearly population increase (%)	2.17	1.83	-	1.31	1.45	1.59	1.14	0.97	0.77
Population density (person/km^2)	73	88	92	93	94	96			

Source: TurkStat. 2011a. Statistics in Turkey 2011, p.7-8.
Projected figures: TurkStat 2011b. Population Projections and Forecast. Accessible at: http://www.tuik.gov.tr.

2.3. Geography

Turkey is situated between the northern latitudes of 36°- 42° and eastern longitudes of 26°- 45°. It is surrounded by Georgia, Armenia, Nakhichevan and Iran in the east; Bulgaria and Greece in the west; Syria and Iraq in the south; and by the Black, Mediterranean, Aegean and Marmara Seas in three directions. Turkey acts as a bridge between Asia and Europe with the straits of Istanbul and Dardanelles. Turkey has 2,875 km of land borders and 8,333 km of sea borders. This geography renders Turkey vulnerable to potential sea level rise due to climate change.

The surface area of Turkey is 785,347 km^2 and approximately 11% of this area is occupied by lakes and marshlands. Turkey has a diversity of freshwater systems including a 1,263 km length of the Euphrates River and 523 km length of the Tigris River. There are many natural lakes and artificial

[1] TurkStat. 2011. News: Address-based Population Registration System 2010 Results, Issue:19. 28 Jan 2011.

lakes of various sizes. Turkey is a mountainous country with an average altitude of 1,141 meters.

Turkey's rich biodiversity is in part due to hosting a wide range of ecosystems including forests, mountains, steppe, wetlands, coastlines and seas, as well as its location at the intersection of the three bio-geographical regions: the European-Siberian (Paleo-boreal European Forest); Mediterranean; and Iran-Turan. This impressive diversity of ecosystems and habitat is home to a significant diversity of species. For example, Turkey contains approximately 19,000 invertebrate species, of which approximately 4,000 are endemic. Approximately 1,500 vertebrate species have been identified to-date, including more than 100 endemic species. In terms of plant diversity, while there are only 12,500 gymnosperm and angiosperm plant species in the whole of the European continent, Turkey accommodates approximately 11,000 species. Approximately one-third of these are endemic to Turkey. Climate change has the potential to pose a significant threat to the biological diversity of Turkey.

2.4. Climate

Turkey is situated within the Mediterranean climate zone. However, the climate varies across its regions. Five climate types are dominant in the country (corresponding with Figure 2.1): I. Mediterranean climate, a Mediterranean climate dominates the Mediterranean (Ia) and Aegean (Ib) regions with hot and dry summers, and warm and wet winters; II. Black Sea Climate, the Black Sea region and the northern shores of the Marmara Region experience consistent wet and warm weather; III. Semi-dry Marmara Climate, in the Semi-humid Marmara region, the summers are hot and slightly wet, while the winters are moderate and wet; IV. Semi-arid steppe climate, the Central Anatolia (IVa) and Southeastern Anatolia (IVb) regions experience a semi-humid steppe climate, in which the summers in the Central Anatolia are hot and slightly wet, and in the Southeastern Anatolia are very hot and extremely dry; V. Continental Eastern Anatolian Climate, the Eastern Anatolian region experiences a continental climate with cool summers in the north and hot summers in the south, as well as cold and snowy winters.

Figure 2.1. Geographical Distribution of the Traditional Climate Regions of Turkey

Ia and Ib. Mediterranean Climate
II. Black Sea Climate
III. Semi-dry Marmara Climate
IVa and IVb. Semi-arid Steppe Climate
V. Continental Eastern Anatolian Climate

Source: Redrawn according to Koçman (1993) based on Türkeş (2000): Türkeş, M. 2000. Climate change studies and activities in Turkey. In: Participants' Presentations for the Advanced Seminar on Climatic Change: Effects on agriculture in the Mediterranean region, Mediterranean Agronomic Institute of Zaragoza, 25-29 September 2000.

The highest yearly average temperatures (20°C) are observed on the shores of the Eastern Mediterranean, and the lowest temperatures occur in the Northeastern Anatolian region, which consists of high plateaus and mountainous areas. The yearly average temperature varies between 8°C and 12°C in the continental regions of Turkey (Figure 2.2). Long-term average temperatures across most of Turkey indicate a significant increasing trend in average summer temperatures (Section 6.1, Figure 6.1c). Significant trends of increasing temperatures have also been recorded in the annual average temperature.

Figure 2.2. Turkey Yearly Average Temperature Distribution (1971-2000)

Source: SMS, 2010. Climate Atlas of Turkey. http://www.mgm.gov.tr.

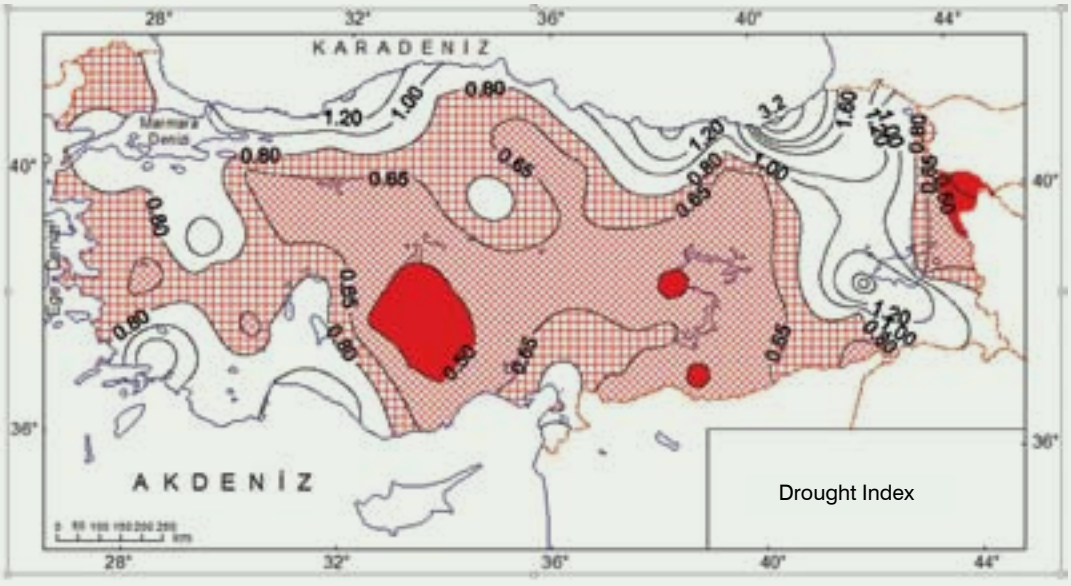
The Western Mediterranean, Western and Eastern Black Sea regions have the highest precipitation levels in Turkey, experiencing average winter and autumn precipitation levels above 1,000 mm. In continental regions and in the eastern parts of the Eastern Anatolia, however, annual precipitation is generally below 500 mm (Figure 2.3). Long-term data indicate a decrease in precipitation levels and increasingly arid conditions across the Aegean, Mediterranean, and Southeastern Anatolia regions, as well as in the south of the central Anatolia. Such arid conditions and the resulting water shortages experienced in most parts of Turkey affect agriculture and energy generation, and also impact water resources management, including irrigation, potable water, other hydrologic systems and operations.

Figure 2.3. Annual Total Average Precipitation Distribution in Turkey (1971-2000)

Source: General Directorate of Meteorology (GDM), 2010. Climate Atlas of Turkey. http://www.mgm.gov.tr

Based on the drought index promoted by the United Nations Convention to Combat Desertification (UNCCD), the Central Anatolia and part of the Southeastern Anatolia region qualify as semi-arid lands. All of the areas shown in red (semi-arid) and red-lined (dry, semi-arid and humid) in Figure 2.4 correspond to areas in Turkey that have a water shortage and are inclined to experience drought and desertification, based on the above drought index. In this context, precipitation variability in the semi-arid and arid-semi-humid areas in Turkey is above 20% in annual precipitation, 30% in winter and spring precipitation and 45-50% in autumn and summer precipitation. As a result, drought poses a significant economic and social threat in the Central Anatolia and Southeastern Anatolia regions since agricultural production is the predominant livelihood strategy.

Figure 2.4. Geographical Distribution of Drought Prone Areas in Turkey, based on the UNCCD Drought Index



Source: Türkeş, M. 2010a. Climatology and Meteorology. First Edition, Kriter Publisher – Publication Number 63, Physical Geography Series No. 1. ISBN: 978-605-5863-39-6, 650 + XXII page. Istanbul.

2.5. Economy

Since 1990, the macroeconomic outlook of Turkey's economy has varied based on regional and global conditions. The Turkish economy demonstrated growth following the financial crisis in 2001, but was significantly impacted by the global financial crises in 2005 and 2008. The impacts of these crises are clearly visible in the economic indicators for 2009 (Table 2.2). Limited growth in 2008 and a contraction of the economy in 2009 were met by an improved economy and high growth rate of 8.95% in 2010.

Turkey's Gross Domestic Product (GDP) of US$734.93 billion US Dollars in 2010 made it the 16th largest economy among the 30 members of OECD. The per capita GDP in 2010 was US$10,067. The service sector constitutes the most important sector to the economy, contributing to 65% of the national GDP in 2009. Industry and agriculture sectors follow the service sector, representing 26% and 9%, respectively. A large portion of the emissions from the industrial sector is based on manufacturing.[2]

Table 2.2. Selected Macroeconomic Indicators of Turkey

Indicators	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
GDP per capita* (With Current Prices, in US Dollars)	4,130	3,021	3,492	4,559	5,764	7,022	7,586	9,240	10,438	8,559	10,067
GDP* (With Current Prices, in Billions of US Dollars)	265.38	196.74	230.49	304.9	390.39	481.5	526.43	648.75	742.09	616.7	734.93
Growth Rate* (% GDP Change)	6.77	-5.70	6.16	5.27	9.36	8.40	6.89	4.67	0.66	-4.83	8.95
Goods Exported** (Billions of US Dollars)	27.77	31.33	36.06	47.25	63.17	73.48	85.53	107.27	132.03	102.14	113.88
Goods Imported** (Billions of US Dollars)	54.50	41.40	51.55	69.34	97.54	116.77	139.58	170.06	201.96	140.93	185.54
Export-Import Coverage Ratio** (%)	51	76	70	68	65	63	61	63	65	72	61

* Ministry of Development. 2011b. Economical Developments. November 2011, p. 2.
** TurkStat. 2011.

The import-export figures of Turkey demonstrate an increase both in imports and exports in the period from 1990 to 2010. In the same period, there has been a foreign trade deficit, which increased from approximately US$9.4 billion in 1990 to approximately US$71.5 billion in 2010. The coverage ratio of exports to imports for 2010 was 61%. In the 7-year period between the 2001 and 2008 crises, both the imports and exports of Turkey grew. As a reflection of the global economic crisis, there was contraction from 2009 to 2010.

2 Ministry of Development. 2011a. International Economical Indicators 2011, p.16.

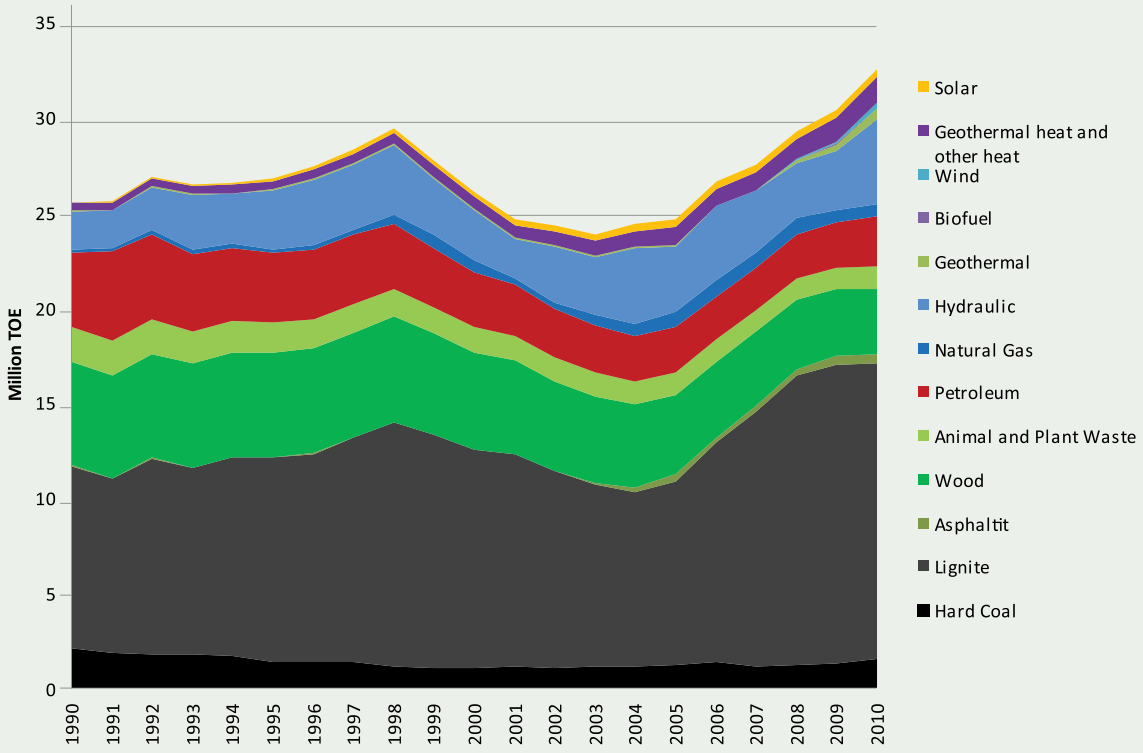
2.6. Energy

Primary Energy

Production from Primary Energy Resources

Turkey's energy production from its primary energy resources fluctuates depending on national demand and water income in hydro-energy (Figure 2.5). Domestic basic energy resources include the following (in order of importance): lignite, biomass, petroleum and hydroelectric energy. Although there has been a substantial increase in renewable energy recently, the share of the renewable energy resources in the production of primary energy is quite small. While 38%, 28%, 15% and 8% of the production of primary energy in the year 1990 was from coal (lignite), biomass (wood and animal, plant wastes), petroleum and hydropower, respectively. These rates showed an important change recently as the use of lignite and hydropower has increased as a percentage of the total energy production (Figure 2.5 and 2.6). There have also been increases in the contributions of geothermal heat and renewable energy to energy generation. The local energy resources of Turkey, especially in terms of the identified petroleum and natural gas reserves, are quite limited and are not adequate to meet national demand. Dependency on foreign energy imports increased from 52% in 1990 to 70% in 2010 with 92% of the petroleum and 98% of the natural gas originating from foreign sources.[3]

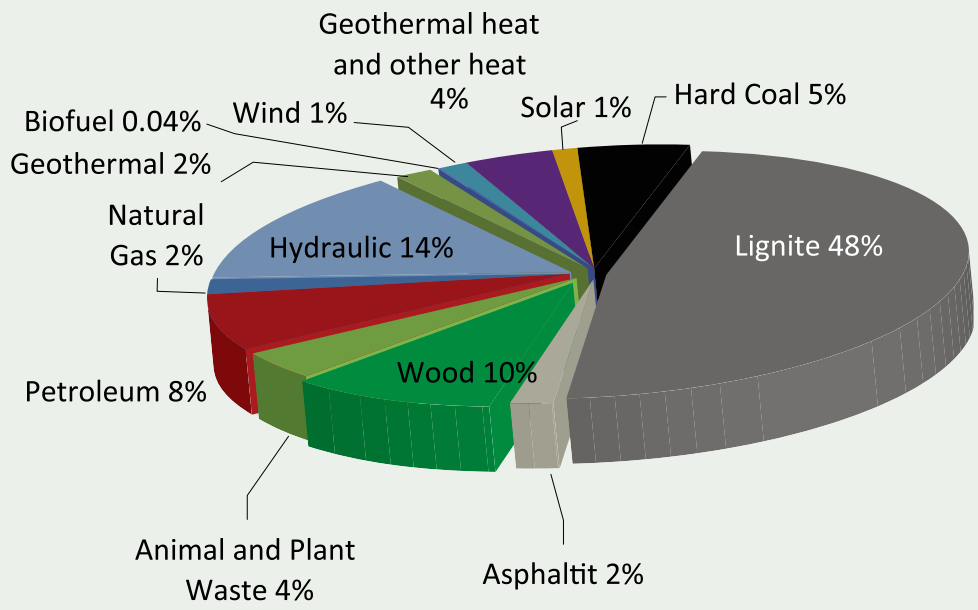
Figure 2.5. The Role of Energy Resources in Turkey's Primary Energy Generation (1990-2010)



Source: MENR. 1990 and 2010. Energy Balance Tables

[3] MENR. 1990 and 2010. Energy Balance Tables.

Figure 2.6. Resources for Primary Energy Generation in Turkey for 2010

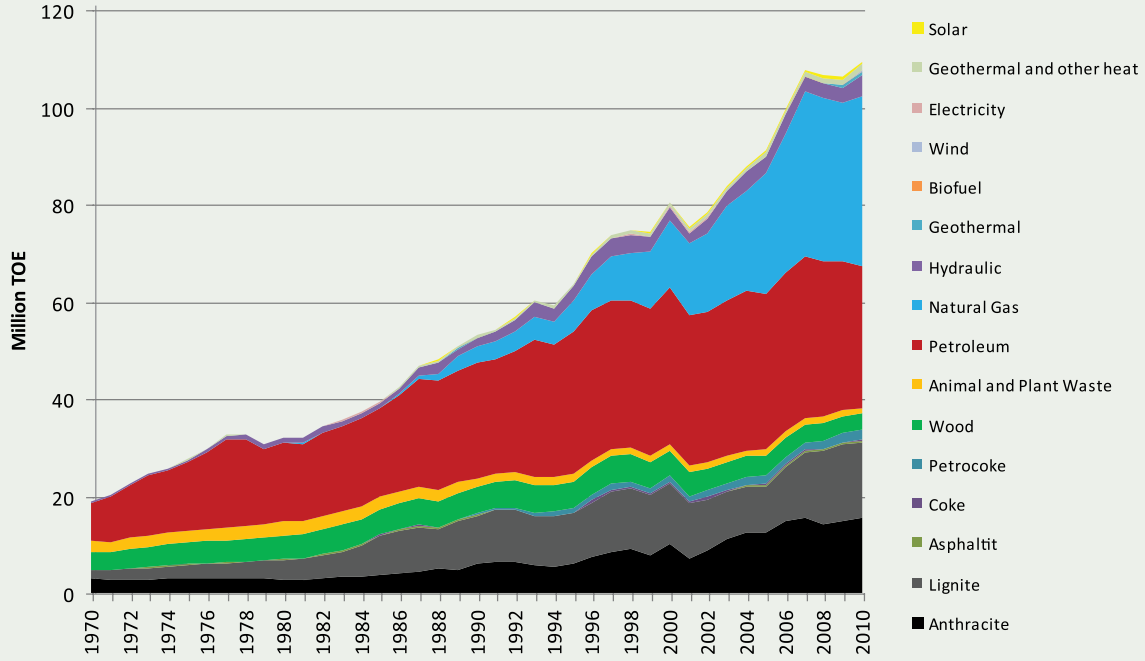


Source: MENR. 2010. Energy Balance Table.

Consumption of Primary Energy Sources

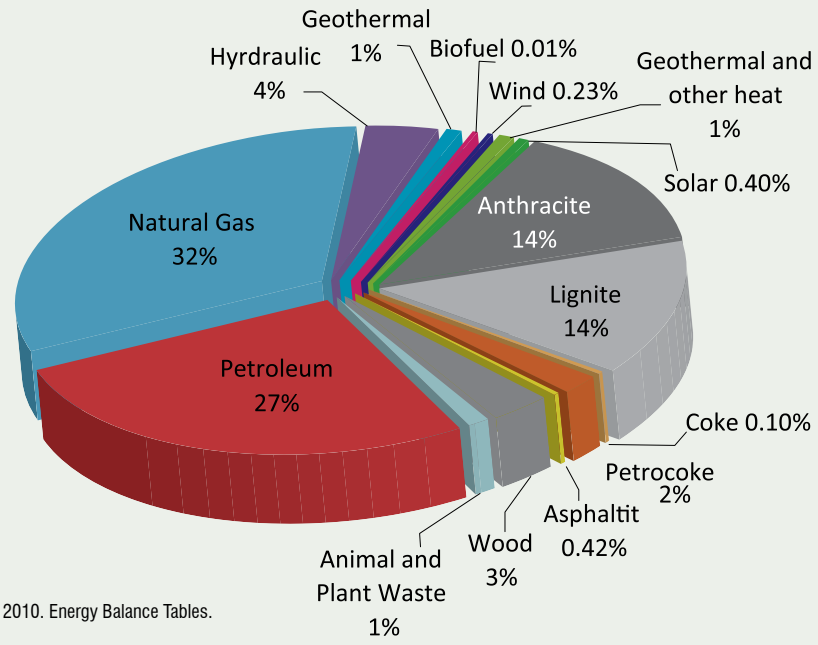
Between 1990 and 2010 the total consumption of primary energy in Turkey increased rapidly in all energy sources except oil, with consumption growing from 53 million tonnes of oil equivalent (TOE) in 1990 to approximately 109 million TOE in 2010. These figures were influenced by the global financial crisis with a decrease in consumption after 2007. The relative importance of oil in primary energy consumption decreased from 45% to 27% between 1990 and 2010, while the importance of natural gas rose from 6% to 32% of energy consumption over this time period. From 1990 to the present this growth of natural gas has represented the largest change (Figure 2.7).

Figure 2.7. The Role of Energy Resources in Turkey's Primary Consumption (1990-2010)



Source: MENR. 1990-2010. Energy Balance Tables.

Figure 2.8 Distribution of the Primary Energy Consumption in 2010 in Turkey Based on Energy Resources

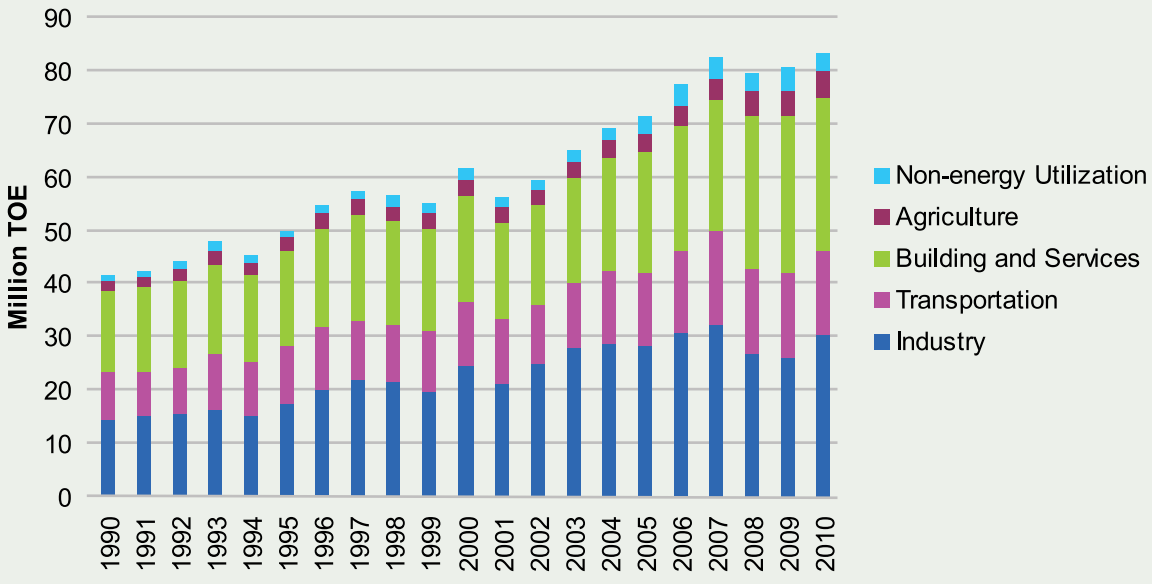


Source: MENR. 2010. Energy Balance Tables.

Sectoral Energy Consumption

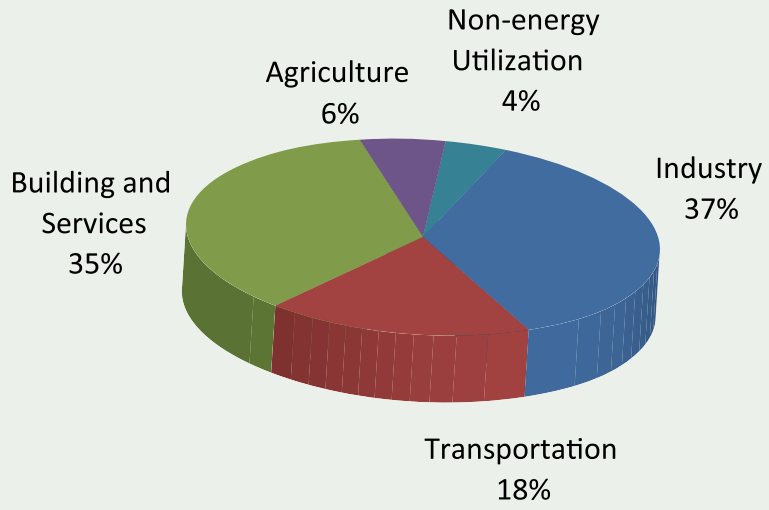
Although energy consumption has risen from 1990 to 2010, in periods of crisis (i.e. 2001 and 2008) clear decreases were observed (Figure 2.9). While in 1990 the largest portion of the final energy consumption belonged to the building and services, since 1990 industrial production has become the largest consumer of energy (Figure 2.10). However due to the financial crisis, in 2009 the relative importance of the industrial sector decreased to 32% and the building and services sector increased in importance to 37% (Figure 2.10).

Figure 2.9. Turkey's Sectoral Energy Consumption (1990-2010)



Source: MENR. 1990 – 2010. Energy Balance Tables.

Figure 2.10. Sectoral Distribution of Final Energy Consumption in Turkey for the year 2010.



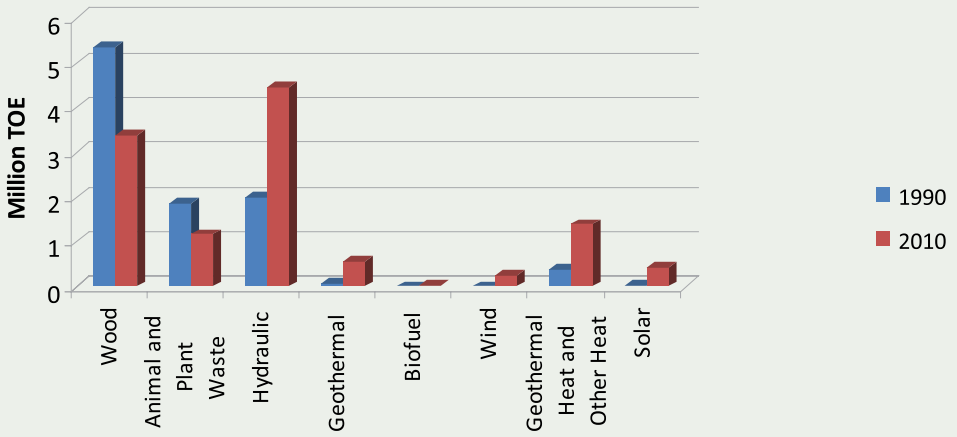
Source: MENR. 2010. Energy Balance Tables.

Renewable Energy Sources

In 2010, 10.7% (11.8 Million TOE) of Turkey's total primary energy supply was met by renewable energy sources. As of the end of 2010, 39% of the renewable energy supply in Turkey was from biomass sources, 38% from hydraulic sources, 17% from geothermal sources, 2% from wind, and 4% from solar energy (Figure 2.12).

According to Turkey's Wind Potential Atlas[4] wind power potential of Turkey was calculated as 48,000 MW of electricity. Turkey has also undertaken studies to evaluate the role of solar and biomass sources in national energy production. These are available in the national Solar Energy Potential Atlas[5].

Figure 2.11. The Change in the Renewable Energy Resource Use between 1990 and 2010

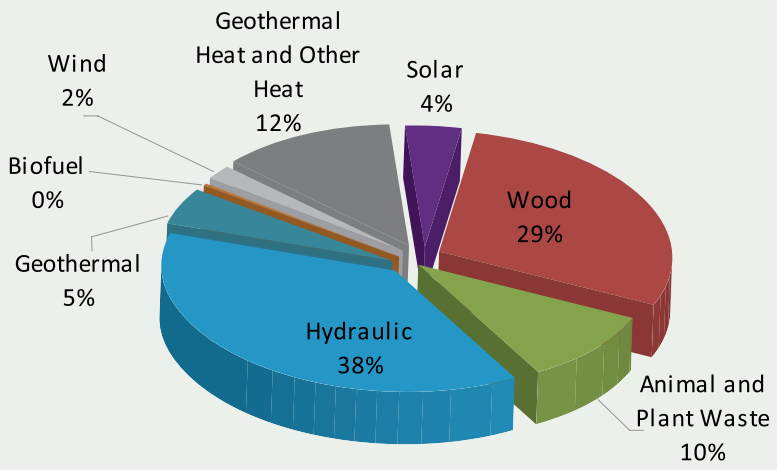


Source: MENR. 1990-2010. Energy Balance Tables.

4 http://www.eie.gov.tr/turkce/YEK/ruzgar/ruzgar_index.html

5 http://www.eie.gov.tr/turkce/YEK/gunes/gunes_index.html

Figure 2.12. The Share of the Renewable Energy Resources in Total Renewable Energy Consumption in 2010

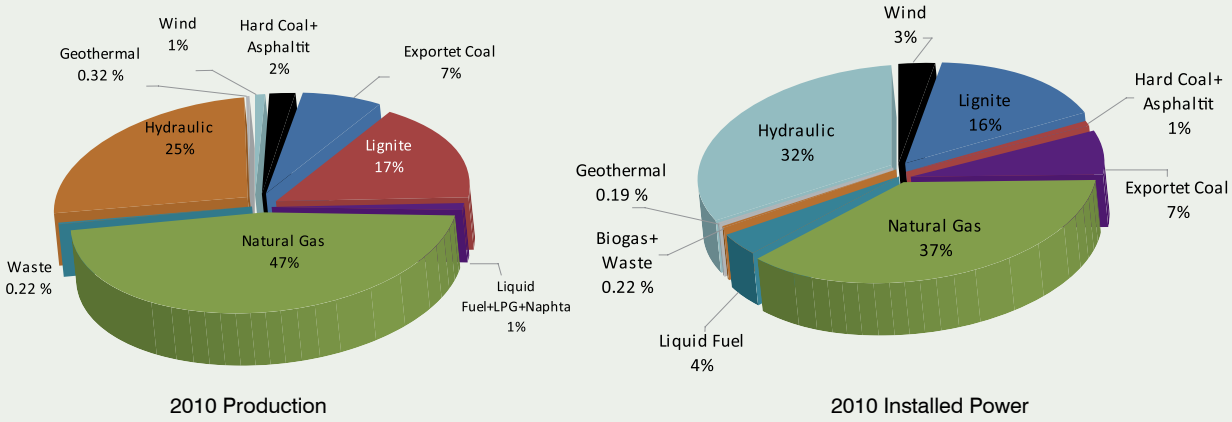


Source: MENR. 2010. Energy Balance.

Electricity Sector

According to the national greenhouse gas inventory, the total CO_2 emission released by the energy sector in 2009 was 271.11 million tonnes of CO_2 eq 96.28 million tonnes of this is attributable to the electricity sector. Annual electricity production grew from 57.5 billion kWh with an installed power capacity of 16,318 MW in 1990 to 211.2 kWh of annual production and 48,932 MW of installed power capacity in 2010.

Figure 2.13. Distribution of Electricity Production and Installed Power Based on Energy Resources (2010)



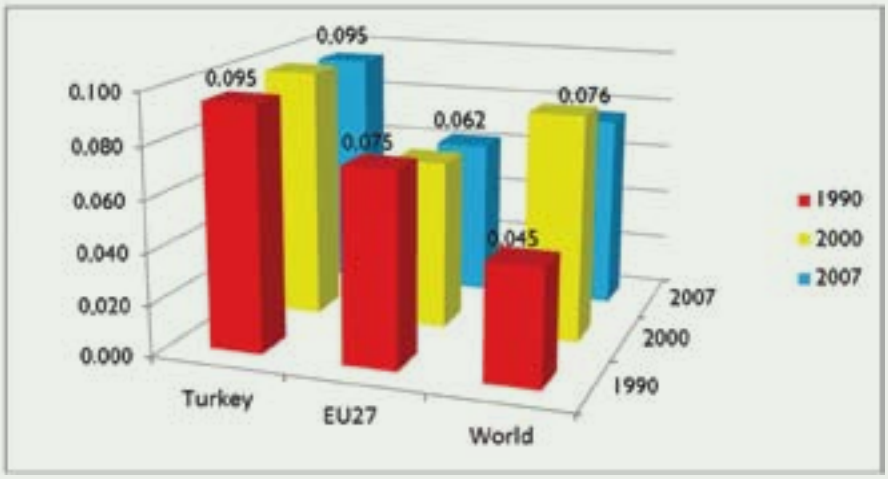
Source: World Energy Council Turkey National Committee Energy Report. 2011.

Over the last decade electricity production has risen by 8% annually and the capacity of power plants has increased regularly. In terms of sources for electricity, in 2010, 47% of the total electricity production was provided by natural gas, 17% by lignite and asphaltide, 25% by hydroelectric sources, 9% by hard coal, 1% by liquid fuels, 1% by wind and less than 1% by geothermal and biogas (Figure 2.13). While use of hydroelectric sources and wind increased from 2009 to 2010, there has been a decrease in local coal and natural gas use rates.

Energy Efficiency

The Turkish economy can be considered to be energy intensive when compared with developed countries. Energy intensity of Turkey is 0.27 toe/thousand 2000 USD in 2009 whereas for the same year, energy intensity of OECD countries is equal to 0.18 toe/thousand 2000 USD. This means that Turkey consumes more energy to generate USD 1,000 of GDP (in 2000 USD) compared to OECD countries. Correspondingly, if the purchasing power parity and energy consumption values of the final use are considered, the energy density of the energy consumption in Turkey for 2007 is 30% higher than the European Union. This demonstrates the potential for energy efficiency investments in Turkey (Figure 2.14).

Figure 2.14. Comparison of the Energy Intensity of Turkey for the 1990, 2000 and 2007 based on the Purchase Power

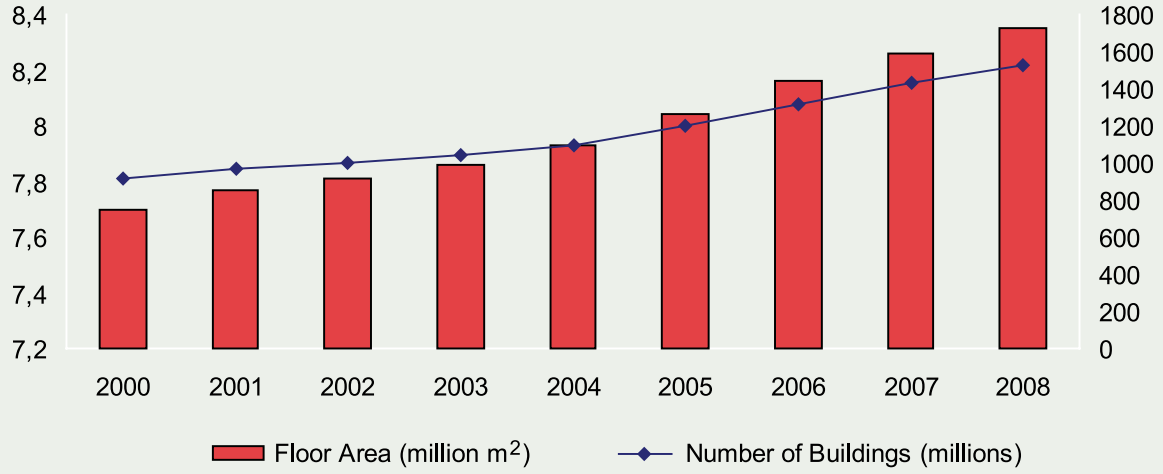


Source: World Energy Council. Available at: http://wec-indicators.enerdata.eu.

2.7. Buildings and Urbanization

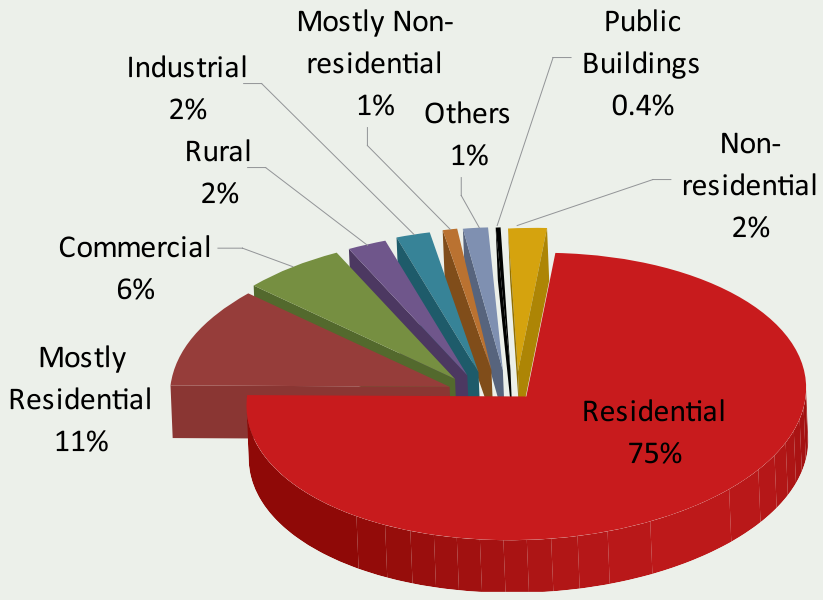
In 2009, 37% (29.5 million TOE) of total energy consumption was attributable to the building and service industry. According to the Turkish Statistical Institute (TurkStad), the number of buildings across Turkey grew from 4.3 million in 1984 to 7.8 million in 2001, and the number of buildings in the same period reached 16.2 million reflecting an increase of 129%. According to building permits, between 2000 and 2008, the area the residentials, commercial buildings and public buildings increased by 56%, reaching 1,524 million m2 (Figure 2.15). Approximately 75% of the buildings in Turkey are residentials (Figure 2.16).

Figure 2.15. Number of the Buildings and Changes in Surface Area between the Years 2000 and 2008 in Turkey



Source: National Climate Change Action Plan (NCCAP). 2011.

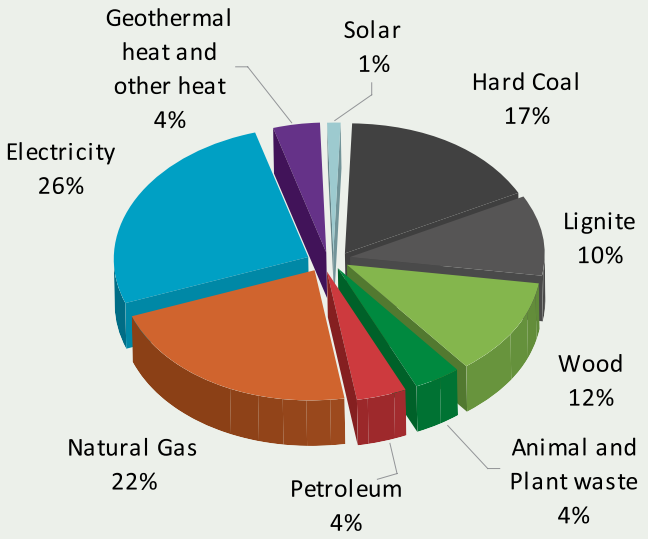
Figure 2.16. Distribution of the Buildings Based on Their Purpose of Use



Source: TurkStat. 2000.

In Turkey, energy consumption in buildings is met by electricity (26%), natural gas (22%) and renewable energy sources (19%) including solar, geothermal, wood and plant/animal residues in 2010 (Figure 2.17).

Figure 2.17. Energy Consumption in the Buildings (Households and Service) according to Energy Types (2010)



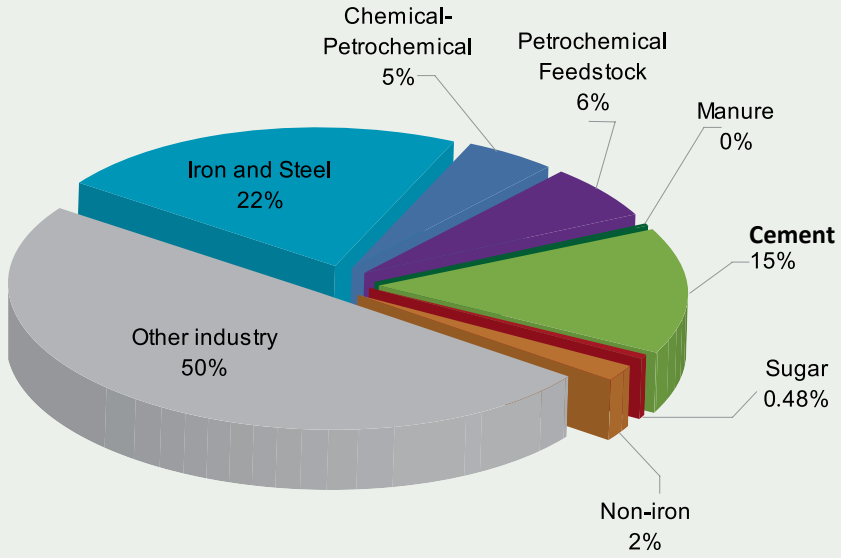
Source: MENR. 2010. Energy Balance Table.

2.8. Industry

Turkish industry is composed of many different sub-sectors with different characteristics that represent between 20-25% in GDP. Industry greatly affects national economic growth. The food and textile sectors represent the largest contributors to industry with an 18.8% and 16.3% share respectively. Those sectors are followed by the petroleum products sector with 8.8%, the iron and steel sectors with 6.2%, the automotive sector with 5.8%, and the chemicals sector with a 5% share. The automotive industry has the highest share of Turkish exports, representing 13.5% of exports. Other export industries include the iron and steel industry (12.8% of the exports) and textiles (10.3% of exports). Small and medium-sized enterprises (SMEs) constitute 99% of the total number of industrial businesses, constituting 56% of the total employment and generating 24.2% of the added-value.[6]

Primary energy consumption across sectors in 2010 was 83.37 million TOE, with industrial consumption responsible for 37% of this value (30.63 million TOE). The majority this use comes from a variety of industries. The largest two single industries, in terms of primary energy use, have been the iron-steel industry with 22% (6.74 million TOE) and cement industry with 15 % (4.63 million TOE) (Figure 2.18).

Figure 2.18. Distribution of Primary Energy Consumption within the Industrial Sector (2010)



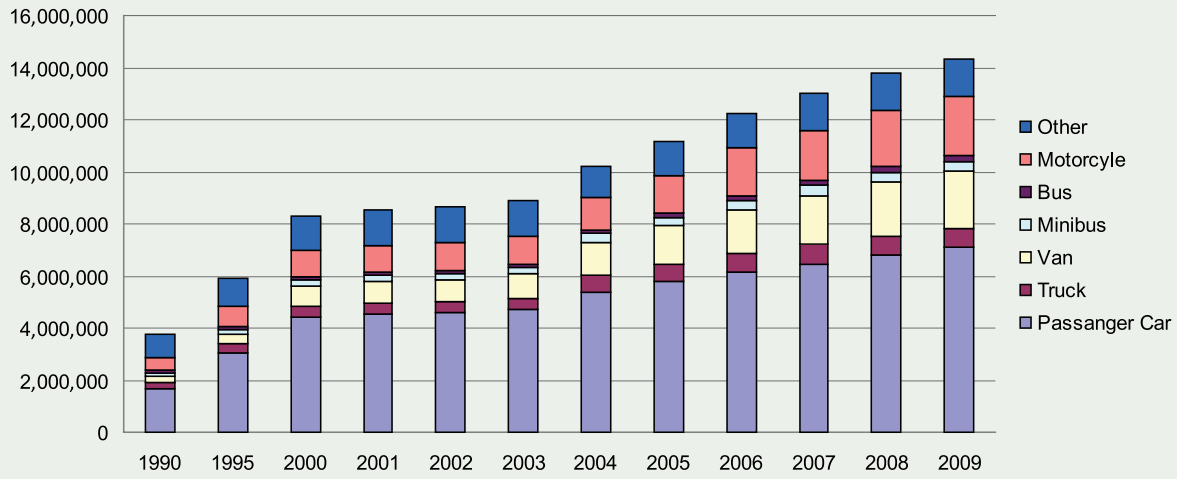
Source: MENR. 2010. Energy Balance Table.

6 NCCAP. 2011

2.9. Transportation

The transport sector was responsible for 18% (15.33 million TOE) of Turkey's primary energy consumption (83.37 million TOE) in 2010. Road transport was responsible for 87% of the primary energy consumption in transportation industry and air transport was responsible for 6.24%.[7] Motor vehicle numbers have been increasing since 1990. While there were 1.6 million personal automobiles in 1990, this number reached approximately 7.5 million in 2010 (Figure 2.19). This is reflected in the rise of automobiles per 1000 people from 30 in 1990 to 103 in 2010. Furthermore, the number of total road vehicles per 1000 individuals grew from 68 in 1990 to 207 in 2010.

Figure 2.19 Change in the Number of Vehicles 1990-2010



Source: Former Ministry of Transportation, General Directorate of Highways. March 2011.

Road transport represents the highest share of CO_2 emissions caused by the transportation sector. Despite this growth in the number of vehicles, transport efficiency has increased over the past two decades with a reduction of 24.64% in CO_2 emissions produced per passenger-km and per freight-km. The main reasons for this decline are new vehicle and engine technologies and an increase in alternative fuel use between the years 2003-2009. A small element of this reduction is based on a tax incentive policy to remove old vehicles from the market[8]. As a result of this policy, approximately 320,000 vehicles were withdrawn from the market resulting in CO_2 emission reduction of 4.9% in transport sector in two years.[9]

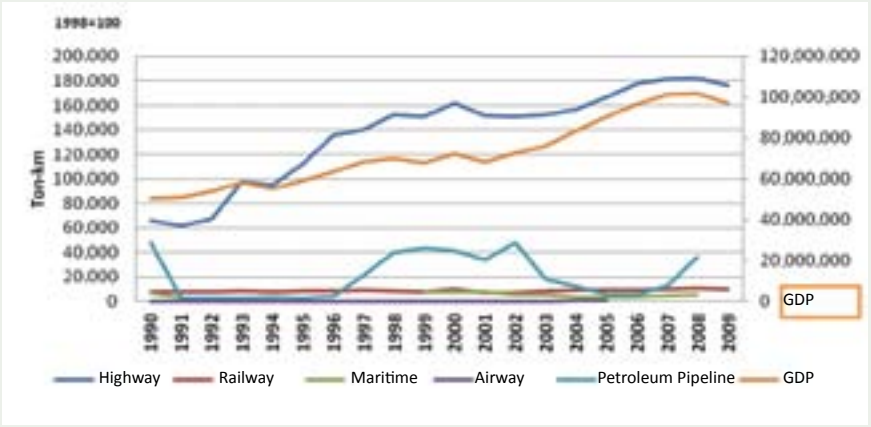
In addition to the measures and developments mentioned above, the Ministry of Finance launched a regulation (#27857) in February 2011 to encourage use of electric vehicles. This reduced taxes of electric vehicles, which are now subject to excise tax based on engine power. For example tax is 3% on vehicles with engine power of up to 85 kW, 7% for between 85 and 120 kW and 15% for engine power above 120 kW. In comparison, the rates of excise duty on vehicles fueled by oil and gas are 37% for up to 1,600cc, 60% for 1,600cc to 2,000cc and 84% for over 2,000cc.

7 MENR. 2010. Energy Balance Table.

8 Communique numbered 62 and 63 released by the MTMAC requires withdrawal of minibus, truck, van, bus, tanker and tow truck produced at and earlier than 1985.

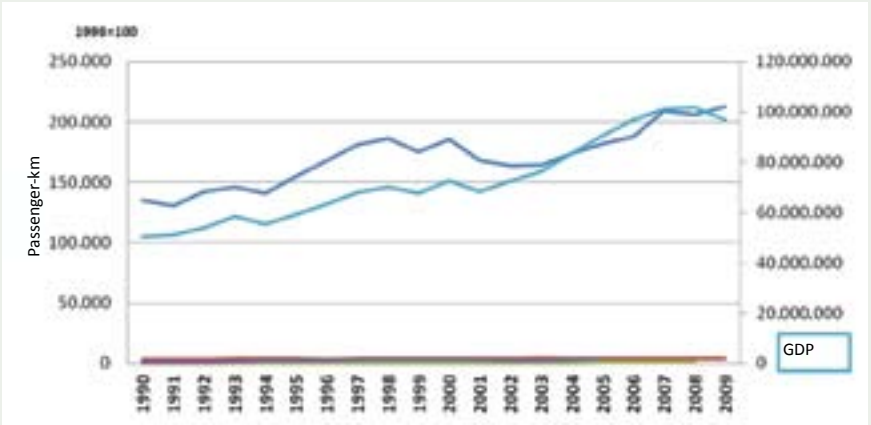
9 Former Ministry of Transportation. 2011.

Figure 2.20 Cargo Transportation in Turkey (1990-2009)



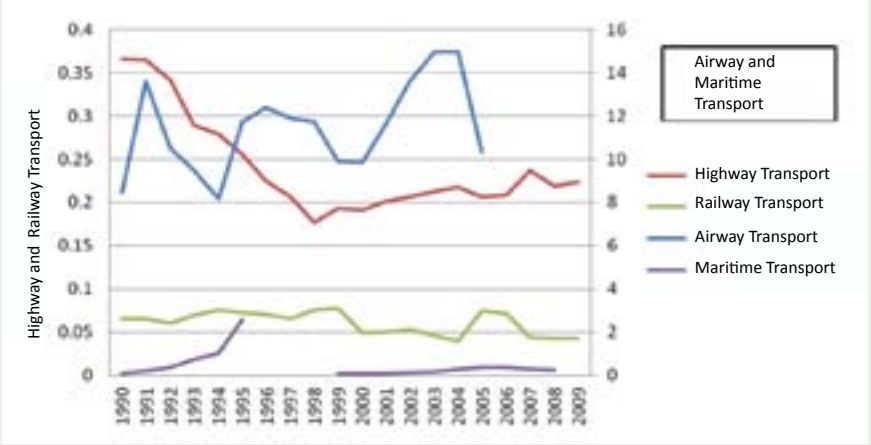
Source: MTMAC. February 2012.

Figure 2.21. Passenger Transportation in Turkey (1990-2009)



Source: MTMAC. February 2012.

Figure 2.22 Emissions of CO_2 per ton-km in Turkey (1990-2009)



Source: MTMAC. February 2012.

2.10. Waste

Greenhouse gas emissions originating from the waste sector in Turkey are mainly related to waste management and wastewater treatment. The sector's most important greenhouse gases are methane (CH_4) and nitrous oxide (N_2O).

Waste Management and Policies in Turkey

Since 2004, Turkey has carried out many actions related to waste management and regulatory policies. The first legal regulation in this field in Turkey was the Solid Waste Control Regulation (#20814 from 14 March 1991). Revisions of the regulation to harmonize it with the EU Landfill policy were carried out in 2010 (#27533 from 26 March 2010). Solid Waste Management Action Plan covering 2008-2012 was prepared by the former MEF, using the outcomes of the EU funded Environmental Heavy Cost Investment Planning (EHCIP) Project, solid waste master plan projects and the EU Integrated Environmental Adaptation Strategy (NES) (2007-2023).

Waste, Composting and Recycling

According to the TurkStat Municipal Waste Statistics the amount of municipal solid waste per person per day was 1.38 kg in 2003, 1.21 kg in 2006 and 1.15 kg in 2008. Published in 1991, the Solid Waste Control Regulation saved 1,220,228 tonnes of packaging waste collected within the scope of the recovery period 1992-2004. In addition, in 2008 275,752 tonnes of waste was gathered in four composting plants whose total capacity is 551,000 tonnes/year. After the decomposition process, 143 tonnes of waste has been composted and 47 tonnes of compost has been produced. From this amount, 121 tonnes of non-compostable waste has been moved to landfill businesses and 12 tonnes of waste has been sold.

The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations (#26891 from 30 May 2008 and coming into force a year later) provides limitations on the use of hazardous wastes. In addition, within the scope of the Waste Electrical and Electronic Good Directive (2002/96/EC), efforts to draft regulations on electrical and electronic waste ongoing. There are 21 electronic waste processing plants registered in Turkey. These institutions dispose of waste in compliance with environmental regulations, and they recycle iron, copper, aluminum, chromium, brass, plastic and cardboard materials. In 2010, 5,000 tonnes of electrical and electronic waste was recovered. The total amount of electrical and electronic equipment is estimated to be around 400,000 tonnes per year. The National Recycling Strategy Document Preparation is under development and is under the responsibility of Ministry of Science, Industry and Technology.

2.11. Agriculture

Greenhouse gas emissions from the agricultural sector in Turkey are mainly the result of production of agricultural products and associated byproducts, as well as livestock (based on enteric fermentation, manure management, etc.). Rice production and agricultural residues caused by the burning of stubble in fields are particularly strong contributors to the sector emissions profiles, with burning stubble causing N_2O, carbon monoxide (CO) and NOx. Agricultural activities and processes are the primary contributors of CH_4 and N_2O.

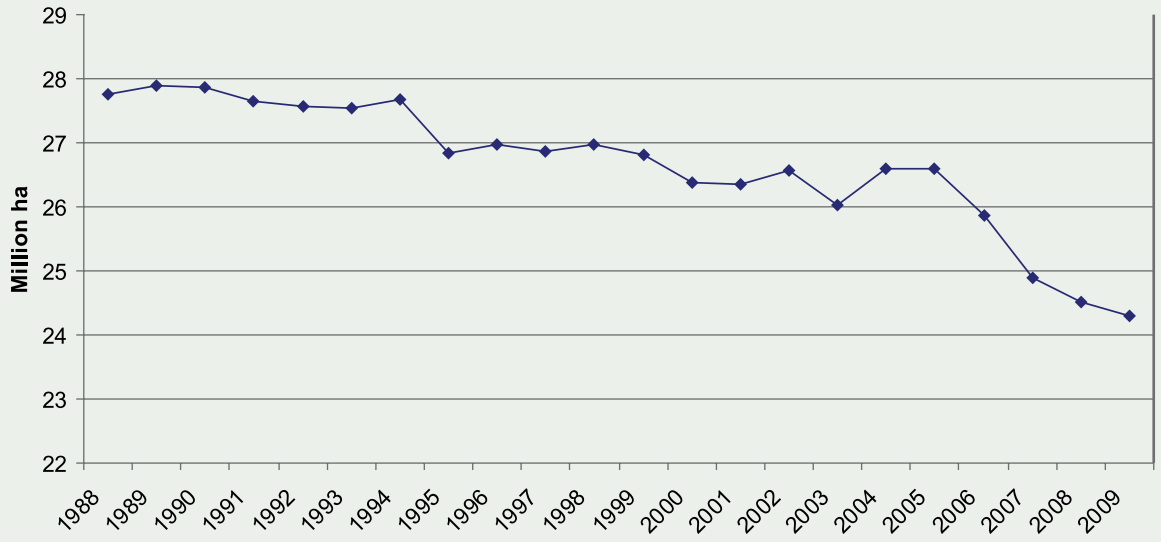
Added Value

With Turkey's economic transformation in the 1980s from an agricultural to a more diversified economy, the importance of agricultural activities in the national economy decreased significantly. The contribution of the agriculture sector to national GDP decreased from 24% in 1980 to 10.6% in 2005 and 9.1% in 2010. As a result, the sector is currently the fifth largest sector in the national economy. Similarly, the proportion of people employed in the agriculture sector has decreased substantially.

Agricultural Lands

In 2009, Turkey had 24.3 million hectares under agricultural land management. Approximately 16.2 million hectares of this were planted, 4.3 million hectares were fallow, 0.8 million hectares were vegetable gardens and about 3 million hectares were reserved for fruit gardens, olive groves and vineyards. Since 1988 however, there has been a significant decline in agricultural land in Turkey (Figure 2.23).

Figure 2.23 Changes in Agricultural Lands (1988-2009)



Source: TurkStat. 2010. Agriculture Statistics.

Livestock

Since 1990, Turkey has experienced a decline in the number of cattle and sheep, but an increase in the number of poultry. In 2009 sheep represented 58% of large and small ruminant livestock, while cattle represented 28% of livestock, and goats 14%.

Organic Agriculture Practices

Organic agriculture practices in Turkey began in the mid-1980s. In order to create an improved legal framework for agriculture practices, the Regulation on Production of Plant and Animal Products through Ecological Methods entered into force in 1994 through the efforts of the former Ministry of repealed Ministry of Agriculture and Rural Affairs. The Organic Agriculture Act No. 5252 was prepared within the framework of the EU laws and was enacted in 2004. On the basis of this law, the Regulation on the Principles and Implementation of Organic Agriculture was passed in 2005 and underwent comprehensive changes in 2008. In 2007, 10,553 organic farmers produced 431,203 tonnes of organic products over an area of 135,360 hectares, while an estimated 5,723 producers are in the process of transition to organic agriculture across 38,924 hectares area.

2.12. Forestry

Turkey is broadly located in the Mediterranean climate zone. Turkey is considered as one the richest country in terms of biodiversity which is the result of topography and different climate zones. A great part of this biodiversity is located in the forest lands. In north Anatolia and part of the Marmara region, forest ecosystems are composed of pure and mixed forests, which include coniferous tree species such as black pine, Scots pine, fir, spruce and juniper, as well as broad-leaved tree species such as beech, oak, hornbeam, alder, chestnut, ash, elm, poplar, maple, hazelnut and rhododendron. In the South, West and large parts of Marmara, the forests are pure and mixed Mediterranean forest ecosystems composed of coniferous tree species, such as red pine, black pine, Taurus fir, Taurus cedar, juniper, stone pine, Aleppo pine, maritime pine and cypress, as well as broad-leaved tree species such as sweet gum, oak, eucalyptus along with maquis elements such as sandal and laurel. Along with the steppes, Turkey has arid and semi-arid forest ecosystems consisting of especially pine, Scots pine, cedar, juniper and oak species. Turkey also has forest ecosystems that are within transition zone between coastal and inland regions in Central, Eastern and South-eastern Anatolia regions.

A large portion of Turkey's forests are natural forests with high biodiversity values. Many of the plant species have additional values in raw material production, including wood, and the use of roots, bark and resin for medicinal and aromatic purposes. Many of the harvested fauna species are used for the production of herbal products of animal origin.

According to the 2009 forest inventory, Turkey's total forest area is 21.4 million hectares. Approximately 10.4 million hectares of this forest estate can be classified as degraded forests (Table 2.3). The inventory estimates that Turkey has approximately 1.4 billion m^3 of wood. Nearly 1.3 billion m^3 of this tree wealth belong to regular forests (Table 2.4). The annual growth of the forest in Turkey is estimated approximately 38.5 million m^3 (Table 2.5). Calabrian pine (Pinus brutia), black pine (Pinus nigra), and Scots pine (Pinus sylvestris) represent over 80% in the total number of coniferous trees. Similarly, oriental beech (Fagus orientalis) and oak (Quercus sp.) represent about 80% of the broad-leaved trees in Turkey. 99% of the forests in Turkey belong to the state. 4.1 million hectares of the total forest area (19%) are found in protected areas and the rest of the 17.3 million hectares of forest area are in managed forests.

Table 2.3. Turkey Forest Cover in 2009, based on National Forest Inventory (1000 ha)

Tree species	Standing forest			Coppice forest			General Total		
	Regular	Degraded	Total	Regular	Degraded	Total	Regular	Degraded	Total
Coniferous	7,279	5,727	13,006	0	0	0	7,279	5,727	13,006
Broadleaf	2,214	1,083	3,298	1,478	3,606	5,084	3,693	4,690	8,383
Total	9,494	6,810	16,305	1,478	3,606	5,084	10,972	10,417	21,389

Source: GDF. April 2011.

Table 2.4. Volume of Wood in Turkey's Forest Estate in 2009 (1000 m^3)

Tree species	Standing forest			Coppice forest			General Total		
	Regular	Degraded	Total	Regular	Degraded	Total	Regular	Degraded	Total
Coniferous	880,595	50,924	931,520	0	0	0	880,595	50,924	931,520
Broadleaf	348,152	12,239	360,391	61,701	20,627	82,329	409,854	32,866	442,720
Total	1,228,747	63,163	1,291,911	61,701	20,627	82,329	1.290,449	83,790	1,374,240

Source: GDF. April 2011.

Table 2.5. Annual Increase in Wood Volume, based on the 2009 Turkey Forest Inventory (1000 m³)

Tree species	Standing forest			Coppice forest			General Total		
	Regular	Degraded	Total	Regular	Degraded	Total	Regular	Degraded	Total
Coniferous	24,128	1,172	25,300	0	0	0	24,128	1,172	25,300
Broadleaf	8,775	308	9,084	3,252	816	4,069	12,028	1,125	13,153
Total	32,904	1,481	34,385	3,252	816	4,069	36,156	2,297	38,454

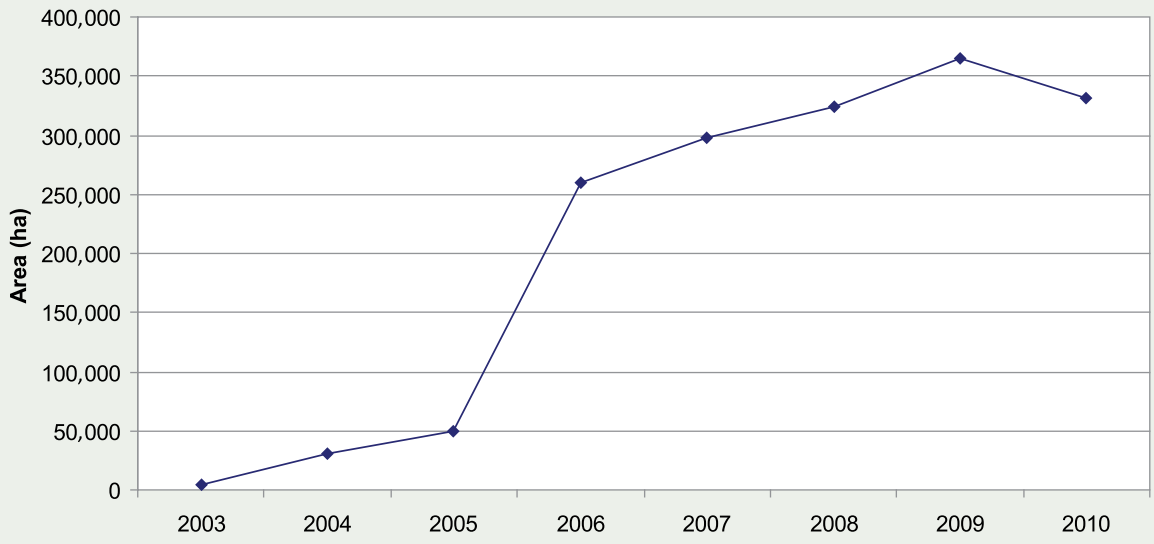
Source: GDF. April 2011.

Forest Restoration

Almost half of Turkey's forests are considered to be degraded, with less than 10% canopy cover (Table 2.3). In addition, 2.3 million hectares of forest has a canopy cover between 11% and 40%. The ability of forests to regenerate declines based on human-induced pressures, including industrialization and urbanization. However in areas where threats have been reduced, forests have regenerated. The General Directorate of Forestry has been conducting activities on the restoration of damaged forests (improvement) and reforestation since 1995. The main goal of these efforts is to develop forest structure and increase the density of forests. This process also covers the maintenance of naturally regenerating forests. In this context, the General Directorate of Forestry prepared actions plans for specific species' rehabilitations such as Cedar Forest Rehabilitation Action Plan (2005-2014), Oak Forest Rehabilitation Action Plan (2005-2014) and Juniper Forest Rehabilitation Action Plan (2006-2015).

Rehabilitation work in Turkey in 2007 impacted 298,000 hectares. These activities have been carried out within the scope of Deforestation and Erosion Control Mobilization Action Plan (2008-2012). Accordingly, land improvement and reforestation has occurred on 1,729,207 hectares of land through 2011. Three hundred thousand hectares of forest area are expected to rehabilitated or reforested (Figure 2.24).

Figure 2.24. Forest Restoration Activities (2003-2010)



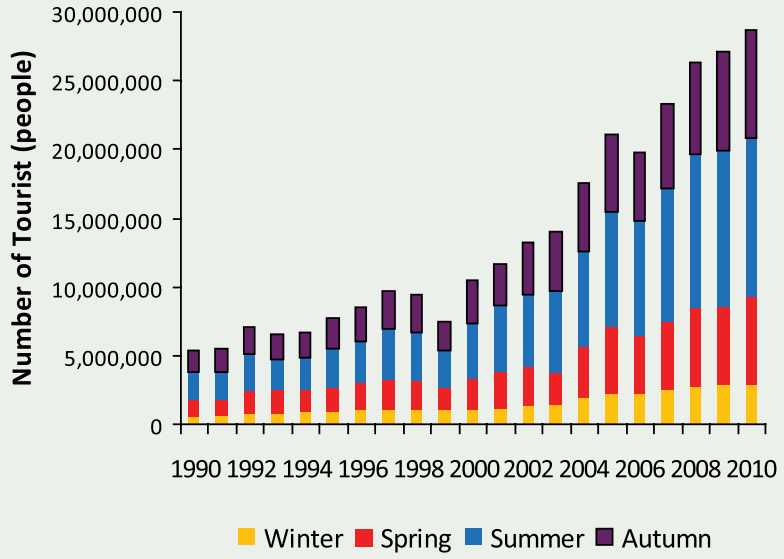
Source: GDF. April 2011.

2.13. Tourism

Surrounded by seas on three sides, acting as a natural bridge between Asia and Europe, and with unique geopolitical importance, Turkey has been a cradle of great civilizations throughout history. There are nine World Heritage Sites in Turkey and an additional 18 temporarily listed values on the World Heritage List. With its 8,333 km long European coastline Turkey's is a major tourist attraction. Tourism is also the country's main source of foreign exchange.

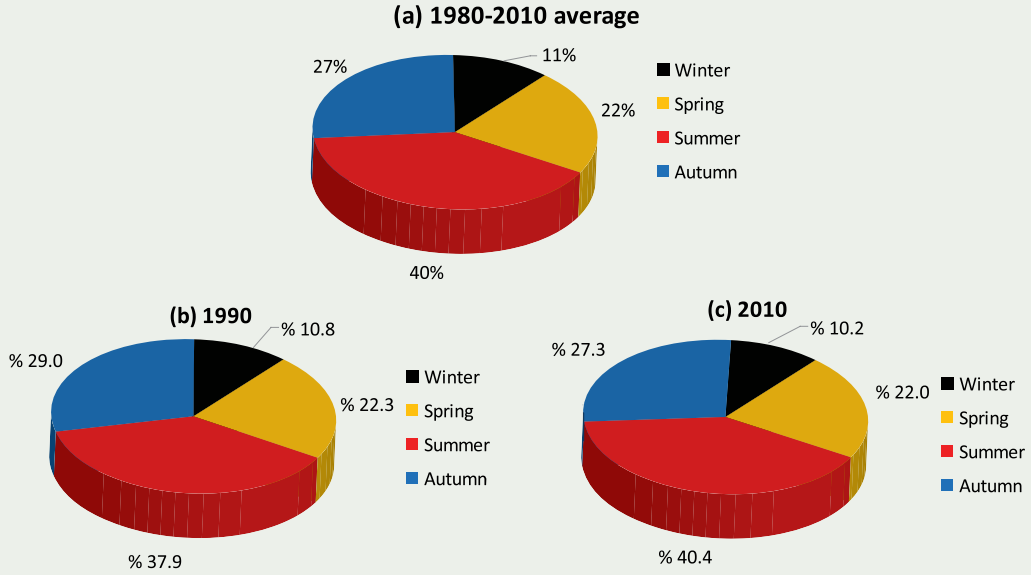
According to the Ministry of Culture and Tourism, there has been a rapid increase in the number of tourists coming to Turkey (Figure 2.25). The annual number of tourists has grown from approximately 5.4 million in 1990 to 10.4 million in 2000, followed by 28.6 million in 2010. This upward trend can be seen across seasons. According to long-term averages approximately 11% of annual tourists visit Turkey in winter, 22% in spring, 27% in fall and 40% in summer.

Figure 2.25. Annual Number of Tourists (1990-2010)



Source: Ministry of Culture and Tourism. 2011. Incoming Tourist Statistics.

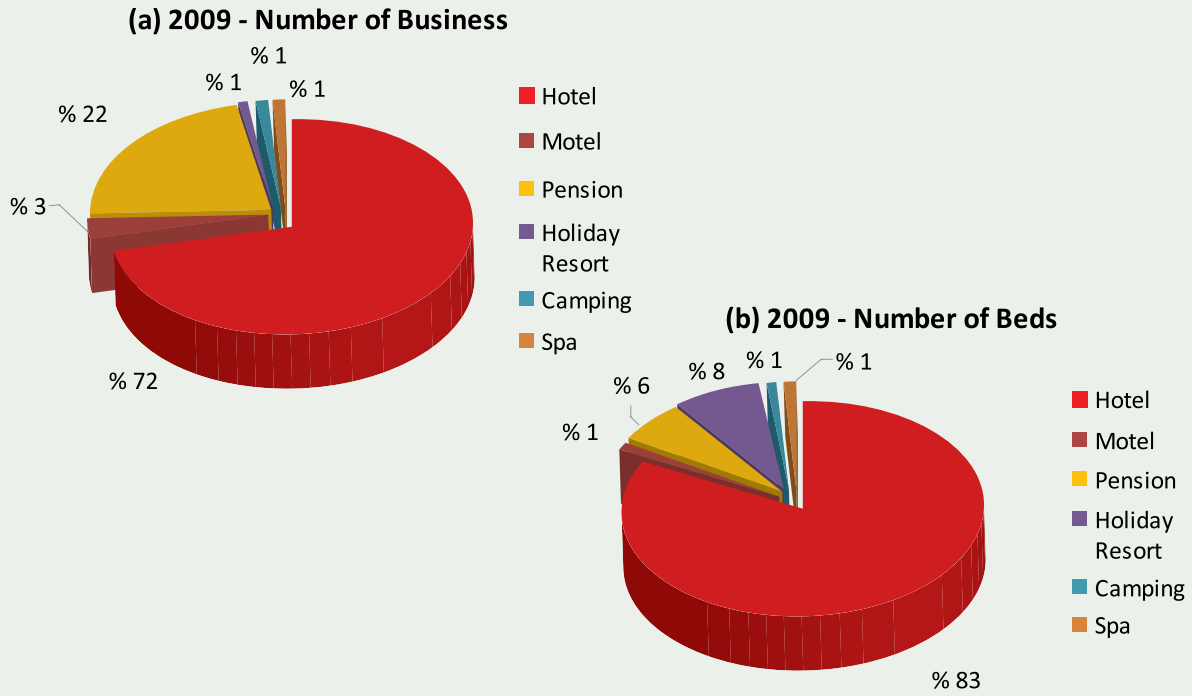
Figure 2.26. Seasonal Distribution of Tourists



Source: Ministry of Culture and Tourism. 2011. Incoming Tourist Statistics.

Bed capacity documented by the Ministry of Culture and Tourism was 568,960 in 2000, and reached 882,450 in 2010. Bed capacity documented by the municipalities grew from 350,000 in 2000 to approximately 527,710 in 2010. The majority of tourism businesses are represented by hotels and hostels (Figure 2.27a) and hotels and hostels make up over 80% of the bed capacity (Figure 2.27b). In 2010, domestic overnight tourism in these accommodations reached approximately 23.8 million person nights; and foreign overnight visits reached approximately 74.3 million person nights.

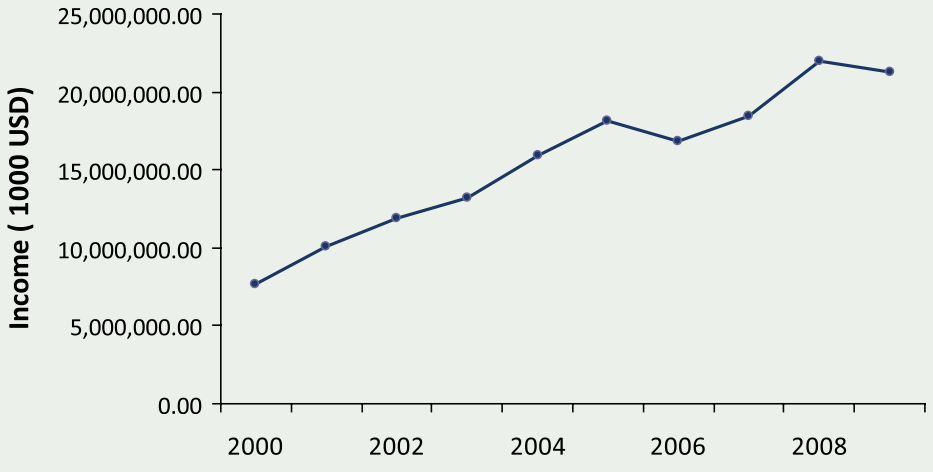
Figure 2.27. Number of the Tourist Accomodations and Bed Numbers (2009)



Source: Ministry of Culture and Tourism. 2011. Statistics of Accommodations Approved by Local Administrations.

The total revenue from the tourism sector increased rapidly in the 1990s. In 2000, tourism revenues were approximately US$7.6 billion, growing to US$18.2 billion in 2005, and US$21.2 billion in 2009 (Figure 2.28).

Figure 2.28 Turkish Tourism Sector Revenue (2000-2009)



Source: Ministry of Culture and Tourism. 2011.

2.14. Water Resources

Rainfall and River Basins

Turkey has a large variety of spatial and temporal precipitation patterns. There is strong seasonality in precipitation. Approximately 40% of the total annual rainfall occurs in winter, 27% in spring, 10% in summer and 24% in autumn. The amount and type of precipitation in the winter and spring seasons are important for replenishing underground and surface water resources. The Black Sea and Mediterranean coastal areas and high mountain areas are the places in Turkey with highest precipitation. The amount of average annual rainfall is highest in the Rize region with rainfall of about 2,300 mm. In contrast, the Central and Eastern Anatolia regions, especially in the lower plains and deep valleys and depressions of tectonic origin, have low precipitation values with the average annual amount of precipitation falling below 350-400 mm.

River hydrological regimes in Turkey depend heavily on the variability of precipitation and these river regimes are thus are quite irregular. According to General Directorate of State Hydraulic Works (SHW), Turkey has 25 hydrological basins. Turkey has a hydro-meteorological observation network of 1,157 flow monitoring stations, 161 snow observation stations and 134 lake observation stations, which are operated by the SHW. However, some responsibilities for observation stations have been transferred among agencies. For example, existing 321 flow observation, 73 snow observation and 48 lake observation stations that were previously under the responsibility of repealed General Directorate of Electrical Power Resources Survey and Development Administration (EIE) been managed by SHW since 2012.

Water Potential and Budget

According to calculations made on the basis of the average long-term annual total precipitation, the amount of average annual precipitation in Turkey is about 643 mm. This corresponds to an average annual flow of 501 billion m^3 of water. Most (274 billion m^3) of this water returns to the atmosphere through evaporation from land and water surfaces and plants, and over 10% (69 billion m^3) feeds the underground aquifers. Almost half (28 billion m^3) of the 69 billion m^3 of groundwater returns to surface water in any given year. An additional 158 billion m^3 of annual precipitation is discharged into lakes, seas, and closed basins. In addition, with an average of 7 billion m^3 of water per year entering Turkey from neighboring countries, gross surface water potential of Turkey reaches 193 (158 + 28 + 7) billion m^3.

When 41 billion m^3 of water feeding groundwater is taken into account, Turkey' total renewable water potential has been determined as a total of 234 billion m^3. The country's consumable surface water potential represents a total of 98 billion m^3 with 95 billion m^3 coming from inland rivers and streams, and 3 billion m^3 from neighboring countries. With the 14 billion m^3 of underground water reserve determined to be accessible (technically and economically feasible to access), Turkey's annual potential for consumable surface and underground water is an average total of 112 billion m^3.

Water Consumption

Turkey is a country that is not rich in freshwater resources. According to the annual per capita water consumption figures, Turkey is a country that experiences water stress. The amount of annual water available per capita is about 1,519 m^3.

Water consumption in Turkey is increasing due to population growth and industrialization. The amount of water used by year for a variety of sectors is given in Table 2.6. According to calculations by the SHW in 2010, only 44 billion m^3 of Turkey's 112 billion m^3 available water potential is used. Current water consumption by sectors is 32 billion m^3 for irrigation (73%), 7 billion m^3 for drinking water (16%), and 5 billion m^3 for industry (11%).

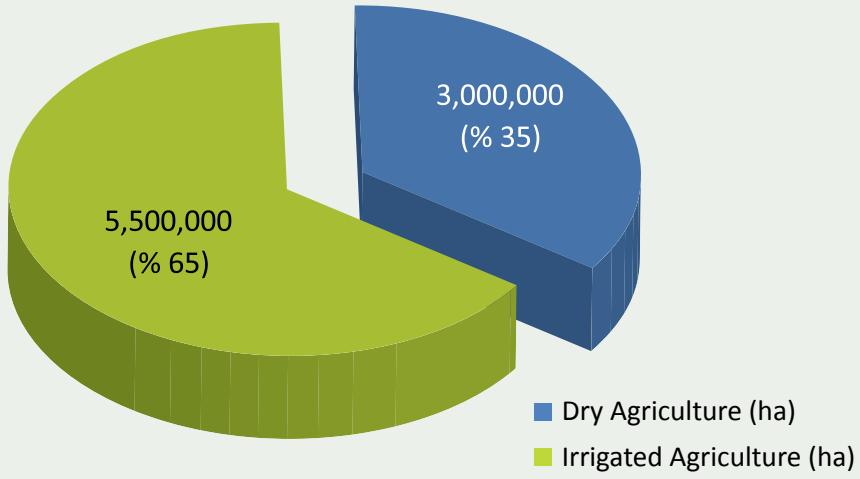
Table 2.6. Sectoral Distribution of Water Consumption (billion m³) and Ratio (%)

Year	Total		Sectors using water					
	Water used		Irrigation		Drinking-use		Industry	
	Consumption	%	Consumption	%	Consumption	%	Consumption	%
1990	30.6	27	22	72	5.1	17	3.4	11
2000	39.3	35	29.3	75	5.8	15	4.2	10
2010	44	39	32	73	7	16	5	11

Source: SHW. April 2011.

In Turkey, a total of 5.5 million out of 8.5 million hectares of land that can be irrigated economically have been brought under irrigation by the end of 2010 (Figure 2.29). The SHW has built modern irrigation networks on 3.21 million hectares of this land. An additional 1.29 million hectares of irrigation has been put into operation by the General Directorate of Rural Services (KHGM) and approximately 1 million hectares of land is irrigated privately by the general population. Future plans include bringing the full 8.5 million hectares of irrigated land by 2023, with 3 million hectares of irrigation being developed by the SHW.

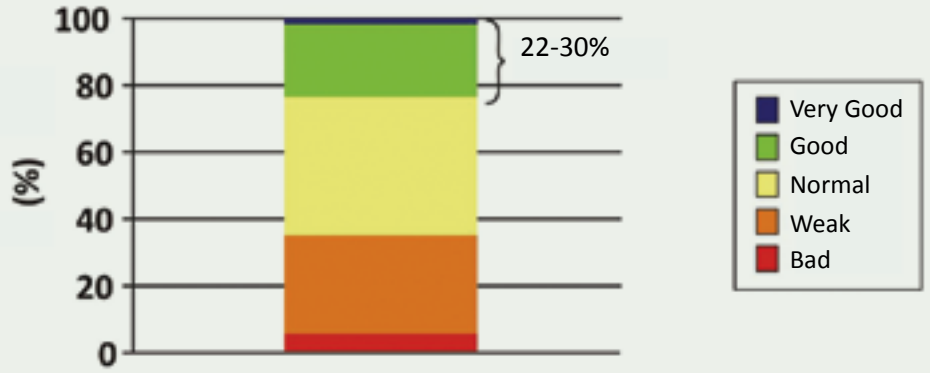
Figure 2.29. Distribution of the Economically Irrigated Areas in Turkey Based on Dry and Irrigated Agriculture (2010)



Source: SHW. May 2010.

Under the Twinning Project completed in 2010 and funded by the Turkey-EU Financial Cooperation Programme, "Capacity Building Support to the Water Sector," Turkey's surface water quality status was estimated, (Figure 2.30) taking human pressure and hydro-morphological characteristics in five river basins. Accordingly, 22-30% of the surface waters (rivers, lakes, transitional waters and coastal waters) of the country have been deemed to meet water quality standards.

Figure 2.30. Estimated Water Quality of Turkish Water Resources (2009)



Source: SHW. Draft Implementation Plan for the Water Framework Directive, 2010.

Turkey's Hydroelectric Potential

Turkey's gross theoretical hydropower potential is 433 billion kWh. However, as it is not possible to use the whole potential with existing technologies, technically feasible potential is about half of this total (at 216 billion kWh). Further limiting potential is the fact that each facility that can technically be constructed may not be economical. Therefore, technical and economic potential is closer to 160 billion kWh/year. Turkey has about 2.3% of the world's economically viable hydropower potential and about 17% of Europe's total potential.

Table 2.7. Comparison of World Hydropower Plant Potential

Continents	Theoretical Potential	Technical Potential	Economical Potential
Americas	13,350	4,377	2,111
Europe	3,489	2,038	937
Asia-Australia	20,058	5,367	2,501
Africa	3,887	2,163	1,416
World	40,784	13,945	6,965
Turkey	433	216	160

Source: UNDP-World Energy Assessment. 2000. Turkey data has been included in the table.

The 15,317 hydropower plants that are in operation of Turkey as of the end of 2010 have an annual production capacity of about 56.1 billion kWh, corresponding to 35% of the national potential. An additional 10,500 MW-powered hydropower plants are currently under construction, further helping Turkey meet the potential for enhanced hydropower development.

2.7. Turkey's Special Circumstances

Turkey, along with being listed in Annex I to the UNFCCC in 2001, is not included in Annex II of the UNFCCC (Decision 26/CP.7) because of its special circumstances recognized at the UNFCCC Seventh Conference of the Parties in Marrakech, Morocco in 2001. Turkey became Party to the Kyoto Protocol in 2009.

Turkey, on the basis of GDP per capita, has a relatively low level of welfare when compared with the UNFCCC Annex I Countries that have greenhouse gas emission reduction targets. It also has a low GDP in comparison to many non-Annex I countries that have fast-growing economies (Table 2.8). Though Turkey's population growth rate has declined in recent years it is still higher than all other Annex I countries. This situation is causing a gradual increase in pressures on natural resources, and can be linked to climate change. There is need in Turkey for greater resources to address environmental issues. As a result of the rapid increase in the rate of urban population in Turkey in proportion to the population in rural areas; greenhouse gas emissions are increasing. This can be attributed to activities related to addressing increasing urban needs for housing, drinking water, wastewater services, solid waste services, infrastructure services, urban and intercity transportation, affordable heating, electrification and agricultural production (Section 3). Considering the principle of historical responsibility, when the cumulative emissions are analyzed, it is seen that 76% of human-induced greenhouse gas emissions have originated from developed countries, and 24% have originated from developing countries, including Turkey. Turkey's contribution to this 24% share is 0.4%.

Table 2.8 Energy and Energy-Related Greenhouse Gas Emissions for 2010

Region/ Country	Population (million)	GDP (billion, 2000 US$)	GDP (PPP) (billion 2000 US$)	Energy Generation (million TOE)	Net foreign-purchase (million TOE)	TBET (million TOE)	Electric Consumption (TW hour)	CO_2 emissions (Mt CO_2)
World	6,688	40,482	63,866	12,369	-	12,267	18,603	29,381
OECD	1,190	30,504	32,868	3,864	1,765	5,422	10,097	12,630
Middle East	199	945	1,630	1,605	-975	594	672	1,492
Former USSR	285	653	2,564	1,691	-616	1,038	1,326	2,426
Europe Excluding OECD	53	189	555	64	48	107	180	269
PRC	1,333	2,844	11,054	1,993	210	2,131	3,293	6,550
Asia	2,183	2,417	8,760	1,263	205	1,410	1,570	3,023
Latin America	462	2,053	3,937	728	-133	575	904	1,068
Africa	984	876	2,499	1,161	-487	655	562	890
Mexico	106.6	769.3	1,192.6	233.6	-47.2	180.6	214.8	408.3
Korean Republic	48	750	1,139	44	195	227	430	501
Spain	45	740	1,095	30	123	138	287	317
Republic of Turkey	71	376	831	29	72	98	170	263

Source: IEA. 2010. Key World Energy Statistics. Paris.

* There might be differences between the socio-economic indicators in the table and the indicators calculated by Turkey using its own data.

In terms of industrialization, Turkey is not comparable with the Organization for Economic Co-Operation and Development (OECD) countries, many of UNFCCC Annex I countries and some non-Annex I countries. In the "human development index," Turkey ranks 92 out of 187 countries, below many OECD and Annex I countries.[10]

In terms of energy indicators, total primary energy consumption per capita of Turkey is lower than all Annex I countries and is lower than the non-Annex I countries with rapidly developing economies, such as the Republic of Korea, Israel, Argentina, Brazil and Mexico. In the last decade, Turkey's use of renewable energy sources has doubled. Although total electricity production has tripled, energy density in electricity production increased by 7%, carbon intensity has decreased by 11% over this period. For example, based on the energy indicators of the International Energy Agency (IEA) in 2008, the world average per capita primary energy consumption is 1.83 TOE, while the OECD average is 4.56 TOE. Turkey's TOE is 1.39, under both the world and OECD averages.

Turkey has lower per capita greenhouse gas emissions than all Annex-I countries, and many non-Annex-I countries, like Mexico, Brazil, and Argentina, the Republic of Korea which have rapidly developing economies that are very similar to Turkey. Among OECD and the UNFCCC Annex I countries, Turkey has the lowest historical responsibility for greenhouse gas emissions per capita and per capita primary energy consumption. In 2009, average per capita greenhouse gas emissions in Turkey were 3.7 tonnes of CO_2 eq. During the same period, per capita emissions in OECD countries averaged of 10.6 tonnes of CO_2 eq; non-OECD European countries averaged 5.1 tonnes of CO_2 eq; and the world average was 4.4 tonnes of CO_2 eq.

The total amount of greenhouse gas emissions (excluding land-use change and forestry) in Turkey in 1990 were approximately 187 million tonnes of CO_2 eq, and the value rose to approximately 370 million tonnes of CO_2 eq in 2009. CO_2 sinks in Turkey stored about 44 million tonnes of CO_2 eq greenhouse gas emissions in 1990 and this value increased to 82 million tonnes CO_2 eq in 2009.

Over recent years, the transportation sector has engaged in important reforms with the potential to reduce emissions, such as: improving the quality of fuel used in vehicles; introducing biofuels; incentivizing vehicles with fuel efficient engines; removing older vehicles from circulation; increasing access to public transportation in big cities through expansion of metro and light rail systems; initiating the Strait Tunnel Project Marmaray linking the European and Asian sides of the Bosphorus; increasing and improving the railway network. Studies have been initiated in the industrial sector to move towards higher quality fuels and alternative fuels particularly in the cement and iron and steel industries to increase energy efficiency. For the waste sector, activities are being scaled up to reduce waste, increase recycling, better manage landfills, and use methane gas for energy production. In addition, contributing to forest carbon sink, Turkey launched the National Deforestation Campaign from 2008-2012 to realize the goal of planting 2.3 million hectares of forest.

Turkey has increased its carbon storage capacity in land through these and other activities. In addition, concurrent adaptation efforts are underway to combat drought and desertification. To further realize this goal of avoiding the adverse effects of climate change, Turkey is prioritizing the development of a new management model for urban and rural areas that is energy-efficient, climate resilient and productive. responsive growth. It will be also beneficial to ensure the use of local materials, and developing urban planning that considers local /regional geographical and climatologic characteristics.

Turkey is considered to be among a highly vulnerable group of countries due to the adverse effects of climate change in the Mediterranean Basin, and considering Turkey's arid and coastal regions. Many of Turkey's ecosystems are vulnerable to climate change impacts, particularly the unique wetlands, steppes, and mountain ecosystems. In this context, harmonization of national efforts on climate change adaptation is needed. It is crucial that Turkey benefit from international financing mechanisms so that it can play a more active role in combating climate change. This requires acceptance that Turkey has different circumstances than other Annex I countries.

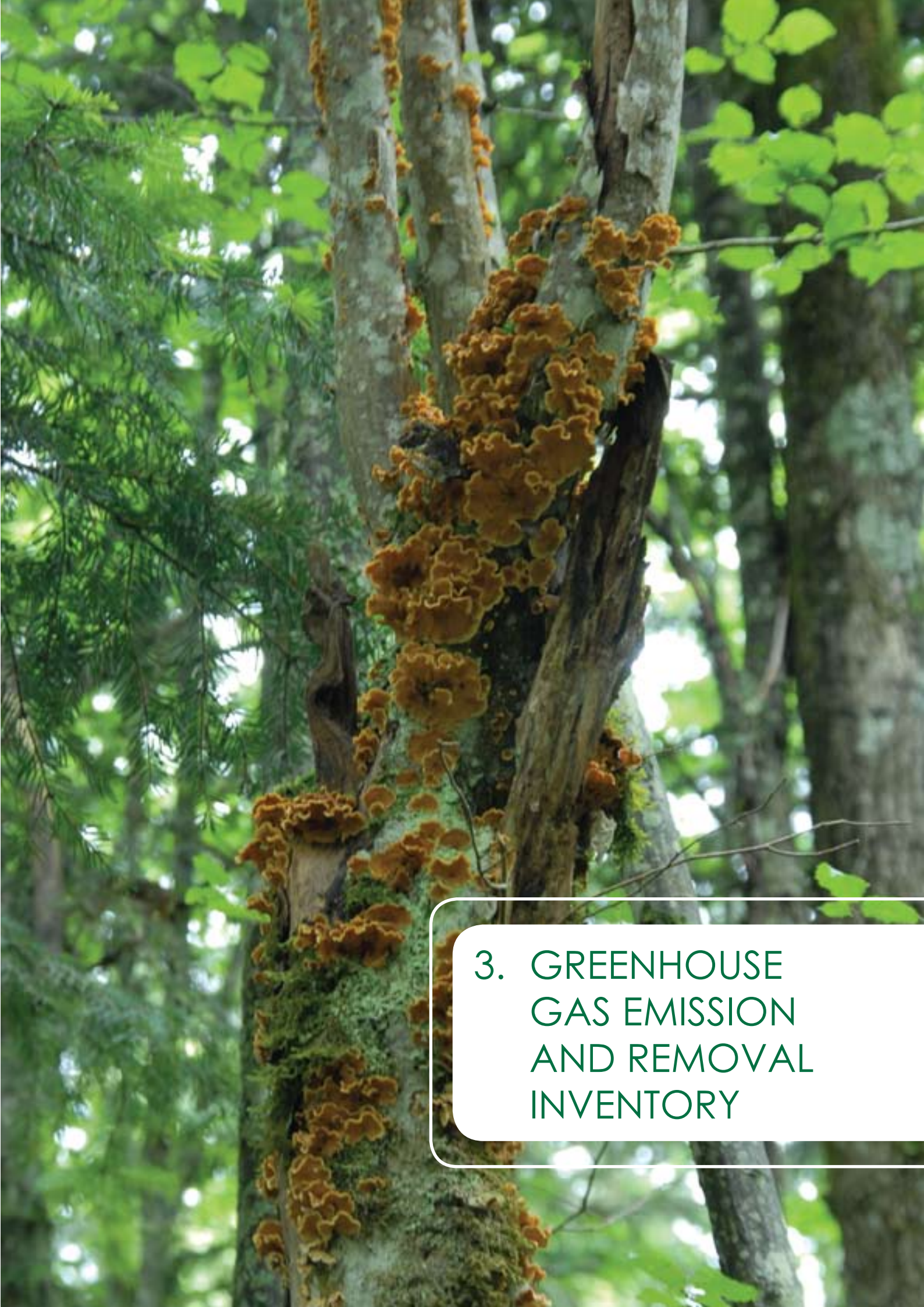
[10] UNDP. 2011. Human Development Report 2011.

The Republic of Turkey is not subject to any emission reduction targets for the reduction of greenhouse gas emissions under the Kyoto Protocol. However, comprehensive studies in all sectors has begun and the necessary legislative efforts, related to environmental law, energy efficiency, renewable energy and their sub-regulations have begun to come into force. As a result of the policies and actions taken starting with the most important GHG producing sectors, such as energy, transport, industry, waste and land use and forestry sectors 2009 CO_2 eq greenhouse gas emissions stood at 369.6 million tonnes. Approximately 82.5 million tonnes of this value is removed by LULUCF in 2009 (Chapter 3).

In the light of the above, in the decision 26/CP.7 at the UNFCCC 7th Conference of the Parties held in Marrakesh in 2001 "Turkey's name be deleted from the list of Annex II and Annex-I countries with different conditions being invited to the recognition that", and with reference to the Cancun Agreements which is one of the outputs of the Conference in Cancun held the end of 2010 the 1/CP.16, Turkey has been noted and recognized to be under different conditions than the other Annex I countries. In addition, Turkey has been noted not to have any obligation to provide finance and technology assistance and it is understood that Turkey is eligible to benefit from financial support. Also, the judgment is given to continue to work to make the decision 26/CP.7 more operational.

On the other hand, among the decisions related to Turkey of the Conference held in Durban at the end "Conference of the Parties; Turkey being in a position different from the position in the list of Annex I of the UNFCCC countries is recognized recalling decisions 26/CP.7 and 1/CP.16 No., the Parties with recognized original conditions by Conference of the Parties of the UNFCCC to help the implementation of mitigation, adaptation, technology development and transfer, capacity-building and financing the procedures for the provision of support to continue the discussion reaches an agreement "has been decided.

Thus, Turkey will continue negotiating to gain support for mitigation, adaptation, technology development and transfer, capacity building and financing within the scope of the UNFCCC.



3. GREENHOUSE GAS EMISSION AND REMOVAL INVENTORY

3. GREENHOUSE GAS EMISSION AND REMOVAL INVENTORY

3.1 Total Emissions and Removal of Greenhouse Gases[1]

Total greenhouse gas emissions (GHG) in Turkey, calculated as (CO_2 eq), were 369.65 million tonnes in 2009 (excluding Land Use Land Use Change and Forestry- LULUCF). Over 75.3% of total emissions originated from the energy sector, 9.2% from the waste sector, 8.6% from industrial processes and 7% from the agricultural sector. Fossil fuel combustion accounts for the majority of emissions in the energy sector. The share of the emissions originating from fuel combustion are as follows; fuel combustion to generate energy accounted for 36.94%, buildings and services accounted for 20.39%, manufacturing accounted for 19.91%, transport accounted for 17.04% and agriculture 5% of emissions in energy sector.

Between 2000 and 2009, GDP increased by approximately 34% whereas for the same period greenhouse gas emissions increased by 24.5%. This indicates a positive progress on decoupling economic growth from GHG emissions. GHG emissions between 1990 and 2009 rose in all years except 1994, 1999, 2001 and 2008 (Figure 3.1). Per capita GHG emissions (excluding LULUCF) have increased from 3.39 tonnes CO_2 eq in 1990 to 5.13 tonnes CO_2 eq in 2009. However, this value is still far below the OECD average of 9.83 tonnes CO_2 eq per capita, and close to the world average of 4.29 tonnes CO_2 eq per capita.[2]

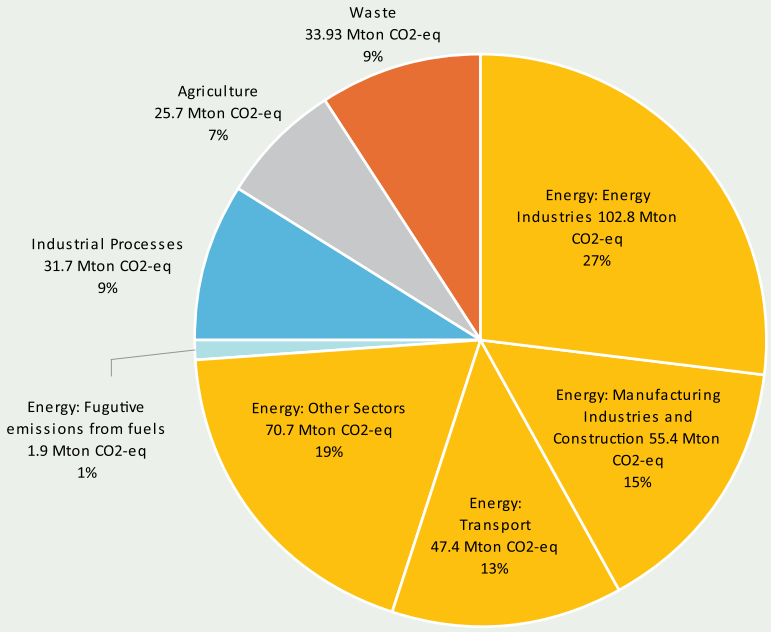
Turkey's LULUCF sink value reached 82.53 million tonnes CO_2 eq in 2009 representing an 84% increase from 1990 values. Although the LULUCF values vary among years, there is an increasing trend. Turkey's total GHG emissions, including LULUCF, were 287.12 million tonnes CO_2 eq in 2009.

Although there are yearly variations in emissions, Turkey has experienced an increase in emissions in all sectors except the agriculture sector (Figure 3.2). Between 1990 and 2009, the highest increase of emissions was observed in the waste sector with a 250% increase. During this time agriculture emissions decreased by 14%. Emission increases in other sectors have been in the range of 84% to 111%.

1 During the preparation of this National Communication, 2012 National Inventory (that includes 1990-2010 emission inventory data) had not been reviewed by the UNFCCC Secretary. Therefore, 2011 National Inventory data (that includes 1990-2009 data) that was reviewed by the UNFCCC was presented in this National Communication. Summary Tables of the 2011 National Inventory Report are provided in Annex A of this National Communication.

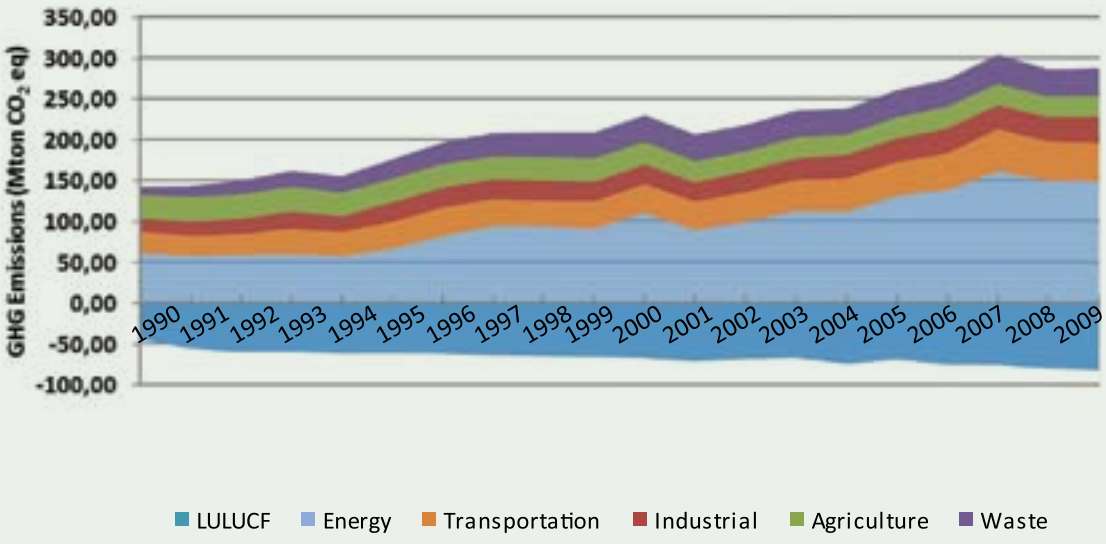
2 IEA, 2011. EIA, CO_2 Emissions from Coal Combustion Highlights, 2011.

Figure 3.1 Total Greenhouse Gas Emissions in 2009



Contribution of each main sector together with energy sub-sectors to total GHG emissions is shown in the graph.

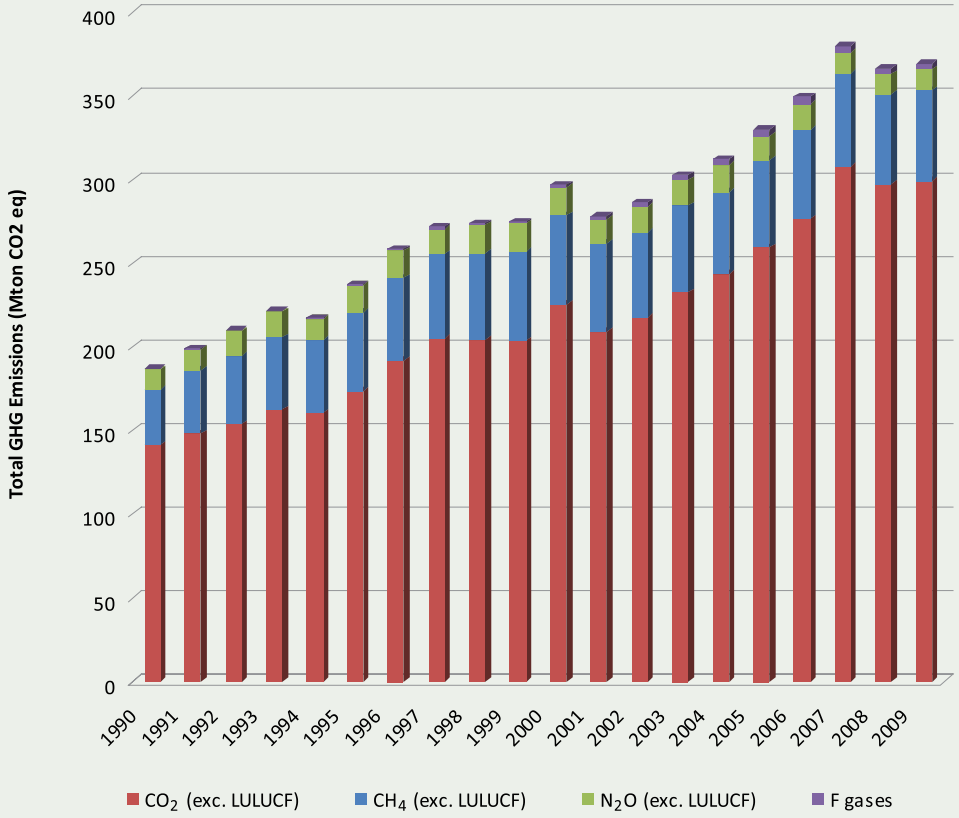
Figure 3.2 Sectoral Greenhouse Gas Emissions, 1990-2009



Emissions by Greenhouse Gas Type

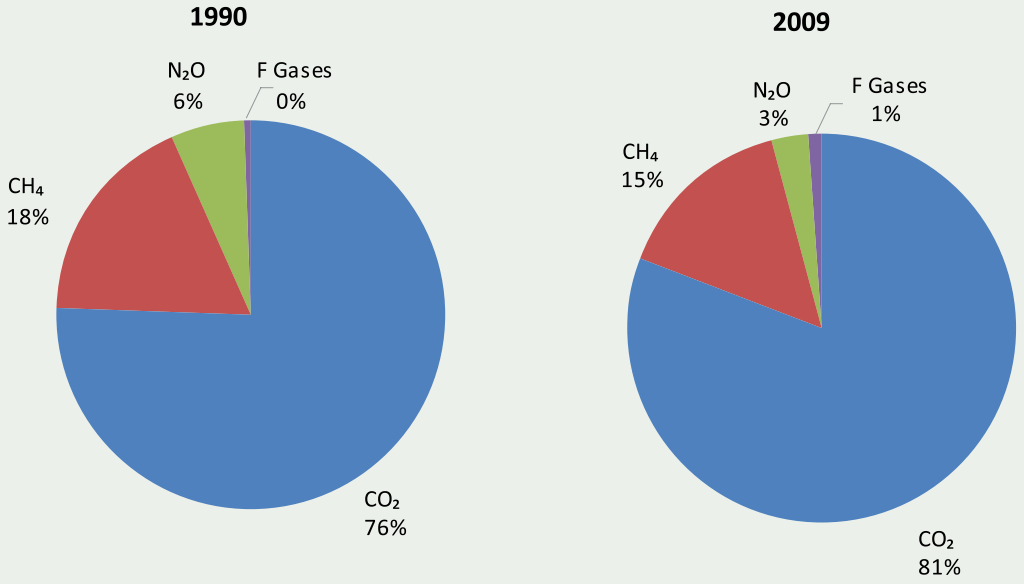
Between 1990 and 2009 most of Turkey's emissions were carbon dioxide (CO_2), followed by methane (CH_4), nitrous oxide (N_2O) and F-gases. All types of GHG emissions increased over this time period, except N_2O which has shown a declining trend since 2000 (Figure 3.3). Contributions of individual greenhouse gases to 2009 emissions were as follows: CO_2 emissions were 299.11 million tonnes CO_2 eq (80.92%); CH_4 emissions were 54.37million tonnes CO_2 eq (14.71%); N_2O emissions were 12.53 million ton CO_2 eq (3.39%); and F-gases emissions were 3.64 million tonnes CO_2 eq (0.99 %).

Figure 3.3 1990-2009 Share of Total Emissions According to Greenhouse Gas Types



From 1990 to 2009, CO_2 emissions' share within total emissions increased from 76% to 81%, methane emissions have decreased from 18% to 15%, the share of nitrous oxide emissions decreased from 6% to 3% and F-gases share increased from 0.4% to 1% in the same period (Figure 3.4).

Figure 3.4 Shares of Emissions by Greenhouse Gas Type within Total Emissions in 1990 and 2009



Factors Underlying Emission Trends

Over the past two decades, Turkey's population has increased by a factor of 1.3, GDP has increased by a factor of 2, and the electricity consumption per capita has increased by a factor of 2.7. The annual population growth rate of Turkey was 1.31% in 2009, well above that of the OECD countries average (0.68%). Among these countries, Turkey has the fourth highest population growth rate. However, primary energy supply per capita and greenhouse gas emissions per capita values are about one third of the OECD average, and Turkey's energy intensity is 25% less than the OECD average (Table 3.1).

Between 2000 and 2009, GDP increased by 33.9% whereas total GHG emissions increased by 24.5%. This indicates that economic growth has been based on activities emitting lower GHG emissions. The energy intensity of the economy decreased by 4.4% between 2000 and 2009. Within the same period the carbon intensity of the economy decreased by only 5.9%, and carbon intensity of energy supply decreased by 0.2%. This indicates that there are still actions that can be taken to reduce GHG emissions from energy sector. On the other hand, the increase of GHG sinks by 83.9% between 1990 and 2009 has been a very important development.

GHG emissions of Turkey demonstrated an increasing trend between 1990 and 2009 except for the years of economic crisis (Figure 3.2). In 2009, GHG emissions from the energy sector decreased by 4% compared to emissions in 2007, when the highest energy emissions were reported.

Table 3.1 Socio-economic, Energy and Carbon Indicators of Turkey (1990- 2009)

Type	Indicator	1990	2000	2009	1990-2009 (% change)	2000-2009 (% change)	OECD countries 2009
SOCIO-ECONOMIC	GDP (PPP+, billion US$)	411.10	589.20	789.10	91.95	33.93	32,114
	Population (million people)	55.10	64.30	71.90	30.49	11.82	1,225
	Per capita GDP (1000 US$)	7.46	9.16	10.97	47.10	19.77	26.22
ENERGY	Total Primary Energy Supply (MTOE)	52.80	76.30	97.70	85.04	28.05	5,238
	Per Capita Primary Energy Supply (TOE/person)	0.96	1.19	1.36	41.80	14.51	4.28
	Energy Intensity of the Economy (TOE/1000 US$, the year 2000 prices-PPP)	0.13	0.13	0.12	-3.60	-4.39	0.16
CARBON	Total GHG emissions (Mton CO_2 eq)	187.03	297.00	369.65	97.64	24.46	
	CO_2 emissions from fuel combustion (Mton CO_2 eq)	126.90	200.60	256.30	101.97	27.77	12,045.00
	Total Removal (Mton CO_2 eq)	44.87	67.56	82.53	83.93	22.16	
	Per Capita GHG emissions (ton CO_2 eq/person)	3.39	4.62	5.14	51.46	11.31	
	Per Capita GHG emissions from the combustion (ton CO_2 eq/person)	2.30	3.12	3.57	55.01	14.43	9.83
	Carbon Intensity of Economy (ton CO_2 eq/2000 US$)	0.31	0.34	0.32	3.23	-5.88	0.38
	Energy Intensity of Energy Supply (ton CO_2 eq/TOE)	2.40	2.63	2.62	9.15	-0.22	2.30

+ dominated 1000 (thousand) US $purchasing power parity (PPP) with prices of 2000
*Figures from 2009 (source: International Energy Agency, 2011)
The data used in this table were taken from International Energy Agency to be comparable with other countries. As a result, it may differ from nationally reported data

3.2 Change in GHG Emissions and Removals by Sector

3.2.1 Energy

The energy sector is the main source of Turkey's greenhouse gas emissions. Fuel combustion for electricity generation and industrial production is the main source of energy emissions. In 2009, emissions from the energy sector were 278.33 million tonnes of CO_2 eq (excluding LULUCF), accounting for 75.3% of total national GHG emissions. Among the sub-sectors of energy, energy industries contributes the highest share (36.94%), followed by other sectos (25.39%), the manufacturing industries and construction (19.91%), and the transport sector (17.04%) (table 3.2).

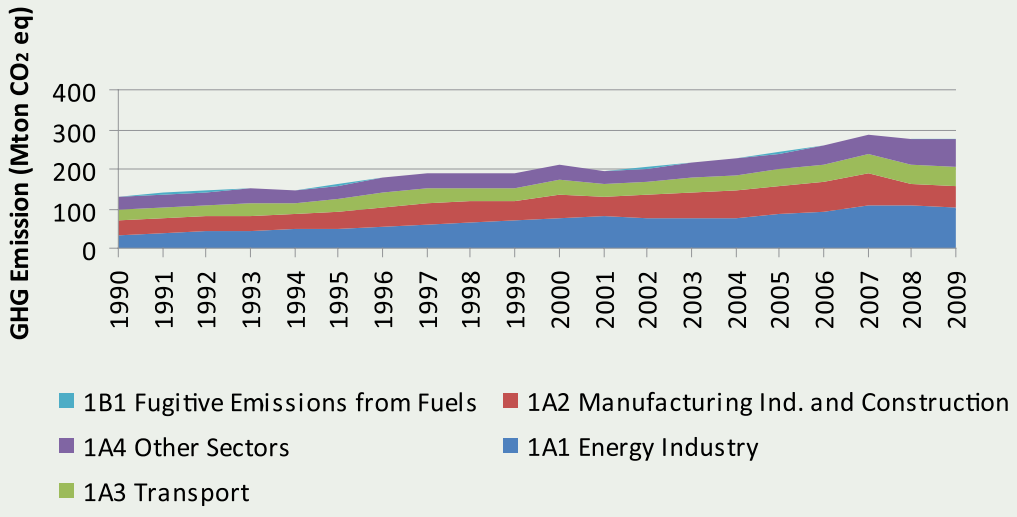
Table 3.2 GHG Emissions and Shares for Energy Sub-sectors (2009)

Energy sub sectors	GHG Emissions (Gg CO_2 eq)	Share within total Energy Emissions (%)	Share within Total Emissions (%)
A. Fuel Combustion (Sectoral approach)	276,332.01	99.28	74.76
1. Energy Industries	102,819.24	36.94	27.82
2. Manufacturing Industries and Construction	55,403.75	19.91	14.99
3. Transport	47,439.72	17.04	12.83
4. Other Sectors	70,669.30	25.39	19.12
5. Others	NA, NO		
B. Fugitive Emissions from Fuels	1,998.83	0.72	0.54
1. Solid Fuels	1,998.83	0.72	0.54
2. Oil and Natural Gas	NA, NO*		
Energy Sector Total	**278,330.84**	**100**	**75.30**

NA: Not available; NO: Not observed

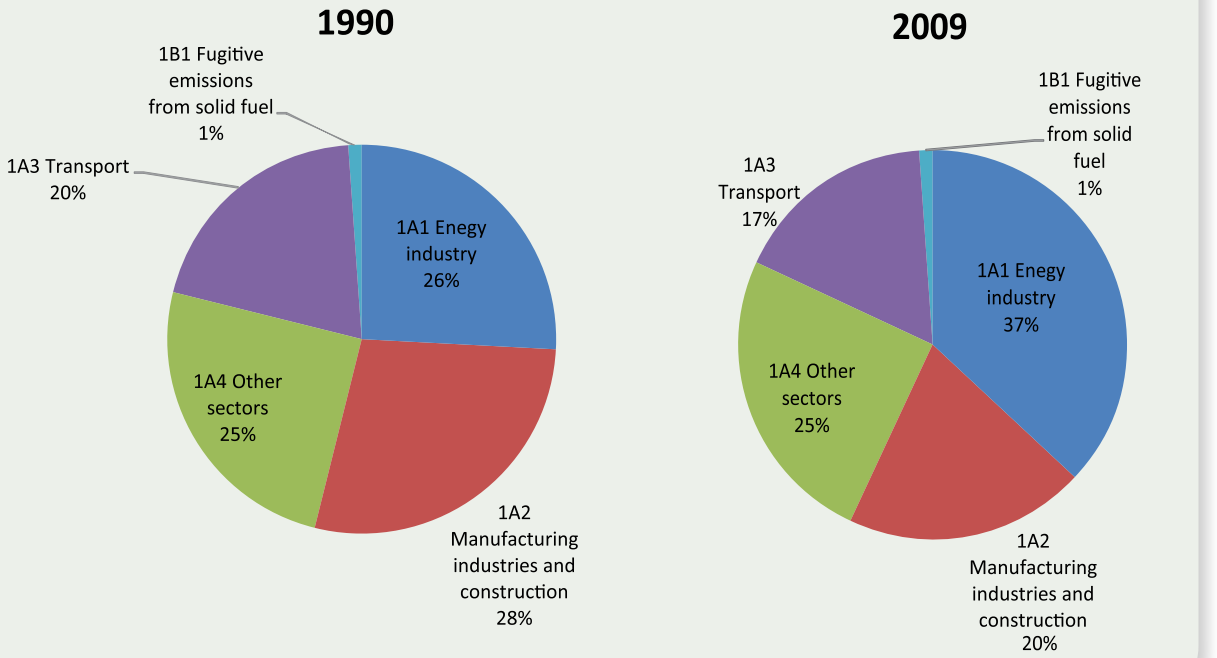
In 2009, there was a 110.65% increase in GHG emissions from energy sector compared to 1990 values. During the economic crises in 2001 and 2008, annual GHG emissions reduced by 7.8% and 3.8% compared to the previous year, respectively.

Figure 3.5 Energy Sector CO_2 eq Emissions between 1990 and 2009



In 2009, emissions from 1A1 industrial energy contributed to the highest share of emissions from the energy sector (37%) whereas, in 1990 1A2 manufacturing industries and construction contributed to the highest share of the energy sector (28%) (Figure 3.6).

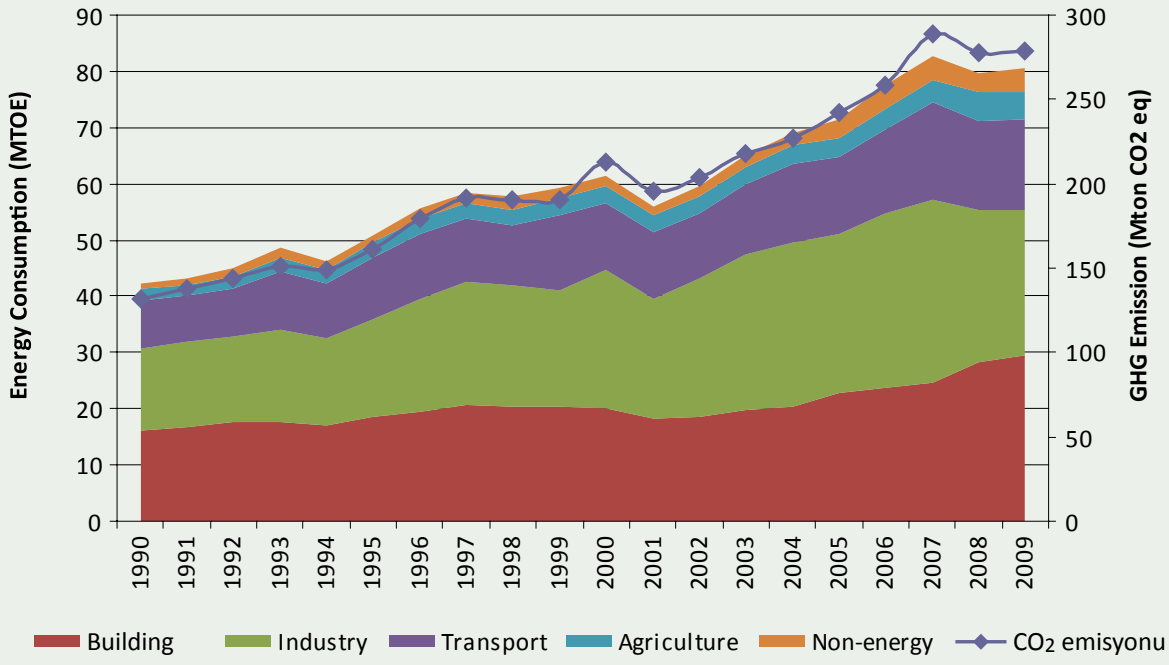
Figure 3.6 Sectoral Distribution of GHG Emissions in the Energy Sector in 1990 and 2009



Energy industries emissions have an annual average increase of 3.8 Mton CO_2 eq and represent 36.6% of energy sector total emissions. It has represented the most rapid increase over time. Electricity and heat production facilities within 1A1 energy industries sector represent a 35% share of CO_2 eq emissions, however emissions from petroleum refineries in this sector only represent 2% of the sector emissions. 1A1 Energy industries have had the highest rate of increase in emissions between 1990 and 2009, at 201.4%. One of the reasons for this is attributable to the decrease in the share of electricity production from hydroelectric power plants from 40% to 18%. In 1990, natural gas contributed to 18% of electricity generation, which grew to 49% in 2009, becoming the main energy source. Over the time period, coal use in power generation has fallen from 35% to 28%. In sum, the total contribution of fossil fuels to electricity generation has increased continuously since 1990, reaching 80% in 2009.

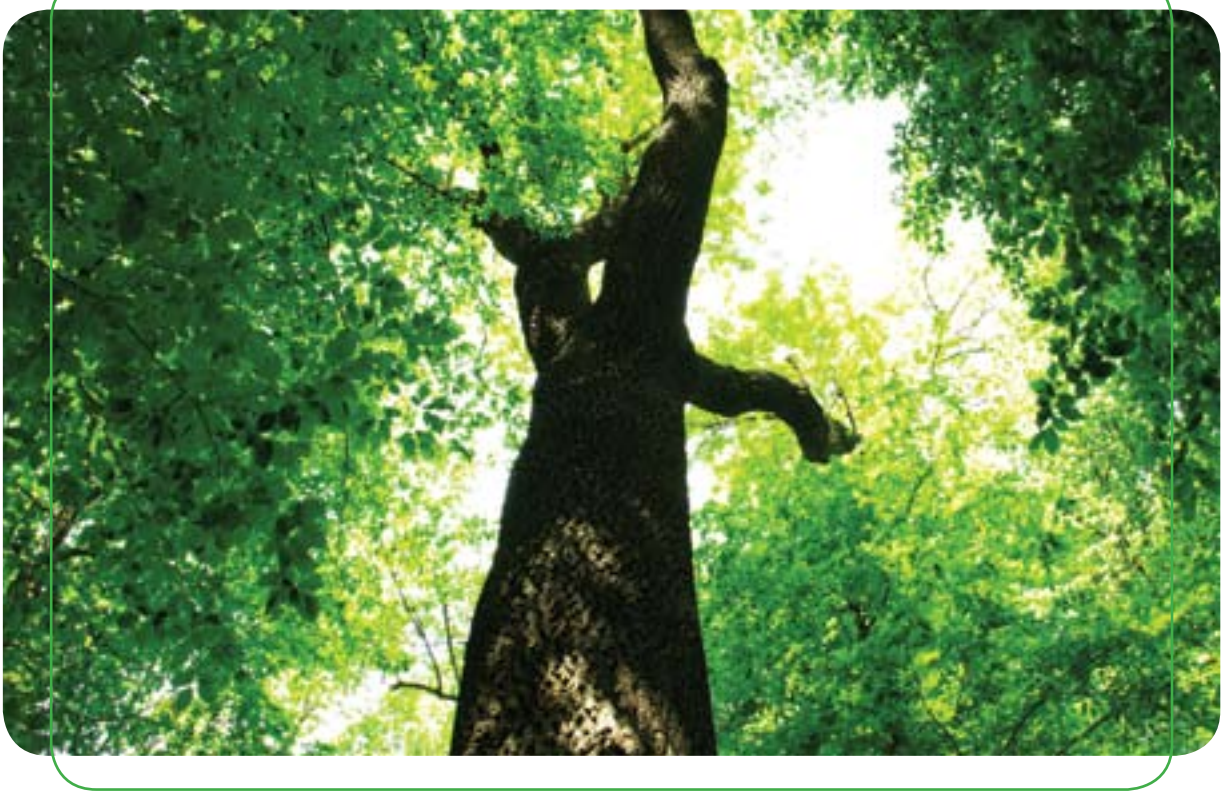
The data on energy consumption (fuel combustion) are taken from the Energy Balance Tables. Accordingly, trends in total emissions are parallel to total energy consumption (Figure 3.7).

Figure 3.7 GHG Emissions (CO_2 eq) and Energy Consumption (1990-2009)



Source: NIR, 2009.

When considering emissions according to GHG gas type; 97.4% of energy emissions in 2009 are made of CO_2 followed by methane (2.1%) and N_2O (0.5%).



Energy Industries

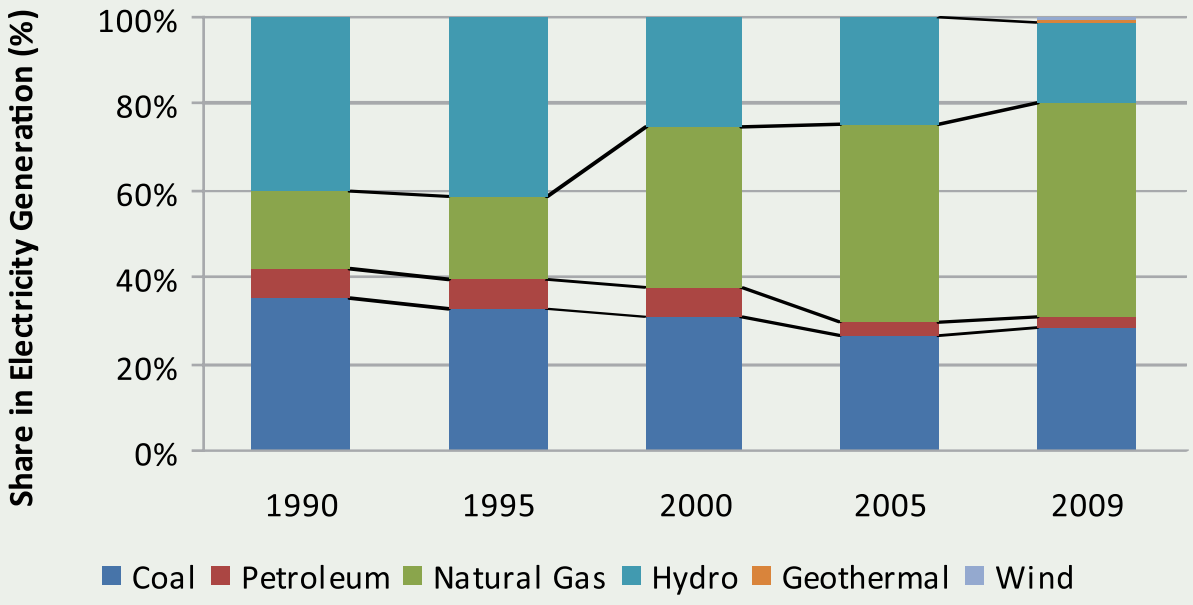
The energy Industries (1A1) sub-sector includes fuel combustion emissions from electricity generation facilities, petroleum refineries, and hard coal production facilities. Energy industries emissions originated primarily (94%) from electricity and heat production, and 6% from petroleum refineries in 2009.

Although, a reduction in emissions was observed in 2007, 2008 and 2009, the average annual increase of emissions from the energy industry was approximately 3.8 Mton CO_2 eq between 1990-2009. It is the sector with the highest rate of increase of emissions, 201.1%, over this time period. The most important reason for the observed increase in electricity production has been increasing energy supply. Total primary energy supply increased by 100.31% from 1990 to 2009, reaching 106.14 MTOE[3]. Total electricity production during this period increased by 238.5%.

In 1990 Turkey's electricity demands were met mainly by thermal and hydroelectric sources. In recent years renewable energy use has increased. The installed capacity of renewable energy in 1990 was 16,318 MW. It grew to 38,844 MW in the year 2005 and 44,761 MW in the year 2009.

In the last 10 years, there has been a rapid growth in electricity generation, and the capacity of power plants has increased steadily. In 1990 60% of electricity supply was provided by fossil fuels (18% natural gas, 35% coal and lignite, 7% fuel oil) and the remaining 40% was provided by hydroelectric power sources. In the period of review, while the share of coal in electricity generation has come down to 29% from 35%, natural gas has increased from 18% to 49%.

Figure 3.8 Share of Sources in Electricity Generation



Source: NIR, 2009

[3] MENR. 2011. Energy Balance Table for the year 2009.

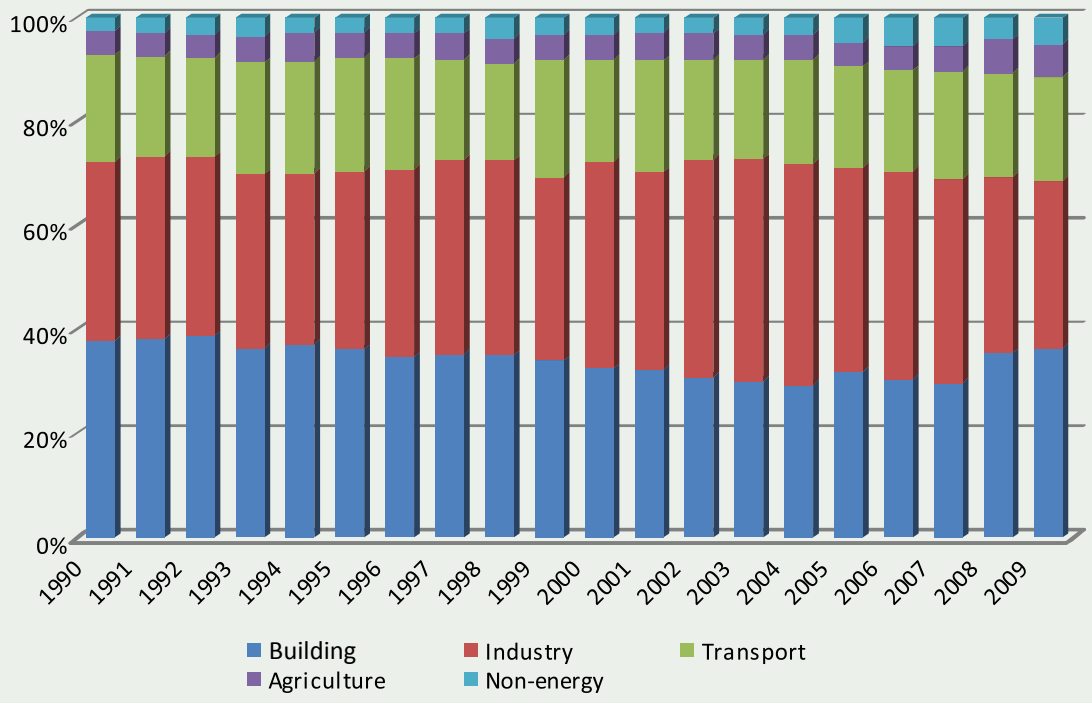
Manufacturing Industry

The manufacturing industries and construction sub-sector (1A2) accounted 19.9% of total energy emissions. Within this sector, the iron and steel industries contribute to 23% of emissions, the cement sector contributes 28% and the rest of the 49% originates from the sugar, fertilizer and other industries.

The observed annual increase in greenhouse gas emissions by the manufacturing industry sector from 1990-2009 was approximately 1.78 Mton CO_2 eq per year which corresponds to a 47% increase during this period. During the periods of economic crisis in 1994, 2001 and 2008, the most significant emission reductions were observed in the sector (See Figure 3.5).

According to the MENR data for 2009, contribution of industrial facilities to energy consumption was 32% (Figure 3.9). In Turkey, for many years the largest proportion of final electricity consumption was in the industrial sector. Due to the reduction of production during the economic crisis, electricity consumption decreased in 2009 in 3% and 7% compared to 1990 and 2005, respectively.

Figure 3.9 Contributions of Sectors in Energy Consumption (MENR, 2011)



Transport

The amount of total greenhouse gas emissions from the transport sector (1A3) was 47.4 Mton CO_2 eq. The contribution of transport sector GHG emissions within the energy sector is 17.04% and its share in national total GHG emissions is 12.83%. Within whole energy sector, the transport sector is the main emission source of N_2O, NOX, CO and NMVOC gases.

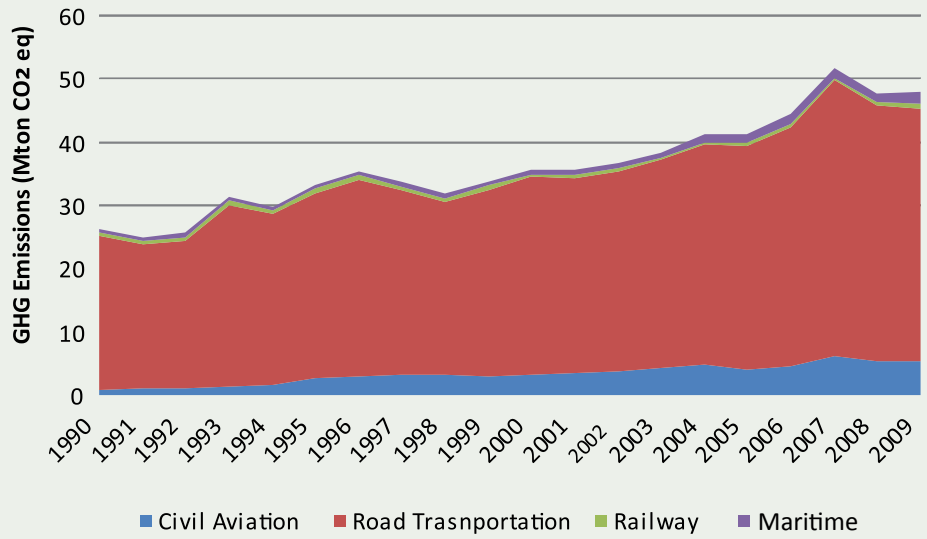
Road transport is the primary greenhouse gas emissions source with 85% of the emission of the sector (Figure 3.10). Road transport contributed to 93% of transport emissions of CO_2 eq in 1990, decreasing to 85% in 2009. Over the same period aviation emissions increased from 3% to 11%.

Greenhouse gas emissions from the transport sector in Turkey have increased by 80.47% from 1990-2009. The average annual increase in the transportation sector, at 1.2 Mton CO_2 eq, was lower than the observed trend in energy and manufacturing industry (3.8 and 1.8 Mton CO_2 eq, respectively). The main reasons for this was new vehicle and engine technologies, the slight increase in the use of alternative fuels, and the encouragement of withdrawal of vehicles from prior to 1985, based on notifications number 62 and 63 from the General Directorate of Land Transport in 2003 and 2009. In 2003-2004 with the joint efforts of the Ministry of Transportation, Maritime Affairs and Communications and the General Directorate of Security, 320,000 old vehicles were withdrawn from the market by providing tax incentives. This resulted in a 4.87% reduction in the CO_2 emissions from transport sector (data from the MTMAC).

Variations of fuel consumption by road vehicle fuel type between 1990 and 2009 are given in Figure 3.11. The use of gasoline increased in the period 1990-1996, and started to decline after 1999. This decline could be attributed to reduction in the use of petrol as a result of a rise in gasoline prices, widespread public transport systems, use of vehicles with lower fuel consumption and smaller engines. Generally there has been an increasing trend in the use of diesel fuel although it has not been continuous. Fluctuations in the use of diesel fuel correspond to periods of economic crises. Increasing fuel prices since 2000 initiated the use of LPG vehicles, and in 2009 LPG consumption rate reached 37%[4].

From 1990-2009, greenhouse gas emissions from rail transport do not show a significant trend and emission levels are very low. Rail network development increased rapidly according to government policy until 1946, and then it entered a steady stage which lasted until 2003. After 2003, as a result of a restructuring of the transportation system and privatization, a new era has begun in the sector.

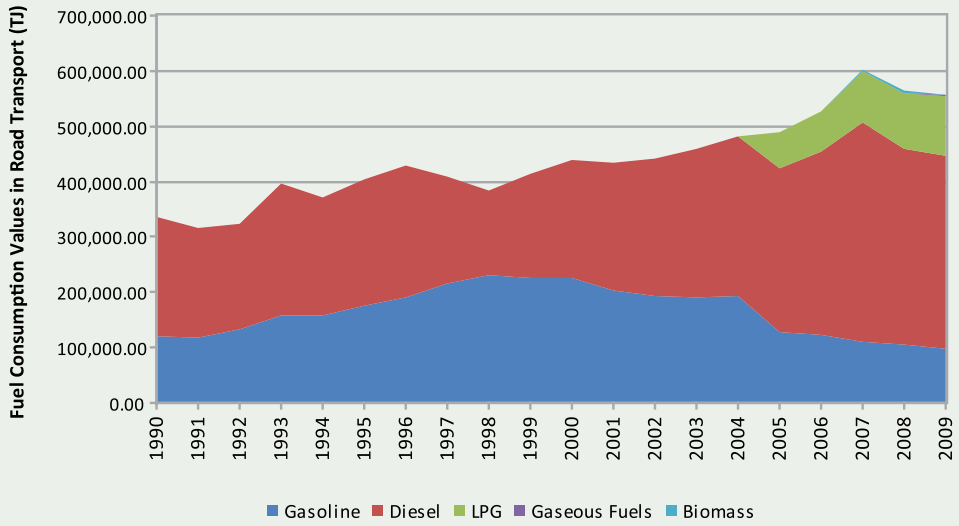
Figure 3.10 Contributions of Sub-sectors to Transport Related GHG Emissions (1990-2009)



4 TurkSTAT, 2011.

During this period, a large part of the 11,000km of railways has been renovated; high-speed train lines between Ankara-Eskisehir and Ankara-Konya have been completed; and the Sivas-Ankara, Ankara-İstanbul lines are under construction. Additionally, light train systems in urban areas are increasingly widespread. Railway projects that will connect the Asian and European sides of Istanbul are also under construction. With these projects, the share of rail transport in freight transport is expected to increase to 13%, and the share of passenger transport will reach 7%[5]. Increasing the share of rail passenger and freight transport is important in terms of reduction in greenhouse gas emissions from transportation.

Figure 3.11 Fuel Consumption of Road Transport during 1990-2009



Source: National Greenhouse Gas Emission Inventory for the year 2009

International Air and Maritime Transport

An inventory of GHG emissions from international bunkering of fuels has been calculated only for 2008 and 2009. In these years, 62.4% of shipping fuel consumption and 81.2% of aviation fuel consumption are from domestic transport. Emissions from international bunker fuels were just over 2.03 million tonnes of CO_2 eq in 2009. In 2009 due to the global economic crisis, international transport emissions decreased by 17.3% compared to 2008. For the years 2008 and 2009, 55% of international freight emissions originated from air transport and approximately 45% from maritime transport.

CO_2 emissions account for 99% of international transport emissions. Emissions of methane and nitrous oxide from transport represent only 1% of the sector's emissions.

Other Sectors

Other sector sub-sector includes emissions from buildings and services and agriculture sectors. In the year 2009, this sector composed 25.4% of total energy emissions. The share of emissions within these sub-sectors is as follows: fuel combustion for buildings is 81% and fuel combustion in agricultural/forestry/ fishing activities is 19%.

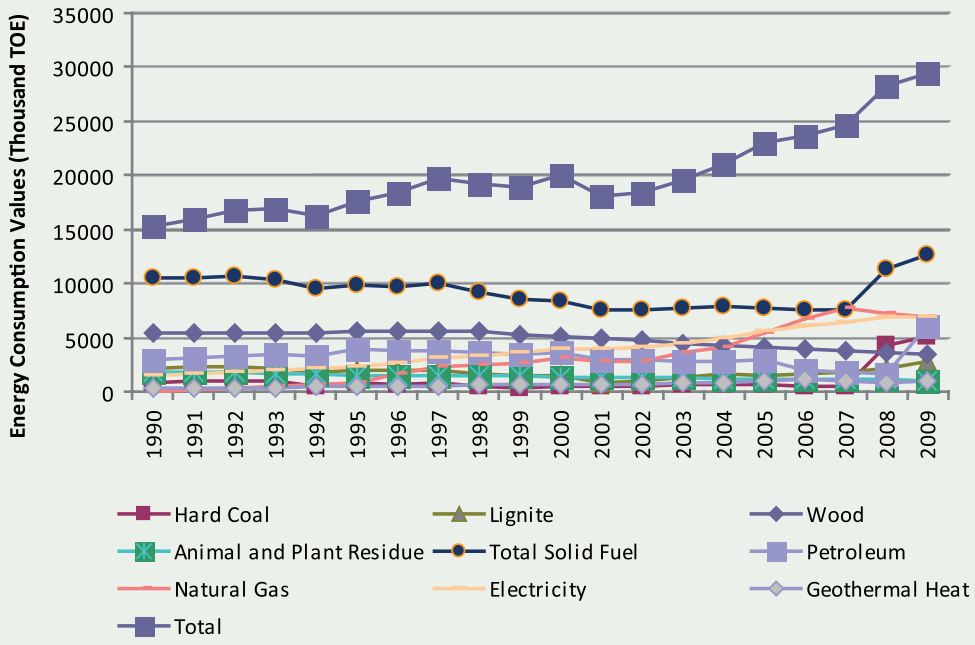
Emissions from the combustion of fuel in residential and agricultural sectors increased by 117% from 1990 to 2009. One of the main reasons for this increase is attributable to the increasing number of buildings and demand on the large houses, despite the economic crisis (Figure 3.12). According to the building census of TurkStat (TurkStat, 2000), the number of buildings was 4.4 million in 1984

[5] Babalık-Sutcliffe, 2007.

and it has increased to 7.8 million in 2000, representing a 79% increase. The number of houses over the same years reached 16.2 million, representing a 129% increase. Between 2000 and 2008, according the construction permits, the surface area of residential, commercial and public buildings reached 1.524 million m2, an increase of 56%. On the other hand, the number of building only increased by 7% (Keskin, 2010).

There are large financing needs to install insulation and achieve other energy savings in the housing sector that is a barrier in the widespread implementation. The energy consumption of residential and services sectors grew from 15.36 million TOE in 1990 to 29.47 million TOE in 2009 (MENR, 2011) (Figure 3.12).

Figure 3.12 Energy Consumption by Energy Source in the Building and Service Sectors



Fugitive emissions from fuels

Fugitive emissions from fuels accounted for 0.72% of energy sector emissions. Emissions increased by 40% from 1990 to 2009. This increase can be explained mainly due to the boost of coal mining production over this time period.

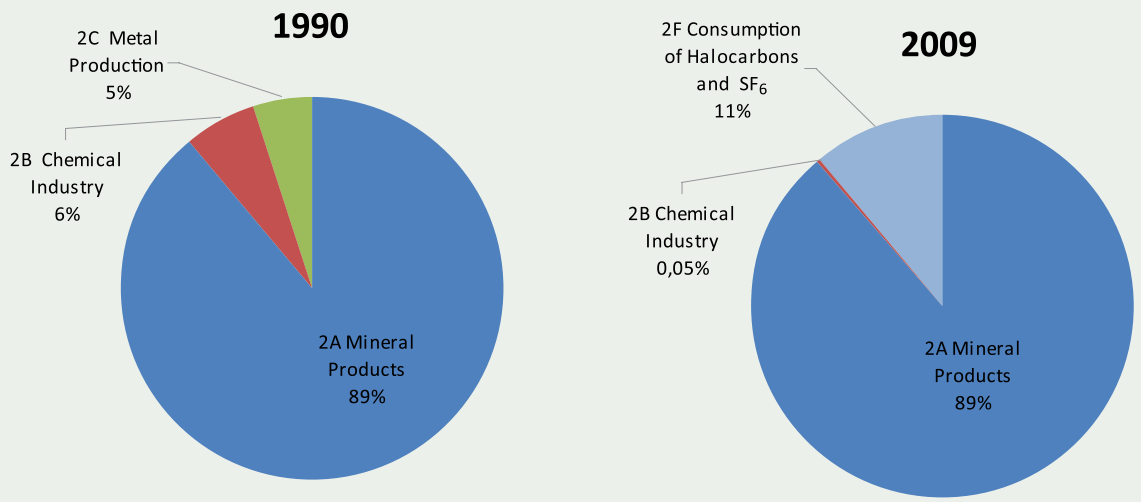
3.2.2 Industrial Processes

Greenhouse gas emissions in 2009 totaled 31.7 million tonnes CO_2 eq from industrial processes, equaling 8.57% of Turkey's aggregate emissions (Table 3.3). Greenhouse gas emissions resulting from industrial processes increased by 105% between from 1990 values. Variations of sub-sectoral distributions from industrial processes are provided in Figure 3.13. Cement and lime production processes (2A mineral products) were the largest emissions sources in this sector contributing to 88% of the sectoral emissions in 1990 and 89% in 2009. The share of emissions from the chemical industry (2B) and metal production (2C) were 6% and 5% of the sector respectively in 1990, but their emissions were not included in Turkey's 2009 aggregate emissions estimates (Figure 3.13).

Table 3.3 Greenhouse Gas Emissions of Industrial Process Sub-sectors, Share of National and Sector Emissions in 2009

Industrial Process Sub-sectors	GHG (Gg CO_2 eq)	Total Industrial Proses Emissions Shares (%)	National Total Emission Share (%)
A. Mineral Products	27,997.04	88.36	7.57
B. Chemical Production	47.22	0.15	0.013
C. Metal Production	C, IE, NA, NE	-	-
D. Other Production	NE	-	-
E. Halocarbon and SF_6 Production	NA	-	-
F. Halocarbon and SF_6 Usage	3,642.72	11.50	0.98
G. Other	NA	-	-
Total Industrial Process	31,686.98	100	8.57
National GHG Emissions Total (LULUCF excluded)	369,647.82		

Figure 3.13 GHG Emissions from Industrial process sub-sectors.



The variations of greenhouse emissions for industrial processes sector 1990 and 2009 for are given in Figure 3.14.

According to the 2009 inventory, greenhouse gas emissions from the industrial sector were 88% CO_2, and 12% F-gases (HFC, PFC ve SF_6) (Figure 3.15). Ninety-one percent of CO_2 emissions originated from the cement sub-sector, and the remaining 9% originated from lime production. CH_4 gas originated from the sugar and food sectors. SF_6 as one of the F-gases is used in the manufacturing of insulation and fire-extinguishing gas in the electromechanical industry. The other F-gases are used in refrigeration and air conditioning equipment manufacturing industries.

Figure 3.14 GHG Emissions from Industrial Process Sub-Sectors (1990 – 2009)

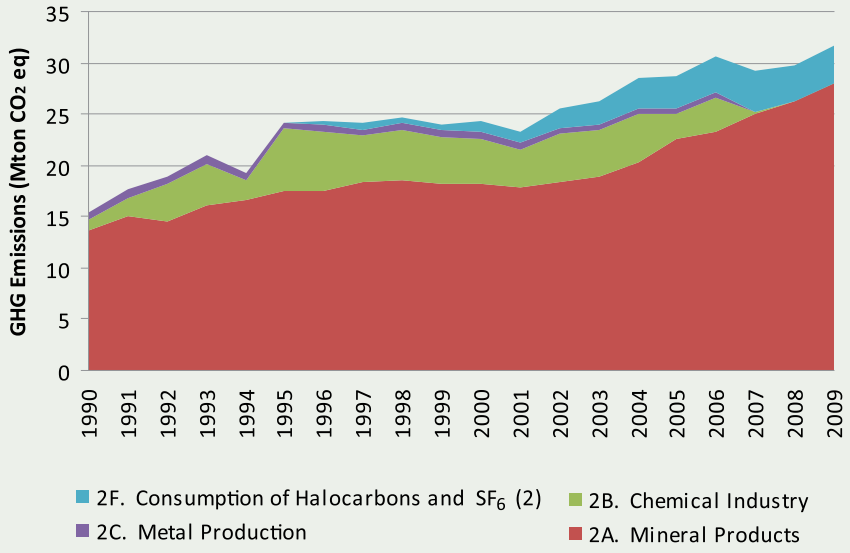


Figure 3.15 Share of Greenhouse Gas Types Contributing to Industrial Processes Sector (1990-2009)

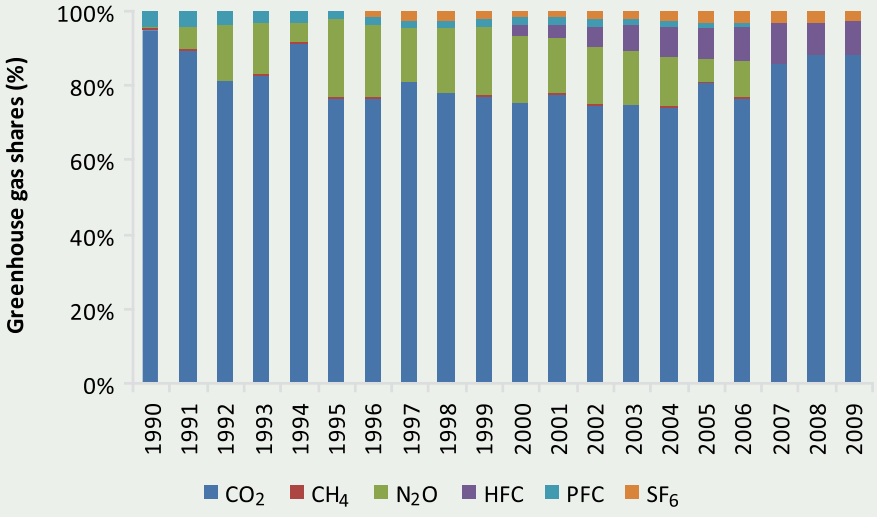
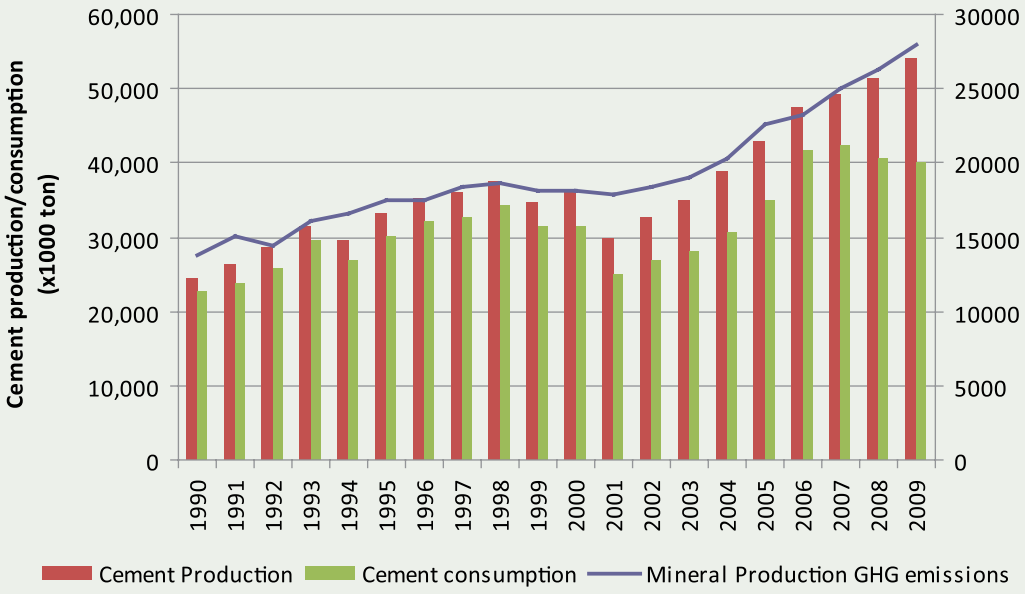


Figure 3.16 Cement Production and Consumption Values and GHG Emissions from Mineral Production Process (1990 -2009)



Greenhouse gas emissions from mineral production and amount of cement production show a similar trend in many cases in Turkey. Since the beginning of 2000s, Turkey became Europe's largest producer of cement with modern investments in this sector. In Turkey, there are 48 integrated cement plants and these plants have 75 rotary kilns and 19 cement production plants. Amount of cement production has been increased from 1990 levels of 24.4 Mton to 59.3 Mton with inclusion of the production estimates of plants which are not members of Turkish Cement Manufacturers' Association as of the year 2009 (MSIT, 2011). Demand on cement industry changes based on the country's economic conditions and investment environments, and production decreases during economic downturns. This was particularly true during the global financial crisis, as impacts on the real estate sector decreased national demand for cement. Nevertheless the growing export of cement from Turkey caused a continued increase in greenhouse gas emissions (Figure 3.16). Turkey's energy consumption values per unit of cement produced, declined to a lower than average level (in comparison with the EU) because many cement companies constructed new facilities and/or made modernizations.

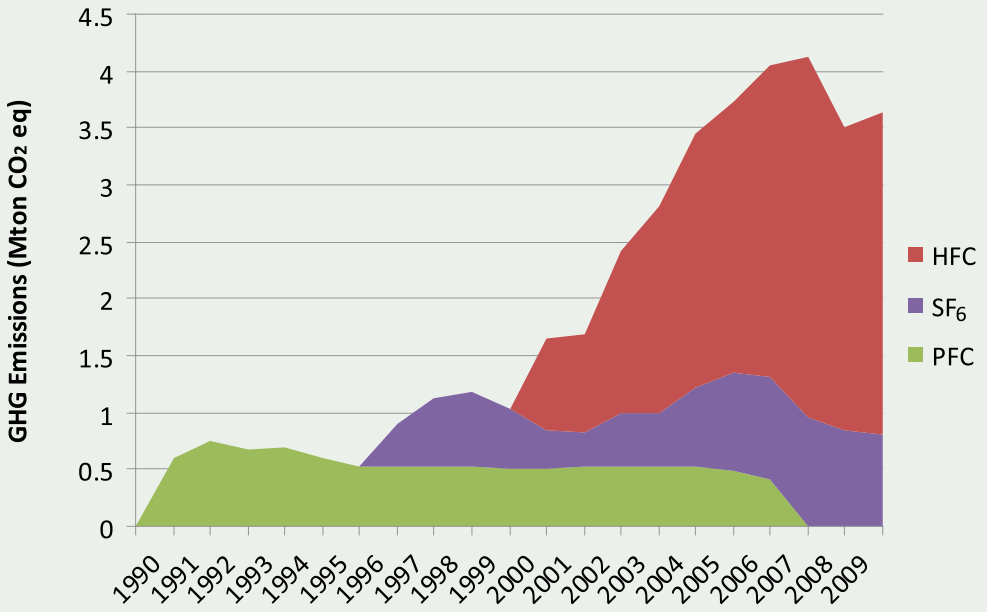
Fluorinated greenhouse gases (HFC, PFC, SF_6)

As there is no production of SF_6 and HFC's within the country, the emissions in the industry are based on the amount of import of SF_6 and HFCs. HFC gas consuming sector like refrigerators, fire extinguishers and air conditioners are growing rapidly in Turkey. With an average of 0.20 Mton CO_2 eq emissions per year increase, the continued development of this sector is expected in the upcoming years.

SF_6 emissions originated from electrical equipment have been recorded since 1996. HFCs have been used as substitutes for chlorofluorocarbons (CFCs) under the Montreal Protocol since the year 2000.

PFC emissions from aluminum production are not included in the inventory due to the confidentiality since 2007. All of the HFCs used in production processes are consumed within the refrigeration sub-sector. HFC emissions are only limited in the sectors that use HFC-134a in the production of refrigerators and air conditioners. A total of 78% of F-gases use are based on HFCs. HFC emissions have increased from 0.82 Mton of CO_2 eq to 2.18 Mton due to the phase out of ozone-depleting substances in air conditioners and refrigerators between 2000 and 2009 (Figure 3.17).

Figure 3.17 GHG Emissions from Total F-gases Use (1990-2009)



3.2.3 Agriculture

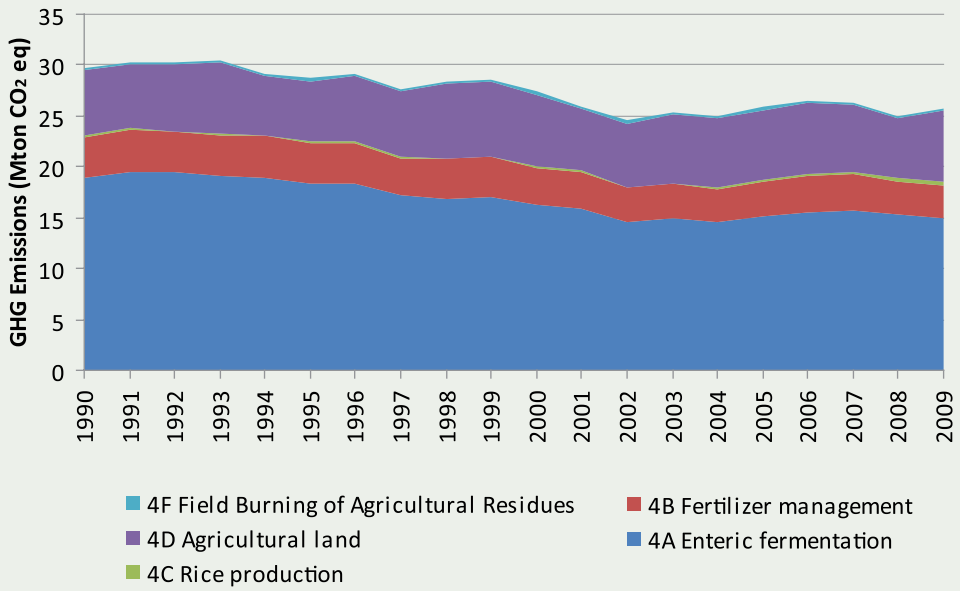
The agriculture sector is an important contributor to greenhouse gas emissions. In Turkey, greenhouse gas emissions from agricultural activities are originated from the manufacturing and processing of agricultural products, the number of animals (enteric fermentation, fertilizer management), rice production, the open burning of agricultural wastes and agricultural land. According to the 2009 National Inventory in Turkey, agricultural activities represent 7% of total greenhouse emission from human activity. In addition, there have been significant increases in greenhouse gases from all other sectors, but there has been a reduction in agricultural activities during the period of 1990-2009 (Figure 3.18). The greenhouse gas emissions originated from agricultural activities have been decreased from 29.78 Mton CO_2 eq in 1990 to 25.70 Mton CO_2 eq in 2009, representing a 14% decline (Table 3.4).

According to the 2009 inventory, 58% of agricultural emissions resulted from animal enteric fermentation, 27% from agricultural lands, 13% from manure management and the remaining 2% from rice production and open burning of agricultural wastes.

Table 3.4 Greenhouse Gas Emissions and Total Emission Shares from the Agricultural Sector in 2009

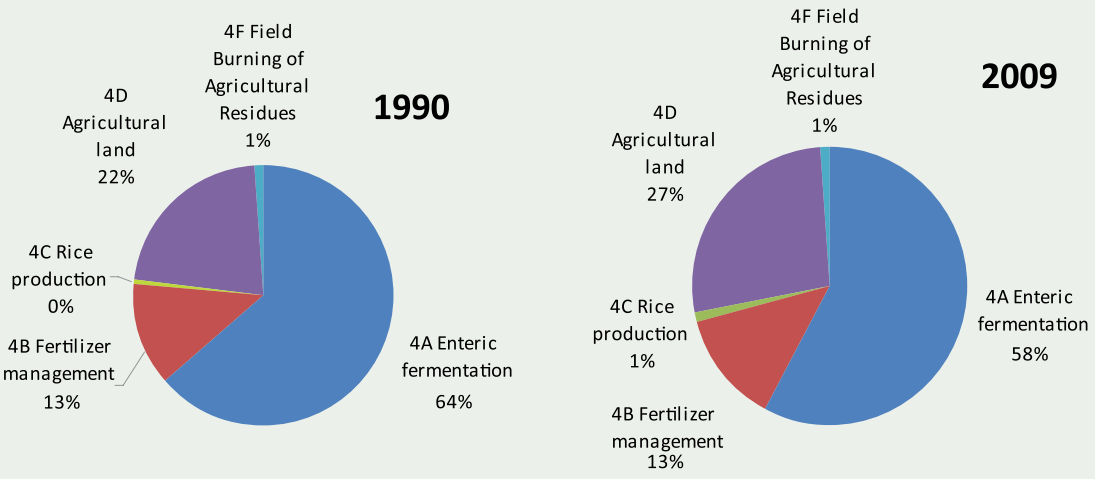
Sub-sectors of Industrial Processes	Greenhouse Gas Emissions (Gg CO_2 eq)	Total Agriculture Emissions Shares (%)	National Total Emission Share (%)
A. Enteric Fermentation	14,859.21	57.83	4.02
B. Fertilizer Management	3,394.29	13.21	0.92
C. Rice Production	203.18	0.79	0.05
D. Agricultural Land	6,989.93	27.20	1.89
E. Savanna Fires	NA	-	-
F. Field Burning of Agricultural Residues	249.32	0.97	0.07
G. Other	NA	-	
Total Agriculture	25,695.93	100	6.95
National GHG Emissions Total (LULUCF excluded)	369,647.82		

Figure 3.18 GHG Emissions from Total Agriculture Sector from 1990 to 2009 (Mton)



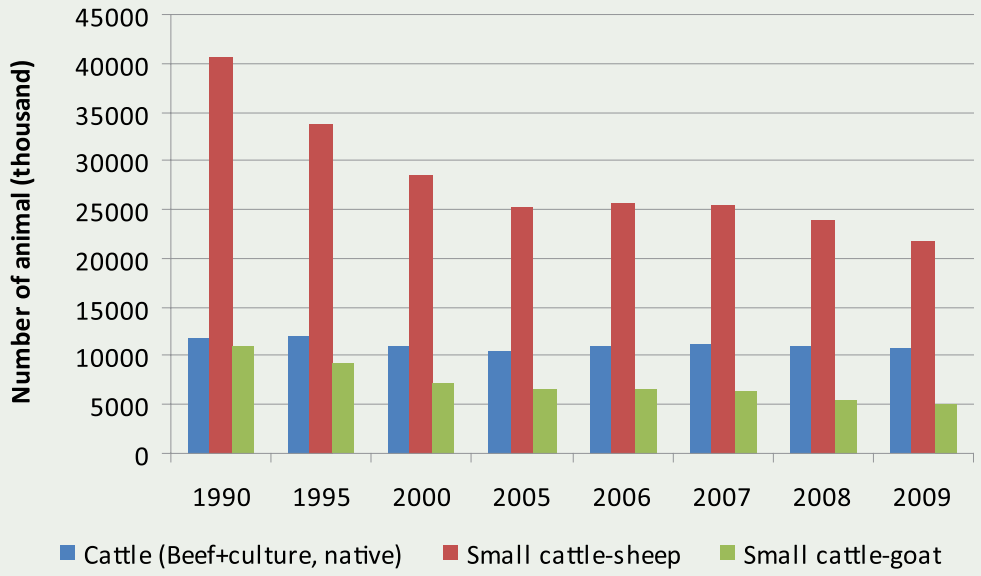
Since 1990, there has been a 22% decrease in emission from enteric fermentation and 7% increase from agricultural lands based on sub-sectoral shares of greenhouse gas emissions originated from agricultural activities. In 2009, total CO_2 eq emissions originated from the agriculture sector consisted of 64% CH_4, and 36% N_2O.

Figure 3.19 Contribution of Sub-Sectors to Total Emissions from Agriculture Sector



Between 1990 and 2009, an annual average of 0.301 Mton of CO_2 eq reductions have been observed in the agricultural sector. The main factor leading to this decrease is the decline of the emissions from enteric fermentation and manure management (Figure 3.20). This is based on a declining number of domestic cattle, sheep and goats. According to TurkStat statistics, between 1990 and 2009, the number of cattle in the country declined by 7% (beef, culture, hybrid and buffalo), sheep declined by 46% and goat declined by 53% (TurkStat, 2011). Within the same period, there was a 6% reduction in the greenhouse gas emissions originated from enteric fermentation in the livestock sector.

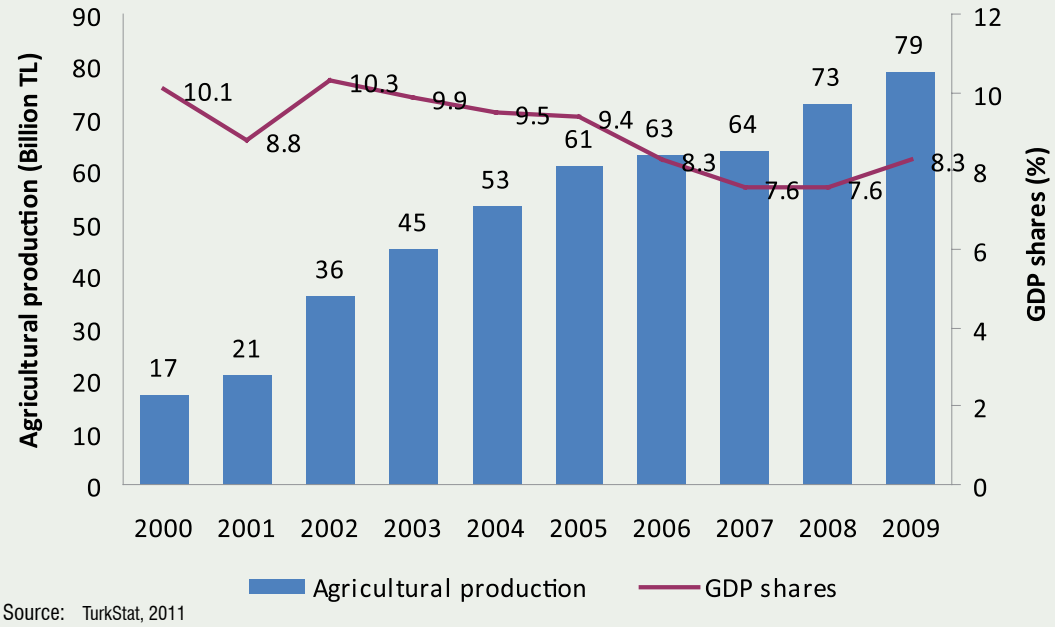
Figure 3.20 Animal Populations in Turkey (1991-2009)



Source: TurkStat. 2011

The contribution of the agricultural sector to the national GDP has declined continuously. In the first year of the Republic in 1923, agriculture contributed to 42.8% of GDP. This declined to 25% in 1980, 16% in 1990, 10.1% in 2000 and 7.6% in 2008. In 2009, there was a slight increase by the sector to 8.3%. The main reason for the steady decrease of the agriculture sector within the national GDP is the faster growth in industrial and services sectors. Although there is now a relatively reduced importance of agriculture in Turkey's economy, domestic food needs have been met, and it is still is of great importance for creating employment opportunities.

Figure 3.21 Agricultural Production and Its Share in GDP (1990-2009)

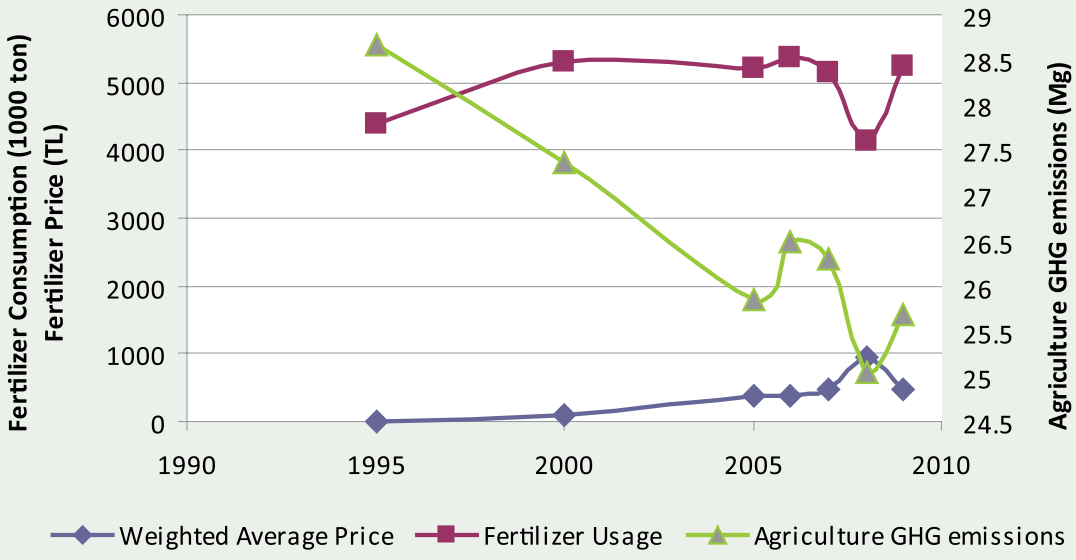


Source: TurkStat, 2011

Forty-one percent of Turkey's 79.6 million hectares of land is agricultural land (CORINE, 2006). Cultivated agricultural land in 1990 was 24.8 million hectares; and this decreased to 21.4 million hectares in 2009. Irrigated farming takes place on approximately 17% of total planted areas and non-irrigated farming occurs on 83% of land. Because of the increase of fertilizer prices by 150% and due to the drought in 2007 and 2008, annual fertilizer consumption decreased down to 4,100,000 tonnes from 5 million tonnes. This resulted in a decrease of greenhouse gas emissions from 4D agricultural lands by 17% in comparison with 2006. In 2009, prices of fertilizer declined and fertilizer consumption reached 5 million tonnes again with resulting increases in greenhouse gas emissions.

As can be seen in the relationship between fertilizer consumption and fertilizer prices (Figure 3.22), fertilizer consumption is greatly influenced by prices. Excessive increase in fertilizer prices in 2007-2008 was linked to increase of raw material prices especially for the petroleum and natural gas. Excessive increase in fertilizer prices has led to shrinking demand. However, shrinking demand due to the effect of global economic crisis reduced fertilizer prices a bit. Increasing fertilizer consumption may cause an increase in greenhouse gas emissions in the by years. Therefore, in order to prevent unnecessary use of fertilizers, efforts have been made to support farmers in using of optimum fertilizers and undertaking soil analysis.

Figure 3.22 Fertilizer Prices and Use by Year



Source: TUGEM, 2011

The continuous decrease in agriculture sector greenhouse gas emissions is a result of best practices implemented by the Food, Agriculture and Livestock Ministry, which are also expected to be implemented in the upcoming years. These best practices include:

- The improvement of low processed or non-processed agriculture practice supplemented with proper mechanical support by the government, and also reduced energy consumption due to combined use of devices;
- Movement to the use of biomass energy instead of open burning agricultural wastes; and
- The encouragement of orchard and removal areas by certified seedling and fruit facilities so that to increase GHG sink areas.

3.2.4 Land Use, Land-Use Change and Forestry (LULUCF)

Land use and land-use changes over time based on greenhouse gas sinks and human interventions in the sector and share of national total emissions are provided in Table 3.5. According to the 2009 inventory of greenhouse gas emissions, the LULUCF sector acts as a net sink. Most of the sinks are due to forests with 15.5% of national emissions for the year 2009, while 5% to 1.8% is due to agricultural fields and pastures and rangeland areas.

Table 3.5 Greenhouse Gas Emissions and Total Emission shares from LULUCF in 2009

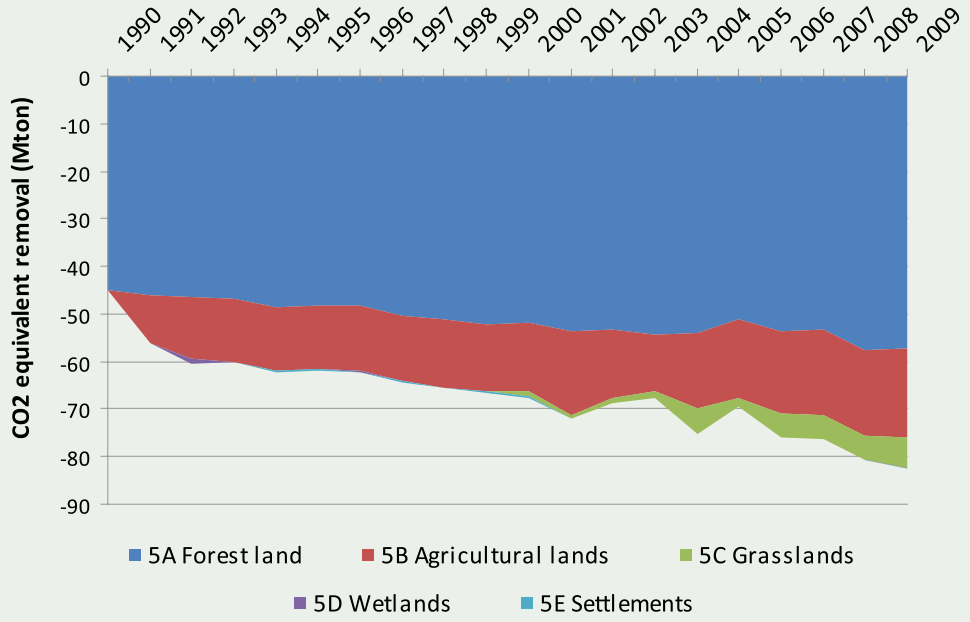
LULUCF Sub-sectors	GHG Emissions (Gg CO_2 eq)	Total LULUCF Emissions Shares (%)	National Total Emission Share (%)
A. Forest Land	-57,364.76	-69.51	-15.52
B. Cropland	-18,529.14	-22.45	-5.01
C. Grasslands	-6,634.39	-8.03	-1.79
D. Wetlands	NA, NE	-	-
E. Settlements	NA, NE	-	-
F. Other Land	NA	-	-
G. Other	NA, NE	-	-
LULUCF Total	-82,528.28	-100	-22.33
Total National GHG Emissions (excluding LULUCF)	369,647.82		

As a result of the change in the GHG emissions from the LULUCF sector, an annual average increase of 1.38 Mton CO_2 eq was observed between the years 1990 and 2000. Increase in removal is mostly caused by an increase in the area of grasslands and forests (Figure 3.23). Annual carbon capture of Turkey's forests has been increased significantly. In 1990, net carbon stock change was 12,023 Mton/year which increased to 15,644 Mton/year in 2009 and CO_2 capture increased from 44,087 to 57,365 Mton/year. Taking carbon amount stored in the soil organic matter into calculations will result in an increase in the stored carbon in LULUCF sector. Some of the factors that accelerate trend of increased storage of carbon in the LULUCF sector are; continued decline of human-induced social pressures on forests as a result of rural to urban migration, avoidance of grazing in the forests, reforestation, and rehabilitation and rejuvenation activities. Because almost all forest land is managed by the state, government activities related to administration, operation, and enhancement of forests play an important role in the increase in the forest lands. The National Reforestation Campaign, targeting reforestation of 2.3 million hectares, will have an important role to play in the sector. With an annual average GHG removal of 0.581 Mton of CO_2 eq, forestry is a promising sector for the removal of GHG emissions providing appropriate policies are implemented.

In 1991, agricultural lands achieve 10.2 Mton of CO_2 sequestration, and this increased to 18.5 Mton in 2009.

Grasslands represented 44.2 million hectares of Turkey in the 1930's and declined to 38 million hectares in 1950, 28 million hectares in 1967 and 13.4 million hectares in 2003 (MARA, 2011). The use of pastures as public domain and ultimately the nature of these areas has led to their degradation. Early and late grazing, as well as general overgrazing, has led to land degradation. The public has used this land as public property, including unmanaged use of these areas, resulting in land degradation. Through this process, grassland has been transformed into cropland or has been overgrazed. Due to the 1998 grassland law (no. 4342), which is focused on the detection, care, protection and control of grasslands, there has been a continuous increase in grasslands in Turkey resulting in 0.7 Mton CO_2 sequestered annually.

Figure 3.23 The amount of CO_2 eq removal from LULUCF sector (1990- 2009)



3.2.5 Waste

Greenhouse gas emissions from the waste sector are based on emissions from municipal solid waste, management and treatment of hazardous and medical waste and sewage sludge and its treatment process at wastewater treatment plants.

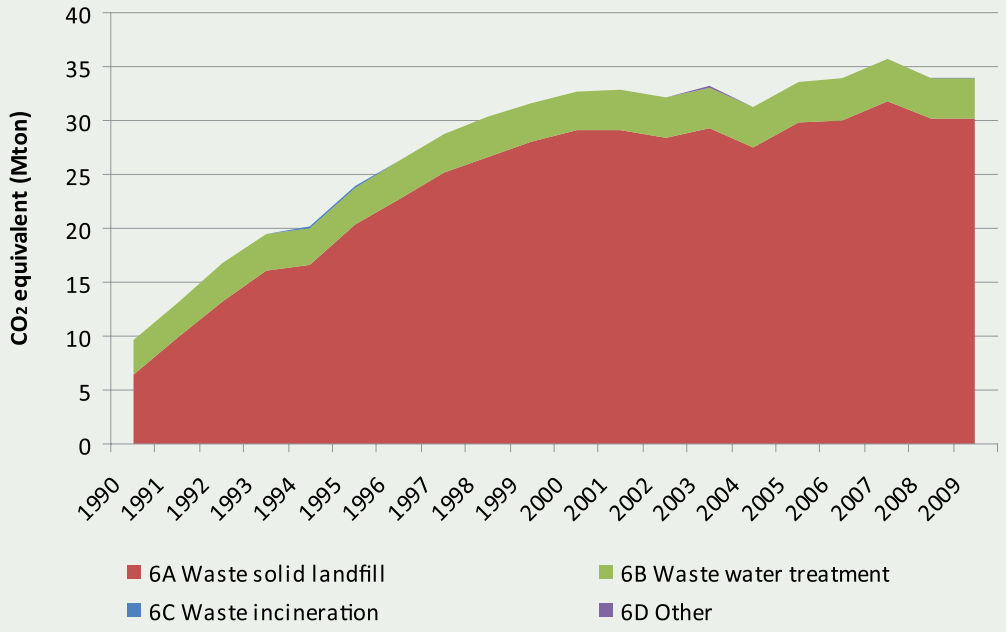
The main greenhouse gases originated from the waste sector are methane (CH_4), nitrous oxide (N_2O) and CO_2. On a global scale, the waste sector contributed to estimated 3% of global emissions (IPCC, 2007). Turkey's total greenhouse gas emissions and its shares by waste sub-sectors are given in Table 3.6. In 2009, the share of total greenhouse gas emissions of waste sector in Turkey is 33.93 Mton CO_2 eq (9.18%), and it is the 2nd largest contributor to Turkey's emissions after the energy sector (Without LULUCF). In Turkey, 88.9% of greenhouse gas emissions from the waste sector are originated from landfill and dumping sites, and the remaining emissions are from domestic wastewater operations (Table 3.6). The 2009 greenhouse gas inventory does not include emissions from industrial wastewater treatment plants.

Table 3.6 GHG Emissions and Total Emissions Shares from the Waste Sector in 2009

Waste Sector	GHG Emissions (Gg CO_2 eq)	Total Waste Emissions Share (%)	National Total Emissions Share (%)
A. Solid Waste Landfill	30,169.77	88.91	8.16
B. Wastewater Treatment	3,764.32	11.09	1.02
C. Waste Incineration	NA	-	-
D. Other	NA	-	-
Waste Sector	33,934.08	100	9.18
National GHG Emissions Total (LULUCF excluded)	369,647.82		

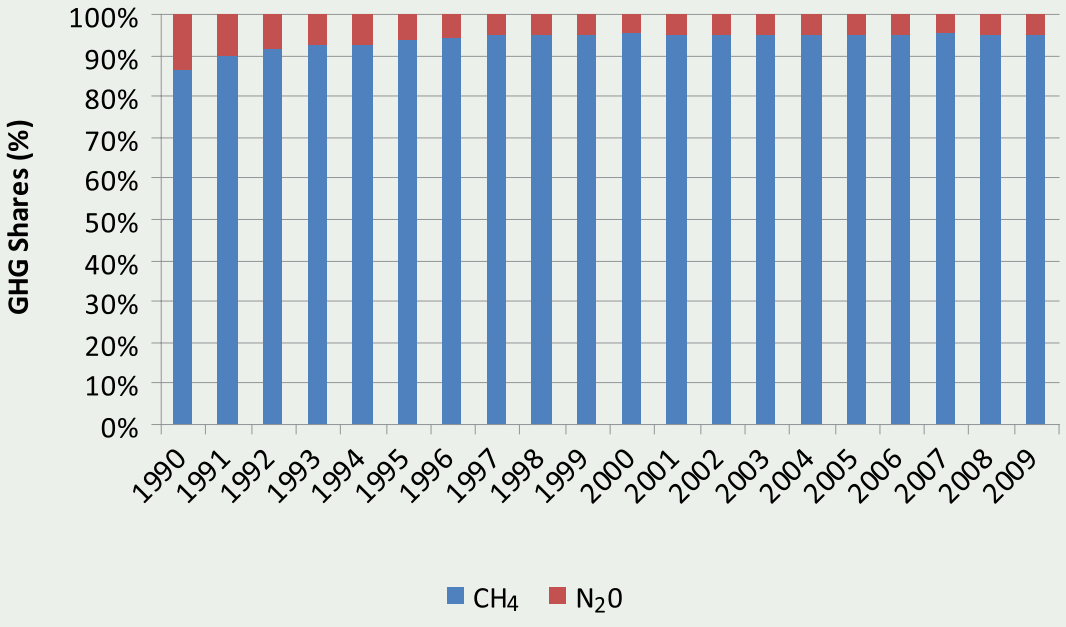
During 1990-2009 period, the variation of Turkey's greenhouse gas emissions from the waste sector is provided in Figure 3.24. Greenhouse gas emissions from the waste sector increased by 250% compared with 1990 levels during 1990-2009.

Figure 3.24 CO_2 eq Emissions from Waste Sector (1990-2009)



95% of greenhouse gas emissions from the waste sector consisted of CH_4, and 5% from N_2O in 2009 (Figure 3.25). Methane gas is originated from solid waste landfill units and wastewater treatment plants, and nitrous oxide emissions are emitted only from wastewater treatment plants. Hazardous waste and waste incineration plant emissions are not included in the 2009 inventory.

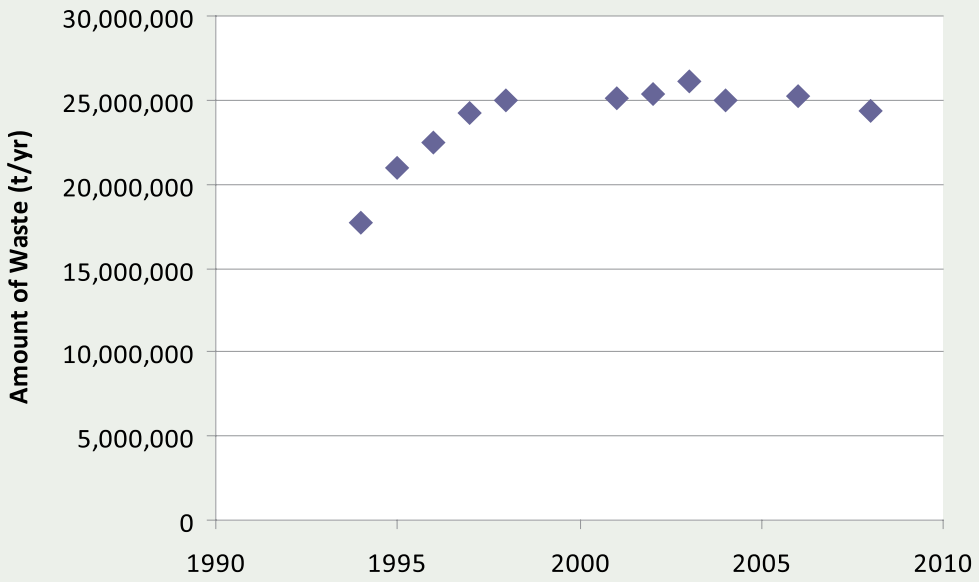
Figure 3.25 GHG Emissions from Waste Sector by Gas (1990-2009)



From 1997 onwards, the amount of waste compared to previous years decreased, and the amount of waste in 2008 was lower than previous years (Figure 3.26). Although the amount of waste decreased, an increase in the methane emissions observed might be explained by biodegradation of the existing wastes in landfills and dumping areas.

The Landfill Regulation entered into force on 26th March 2010 and aims to reduce biodegradable wastes in landfills as well as collecting landfill gas for energy production or flaring. It promotes the use of landfill gas for energy production and in the absence of use for energy it stipulates torching methane (resulting in reduced emissions). These actions are expected to reduce the share of greenhouse gas emissions from the waste sector.

Figure 3.26 Municipal Waste Amount between (1994-2008)



As of 2008, urban solid waste amount was around 24,360,863 tonnes/year (1.15 kg/person/Day or 420 kg/person/ year). Approximately 82% of the total population and 99% of the city population made use of waste collection services. Forty-six percent of the waste collected from municipalities is disposed by using waste management methods, such as storing and decomposing. While 46% of the city population used such methods, 54% of the waste was managed by dumping and other methods. Within the Ministry of Environment and Urbanization's Waste Management Action Plan (2008-2012), 70% of the solid waste is expected to be disposed to landfill as of 2012. The waste management industry is one of the fastest growing industries in Turkey since 2004 due to the start of the European harmonization process. It is expected that greenhouse gas emissions will decrease dramatically landfills plants are built at regional scales and once the dumping site are improved.

'Landfill gas to energy projects' projects have been established to dispose and use of landfill gas from landfills. In addition to the reduction of carbon emissions, energy production is also provided through these projects.

In 2008, 3.26 billion m3 wastewater was collected via sewerage system and discharged 44.7% into the sea, 43.1% into streams and rivers, 3.5% into dams and reservoirs, 2.1% into lakes and ponds, 1.5% onto land and 5.1% into other receiving bodies. About 2.25 billion m3 of 3.26 billion m3 discharged water was treated by treatment facilities. Biological treatment was applied to 38.3% of treated water, physical treatment to 32.2% of water, advanced treatments systems were used on 28.8% of water and natural treatment at 0.3% of water. It was determined that, in 2008 73% of Turkey's population was served by sewerage, including 88% of total municipal population.

The percent of municipal population served by wastewater treatment plants was 46% of national population and 61% of municipal population. In 2010, the share in the national population reached to 52% and share in the municipal population reached to 62%.

3.3 Emission Variations based on Greenhouse Gases

3.3.1 CO_2 Emissions

During the 1990-2009 period, national CO_2 emissions increased by around 111% from 141.36 Mton in 1990 to 299.11 Mton in 2009 (Figure 3.27). The energy sector is the most important sector, contributing 90.6% of CO_2 emissions in 2009, which is only a slight growth from 89.6% in 1990. The highest sources of sub-sectors in energy sector causing CO_2 emissions and their sectorial share changes for 1990 and 2009 are provided in Figure 3.28.

For the year of 2009, the highest share of sub-sectors within the energy sector causing CO_2 emissions are the 1A1 Energy Industry with 37.8%, 1A4 Other Sectors with 24.6%, and 1A2 Manufacturing Industry and Construction with 20.3%. During the economic crises of 1994, 2001 and 2008, production reductions were observed within the manufacturing, industrial and the construction sectors especially, resulting in significant decrease in CO_2 emissions in this sub-sector.

In 1990, the transport sector accounted for 18% of Turkey's total CO_2 emissions, and its share decrease to 15.6% in 2009. In 1990, CO_2 emissions in the transportation sector were around 30% in the European Union (EU) and OECD countries, and up to 40% in some developed countries (International Transport Forum [ITF], 2005). While transportation can lead to CO_2 emissions in other sectors, such as energy production, manufacturing industry, and residential heating, achieving significant reduction in emissions can be reached by increasing energy efficiency. However, net reductions were not observed within the transportation sector; although productivity has improved due to an increase in freight and passenger transport. In the upcoming years, the transport sector will continue to be an important contributor to global warming.

Figure 3.27 Temporal Variations in the Source of CO_2 Emissions (excluding LULUCF, 1990-2009)

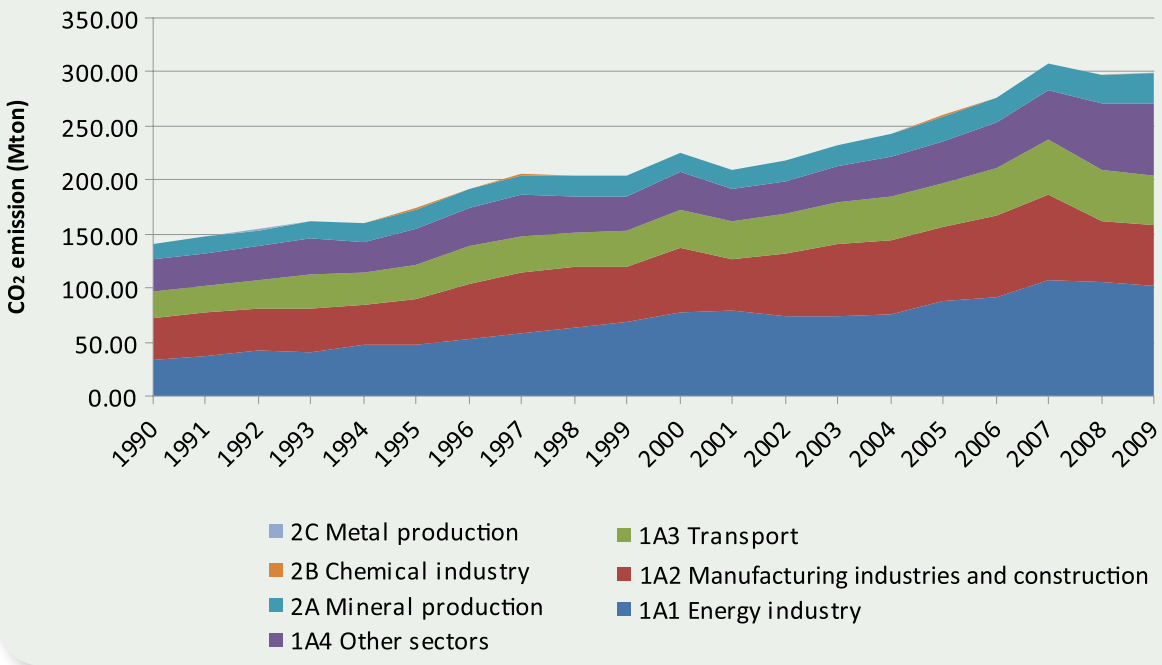
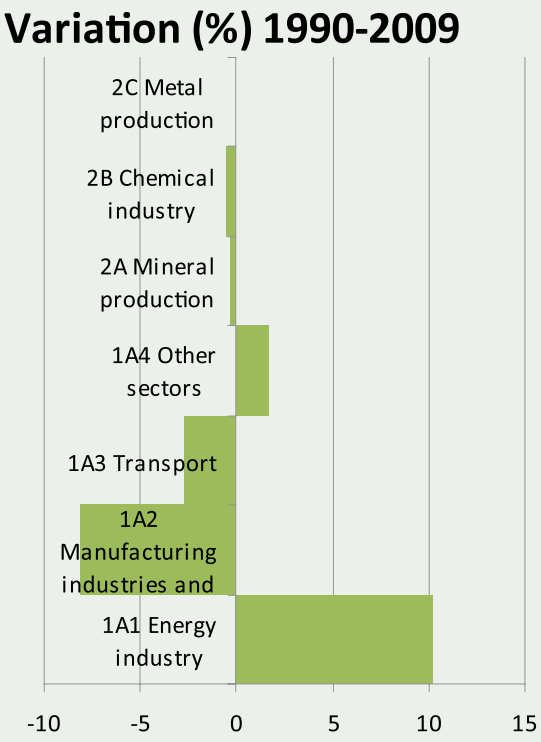


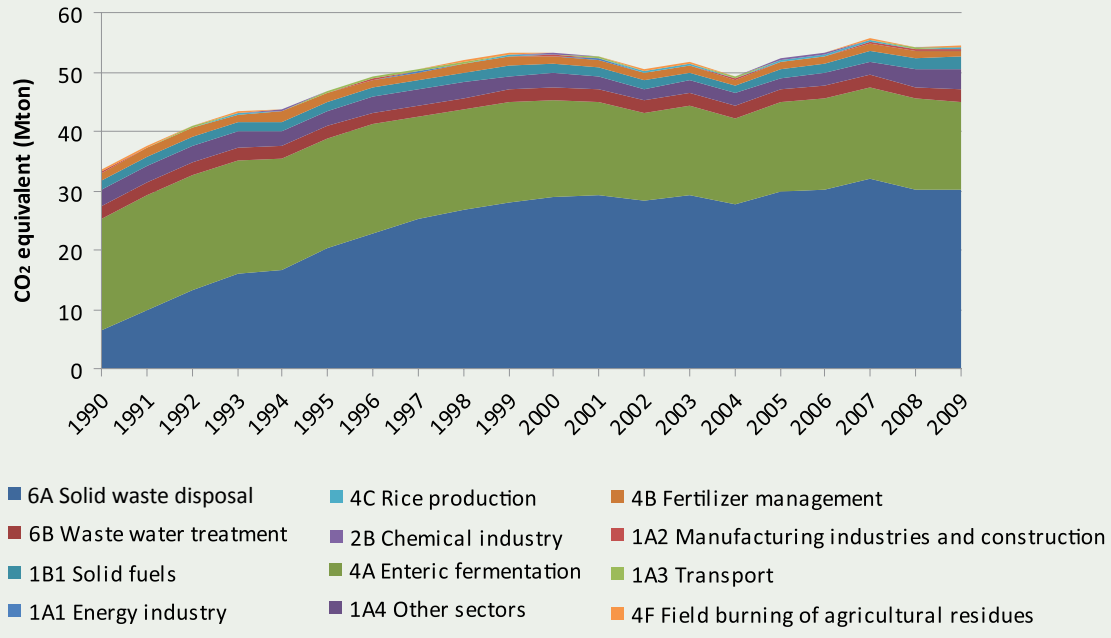
Figure 3.28 Changes in the Contribution of Sectors to CO_2 Emissions in 1990 and 2009



3.3.2 Methane Emissions

In 1990, methane emissions were 1.6 Mton (33.3 Mton CO_2 eq), increasing by 62% to reach 2.6 Mton (54.4 Mton CO_2 eq) in 2009 (Figure 3.29). The most important sources of methane in 1990 were enteric fermentation from animals (58%) and waste disposal (19%), while the share of waste landfill increased to 56% and share of enteric fermentation decreased to 28% in 2009 (Figure 3.30).

Figure 3.29 Sources of Methane Emissions and their Contributions (1990-2009)



Changes in methane by sectors between 1990 and 2009 are given in Figure 3.31. The biggest change has been observed through solid waste disposal and enteric fermentation. Increasing population and widespread service of municipal solid waste collection have led to an increase in methane emissions. Methane from enteric fermentation in livestock sector is declining due to the decrease in animal populations.

Figure 3.30 Sectorial Shares of CH_4 Emissions during 1990 and 2009

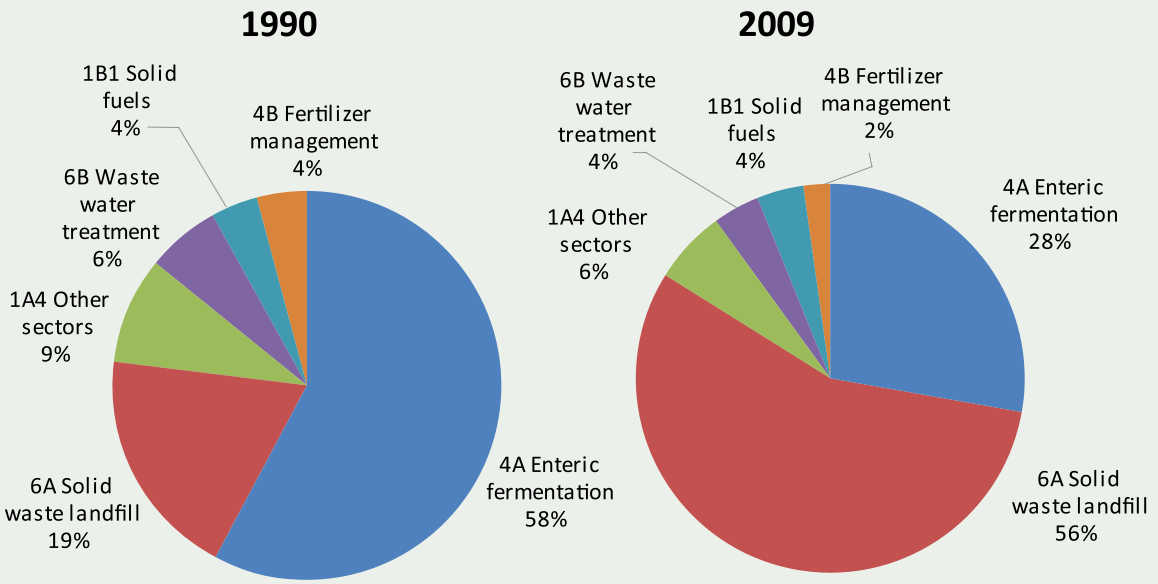
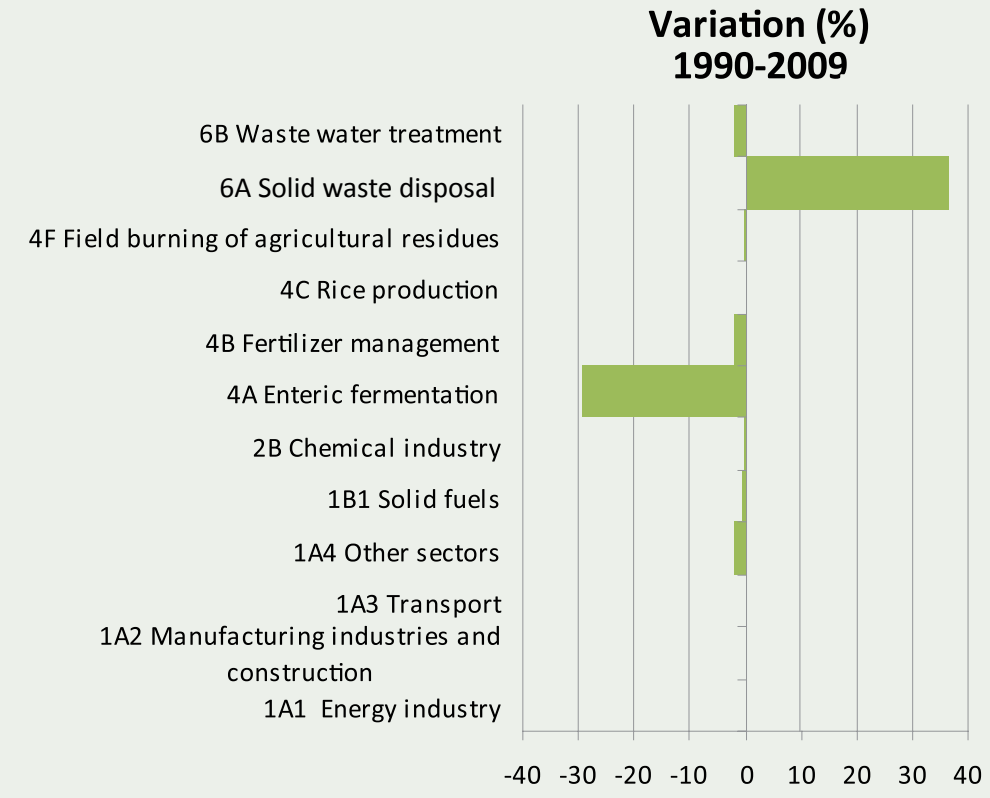


Figure 3.31 Changes in the Contribution of Sectors to CH_4 Emissions in 1990 and 2009



3.3.3 Nitrous Oxide Emissions

In 1990, nitrous oxide emissions were 37.31 Gg (11.56 Gg CO_2 eq), increasing by 8.3% to 40.42 Gg (12.531 Gg CO_2 eq) in 2009 (Figure 3.32). The most significant sources of nitrous oxide are nitrogen fertilizer used in agriculture and animal wastes (Figure 3.33). In 1990, important sources of nitrous oxide were 4D Agricultural Soils (58%), 4B Manure Management (22%) and 6B Wastewater Treatment (12%); whereas in 2009, share of methane emissions from Agricultural Soils reduced to 57% and Manure Management to 18%, while the share of Wastewater Processing increased to 14% (Figure 3.33). During 2008, nitrous oxide emissions decreased 8.3% compared to 2009 due to increased price of fertilizers, and reduction of cultivated agricultural land due to drought.

Figure 3.32 Emissions of Sub-sectors contributing to N_2O Emissions (1990-2009)

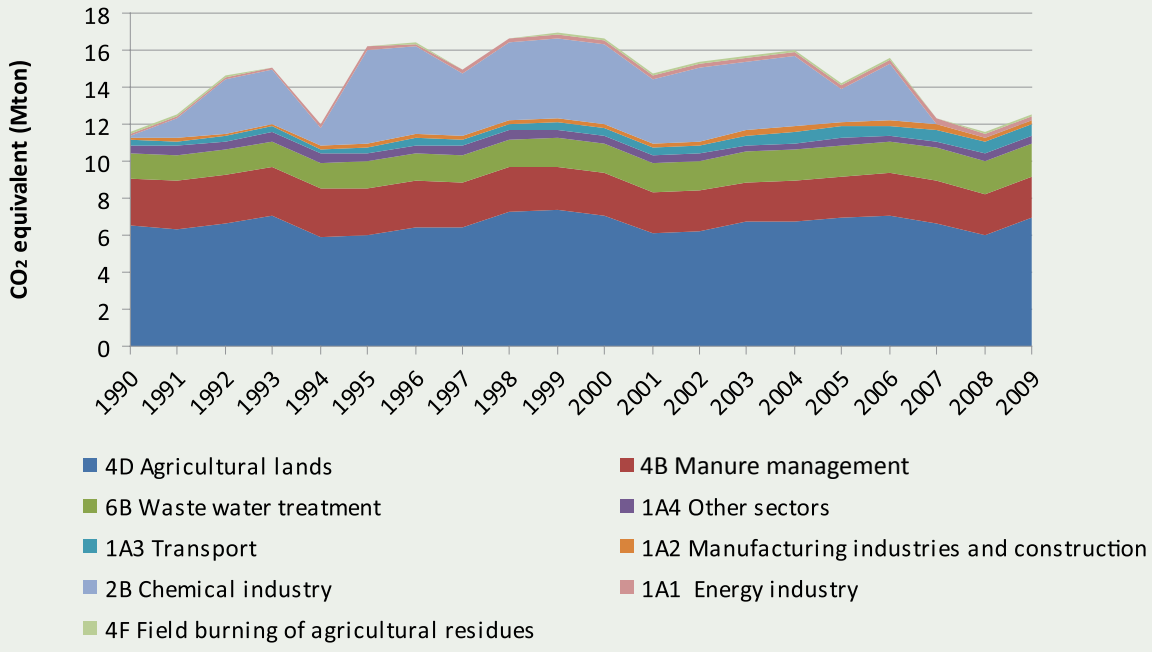


Figure 3.33 Sectorial Shares of N_2O Emissions

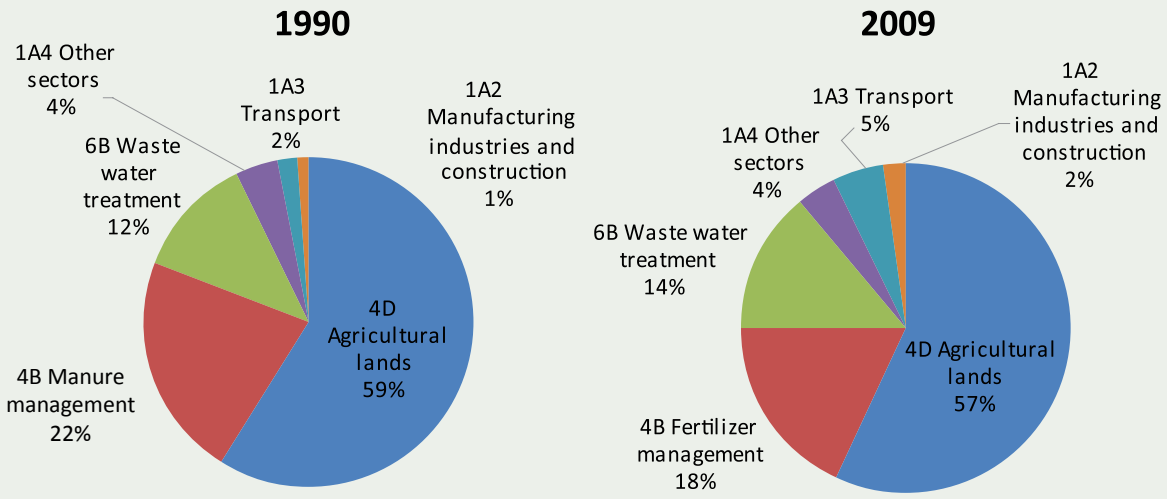
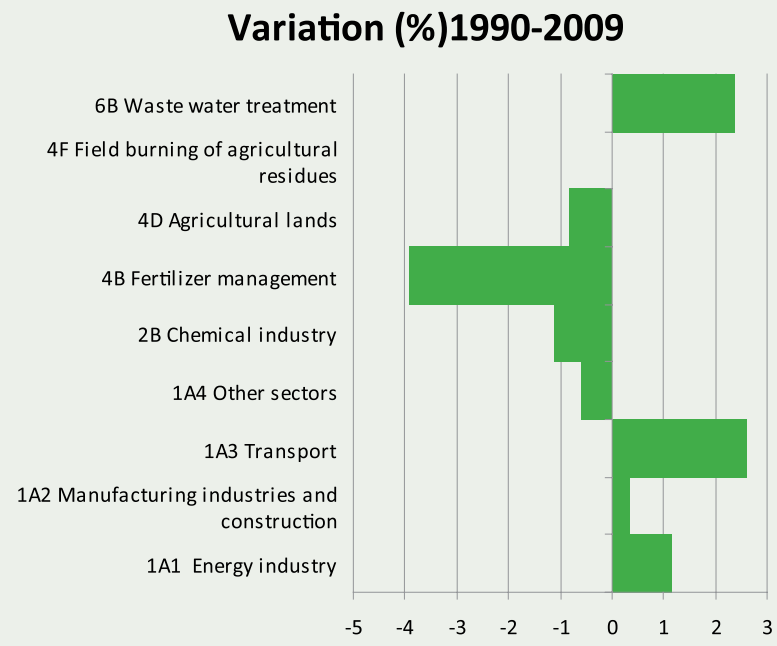


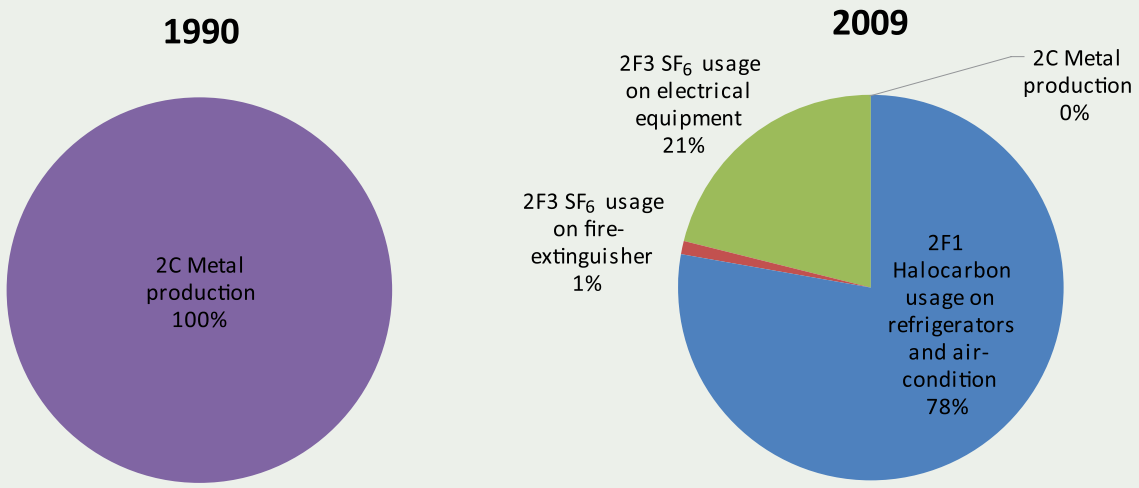
Figure 3.34 Changes in the Contribution of Sectors to N_2O Emissions in 1990 and 2009



3.3.4 HFCs, PFCs and SF_6 emissions

The most important cause of F-gases emissions is the consumption of halocarbons and SF_6. In 1990, F-gases emissions were approximately 0.603 Mton of CO_2 eq. By 2009, it is increased by 504% and reached 3.643 Mton of CO_2 eq. In 2009, the sub-sectors that caused emissions of F-gases was the use of SF_6 in electrical equipment and fire extinguishers and the use of HFC gases in refrigerators and air conditioners. For 1990, sources of-F gases are included PFC usage in 2C Aluminum Production facilities which were not included in emissions inventories since 2007 due to "confidentiality". HFCs have been consumed at an increasing rate since 1999. The economic crisis in 2008 reduced HFC consumption, and it has since risen. The highest PFC emissions were observed between 1990 and 1994 due to the consumption of low quality pitch in aluminum production. Since 1995, the highest quality pitch has been imported, as it improves production efficiency, and consequentially reduced emissions of PFC facilities have been observed. SF_6 emissions from electrical equipment used in fire extinguishers have increased over time, with periodic reduction due to economic crises.

Figure 3.35 Share of Sources in Halocarbons and SF_6 Emissions in 1990 and 2009



3.4 Comparison of Inventory with the Previous Inventories

Turkey has prepared and submitted seven National Greenhouse Gas Emissions Inventories to the UNFCCC, the first one for the 1990-2004 period and the latest one for the 1990-2010 period. As explained at the beginning of this chapter, during the preparation of the National Communication, national inventory that includes 1990-2010 data had not been reviewed by the UNFCCC Secretariat. Therefore, inventory data for 1990-2009 that was reviewed by the UNFCCC was used. Hence, comparison of the data with 1990-2008 inventory data is presented here.

National Greenhouse Gas Emission Inventories have been prepared in accordance with the Revised IPCC Guidelines on National Greenhouse Gas Emission Inventories (1997), IPCC National Greenhouse Gas Emission Inventory Uncertainty Management and Best Practice Guidance (2000), and IPCC Guidelines for LULUCF (2000 and 2003). As recommended in the Guidelines, when calculations are changed based on new sectors or calculation methodologies, and when national emission factors are revised, all calculations have to be calibrated to 1990 in order to satisfy the temporal consistency of the inventory.

Changes in the inventory approaches prepared for the year 1990-2009 compared to previous years, and the recalculations of sector/sub-sectors are listed below:

- 2B5 Other: Production information of chemical manufacturing facilities have been made “confidential”, as required by law and hence, they are provided as aggregate since the year 2004.
- 2C Metal Fabrication: Production information of aluminum and fero-alloys are considered “confidential” as required by law and have not been included in the calculations since 2007.
- 3 Solvent and Other Product Use: For the first time this is included in the inventory. Considering the amount of cars produced between 1990 and 2009, activity data has been established.
- 3C Chemical Products: Activity data for manufacturing and processing sub-sector was determined for 1990-2009 period, using population and household data.
- International Transport Emissions after 2008 are now included in the inventory. However, due to the lack of data, emission data from 1990-2007 have not been produced.

Overall, Turkey’s emission inventory was completed for the major sectors, and observation of change can be seen as sufficient.

3.5 National System

Turkey became a party to the UNFCCC on 24 May 2004 and, in accordance with the decisions in UNFCCC Articles 4 and 12 and related decisions of the Conference of the Parties (COP), Turkey is responsible for preapering an inventory of greenhouse gas emissions each year, and preparing national communication reports every four years. The first National Greenhouse Gas Emission Inventory was submitted to the UNFCCC in April 2006. The National Greenhouse Gas Emissions Inventory for the period 1990 – 2009 was submitted to the UNFCCC Secretariat on 15 April 2011. The data contained in this report is consistent with the National Greenhouse Gas Inventory for the period of 1990-2009.

Turkish Statistical Institute (Turk Stat) is responsible for collecting, updating and organizing data for the National Greenhouse Gas Emission Inventory. The following institutions and organizations worked in collaboration with TurkStat in the preparation of the inventory.

- Ministry of Food, Agriculture and Livestock (MFAL)
- Ministry of Forestry and Water Works (MFWW)
- Ministry of Environment and Urbanization (MEU)
- Ministry of Transport, Maritime Affairs and Communications (MTMAC)
- Ministry of Energy and Natural Resources (MENR)
- Turkey Cement Manufacturers' Association
- Lime Manufacturers' Association
- ETI Aluminum Inc.
- Automotive Industry Association (AIA)
- Turkish State Meteorological Service (SMS)

An outline of the national emission inventory system is shown in Figure 3.36. The basis of the national system is data collection, data processing and analysis, selection of emission factors and methods, determination of key greenhouse gas emission sources, and evaluation of results. According to the national system, the Common Reporting Format (CRF) tables of each sub-source category are prepared by the responsible organization. In order to finalize the report after transfer of the data to the system, technicians undertake an analysis to identify the key sources of greenhouse gas emissions, to perform an uncertainty analysis of the results and to evaluate results.

Data sources of the National Greenhouse Gas Emission Inventory are:

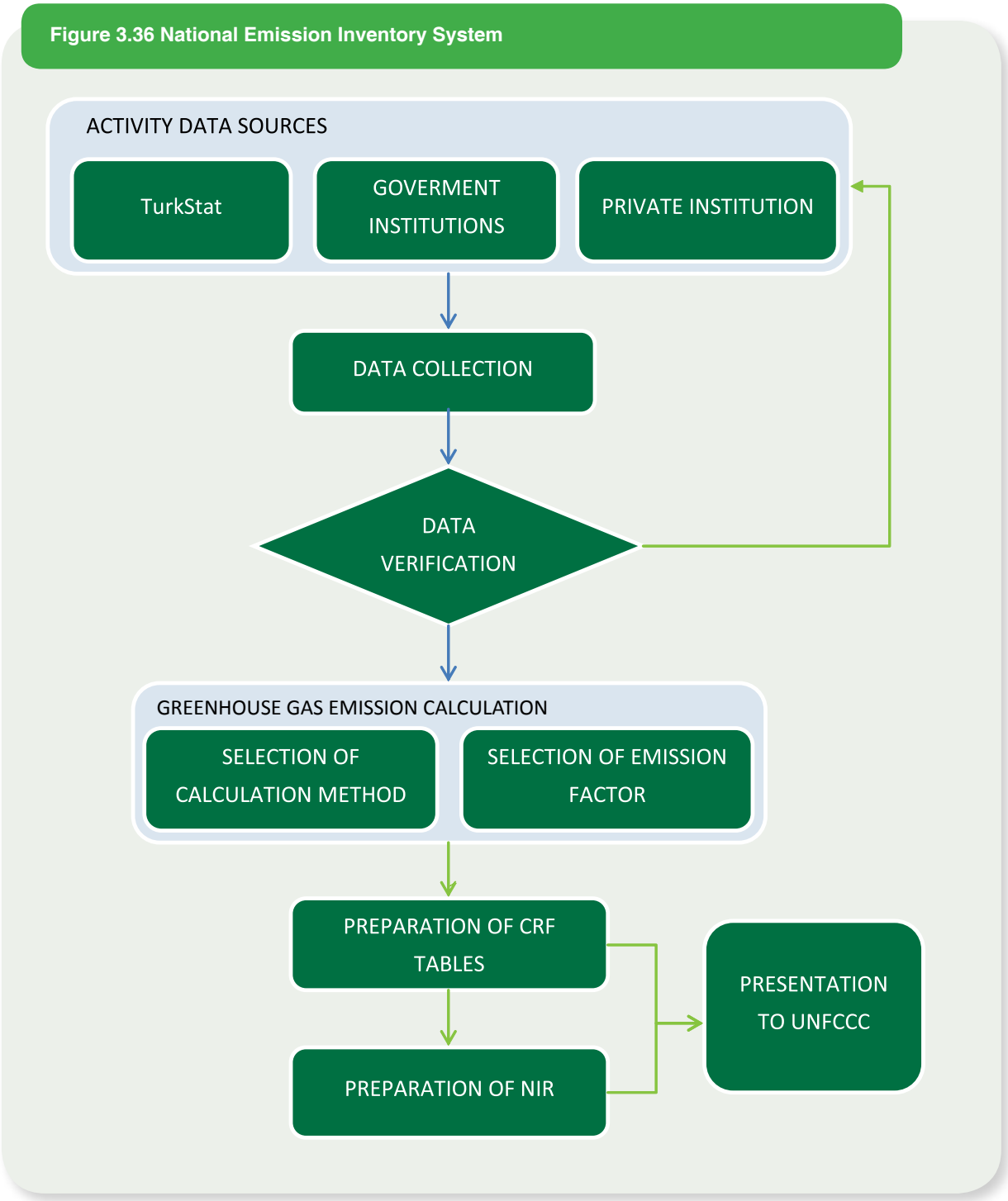
- Energy balance tables from the Ministry of Energy and Natural Resources;
- Industrial production data from Turkish Statistical Institute;
- Agricultural production and agriculture data from Turkish Statistical Institute;
- Land use change calculations and data from the Ministry of Food, Agriculture and Livestock;
- Forest carbon sinks and emissions calculations and data from the Ministry of Forestry and Water Affairs;
- Waste data from TurkStat;
- Transport related emission calculations and data from the Ministry of Transport, Maritime Affairs and Communications; and
- HFCs, PFCs and SF_6 emissions calculations and data from the Ministry of Environment and Urbanization.

In the calculations, data privacy is a significant problem. This problem was addressed by aggregated reporting for some categories, without mentioning the quantities or production, or in some cases data was not used in the inventory at all.

Industrial production data have been collected annually by TurkStat through seasonal and annual questionnaires filled by the affected industries. In addition, data has been collected from significant greenhouse gas emitter organizations or unions, like the Cement Manufacturers Association, the Automotive Manufacturers Association, and the Lime Manufacturers Association. Electronic databases are created, activity data is directly transferred to an Excel-based program and calculations are automatically performed and results transferred to the CRF tables in the desired format. The emission factors and activity data used in the calculations can be controlled.

LULUCF sector data collection, selection of methods and emission factors, sink calculation and reporting liabilities are undertaken by the Ministry of Food, Agriculture and Livestock and the Ministry of Forestry and Water Affairs. All calculations and preparation of National Emission Inventory of the LULUCF sector are performed by these organizations. TurkStat prepares the CRF tables and submit them to the Secretariat.

Figure 3.36 National Emission Inventory System



3.5.1 Quality Assurance and Quality Control (QA/QC)

Turkey, since 2006, submits its National Inventory Reports and CRF tables to the UNFCCC. After the preparation of reports, and before they are submitted to the Secretariat, in accordance with quality control procedure, the experts of TurkStat perform quality control analysis of the data. Presently, in accordance with IPCC 2006 Guidance, the quality control system is undertaken through by meeting the criteria listed below:

- The sectors other than 1A1.a Electricity and Heat Production, 2F Consumption of Halocarbons and SF_6 and 5 LULUCF sectors;
  - The activity data, emission factors and selected other parameters documented are controlled
  - Emissions and sinks calculations are controlled
  - Appropriate correction factors are stored correctly and that the parameters used and the units are controlled
- All sub-sectors are checked for consistency of data across categories;
- The accuracy of the database files except LULUCF are examined;
- Across all sub-sectors, the data is checked for completeness;
- Trends are controlled for (depending on years of trends in emissions compared to all sub-sectors); and
- Documentation is reviewed and archived.

The National Inventory Report and CRF tables submitted to the UNFCCC Secretariat are reviewed by international experts. International experts revise the reports and CRF tables. The reports are then revised and recalculated by TurkStat experts based on the recommended corrections of the experts.

National Quality Assurance and Quality Control (QA/QC) Plan of the GHG emission inventory is under preparation in accordance with the IPCC guidelines and FCCC/SBSTA/2006 requirements. After became official this plan is going to be used during preparation of the inventories.

3.5.2 Uncertainties

One of the most important parts of the National Emissions Inventories is the estimation of emission inventories uncertainty. Uncertainty calculations, not only provide information about inventory accuracy, they also lead to determine priorities for improvement of inventories, and for the choice of future methodologies. There are many reasons for the emergence of uncertainties in inventories, from the data used, the selected emission factor value and the methodology used for emission calculation. The estimated total uncertainty is a combination of individual uncertainties.

Based on the simple uncertainty analysis approach (Tier 1) stated in the 2000 IPCC Good Practice Guide, the total uncertainty of Turkey's National Emission Inventory for 2009, with and without LULUCF is 12.1% and 1.87%, respectively. Emission factor uncertainties are used to calculate emissions from different sectors in general. They were selected from the recommended values given in the 2000 IPCC Guide. Uncertainty of activity data is based on expert opinion.

Uncertainties of energy use activity data have been estimated by expert opinion within the Ministry of Energy and Natural Resources. The energy industry sub-sector that has the highest CO_2 emissions in the energy sector causes the highest uncertainty with 3.1% share in the sector. Transportation with an uncertainty of 2.9% has the second highest sub-sector uncertainty. The uncertainty of commercial/institutional, residential and agriculture/forestry/fisheries sectors of other sector sub-group is 2.7%. The uncertainty of fuel combustion emissions at refineries and manufacturing industry sub-groups are approximately 2.2% and 1.9% respectively.

The total uncertainty of the industrial processes sector is calculated as 5.9%. The uncertainties of industrial processes of production activity data were determined by expert opinion by TurkStat. As

the uncertainties are high both in terms of activity data and the emission factor used, the highest uncertainty of 6% is within the SF_6 and halocarbons sub-sectors. The uncertainty of the mineral products sub-sector is 4.7%.

The total uncertainty of the agricultural sector is 4.1%. Uncertainties of agricultural activity data were determined by expert opinion by TurkStat. Sub-sectors within the agricultural sector with the highest uncertainty are the field burning of agricultural wastes (23.2%) and rice production (22.4%) sub-sectors. Enteric fermentation, waste management and agricultural soils sub sectors uncertainties ranged from 6.2 to 6.4%.

The LULUCF sector has the highest uncertainty with 41.2 %. The total uncertainty of the waste sector is 15.6%. Uncertainties regarding the storage of solid waste and wastewater processing sub-sectors are around 17.2% and 17.4%, respectively. Uncertainty of activity data of solid waste and wastewater were determined by expert opinion with TurkStat.

In Table 3.7, the highest ranked sub-sectors that cause uncertainty within the national emission totals as percentage were listed for 2009. According to this table, the sector with the highest total uncertainty in national emissions is LULUCF. Following the LULUCF sector, the methane emissions from controlled and regular landfills have the second highest uncertainty. Another important source of uncertainty is originated from the CO_2 emissions of electricity generation or burned lignite, natural gas and hard coal at buildings. The uncertainties of HFC-134a and SF_6 emissions due to the consumption of HFC and SF_6 are high as well. Methane emissions from enteric fermentation of livestock sector, methane and nitrous oxide emissions from wastewater processing are seen as important sources of uncertainty.

Studies that can be done to reduce the uncertainty of the national emission inventory include the more accurate collection of activity data and the determination of country specific emission factors.

Table 3.7 Uncertainty of the National Total Emissions in 2009

Sectors	Uncertainty of Activity Data (%)	Uncertainty of Emission Factor (%)	Combined Uncertainty (%)	Combined Uncertainty as %of Total National Emissions
LULUCF	40.00	10.00	41.2	-11.85
CH_4 emissions from landfills	15.00	19.0	24.2	1.49
CH_4 emissions from dumping site	15.00	19.0	24.2	1.05
CO_2 emissions from lignite burned public electricity and heat production	5.30	3.0	6.1	0.88
CO_2 emissions from hard coal usage in buildings	7.00	3.0	7.6	0.53
CO_2 emissions from road transportation	0.00	5.0	5.0	0.45
CO_2 emissions from cement production	0.00	5.0	5.0	0.44
HFC-134a emissions from HFC usage	40.00	20.0	44.7	0.44
CO_2 emissions from natural gas electricity and heat production	0.00	3.0	3.0	0.40
CO_2 emissions from hard coal electricity and heat production	7.00	3.0	7.6	0.35
CH_4 emissions from enteric fermentation	6.30	1.0	6.4	0.33
CO_2 emissions from lignite usage in buildings	5.30	3.0	6.1	0.25
CO_2 emissions from fuel usage at agriculture/forestry/ fisheries sectors	0.00	5.0	5.0	0.23
CO_2 emissions from Iron and Steel production due to coal burning	7.00	3.0	7.6	0.23
CO_2 emissions from natural gas usage in buildings	0.00	3.0	3.0	0.17
CH_4 emissions from residential and commercial wastewater processing plants	15.00	19.0	24.2	0.17
CO_2 emissions from cement production due to hard coal usage	7.00	3.0	7.6	0.15
CO_2 emissions due to lignite usage at other industries	5.30	3.0	6.1	0.15
N_2O emissions from residential and commercial wastewater processing plants	15.00	19.0	24.2	0.15
N_2O emissions due to synthetic fertilizer usage	1.00	9.0	9.1	0.14
CO_2 emissions from road transport due to LPG usage	2.50	5.0	5.6	0.14
CO_2 emissions from lime production	15.00	1.0	15.0	0.13
SF_6 emissions due to SF_6 usage	40.00	20.0	44.7	0.13
CO_2 emissions from road transport due to gasoline usage	3.00	3.0	4.2	0.10
CO_2 emissions from Other Industries natural gas usage	0.00	3.0	3.0	0.10

4. POLICIES AND MEASURES

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4.1. Policy Framework and Policy-Making Process

SUSTAINABLE DEVELOPMENT

Turkey's climate change policies are generally based on the principle of sustainable development, referred to in Turkey's Sixth Five Year Development Plan (1990-1994). Implementation of the concept of sustainable development was advanced by the Local Agenda 21 Program (1997), the National Environmental Action Plan (1998), and it further gained speed through Turkey's EU membership process. The "National Sustainable Development Report," published in 2002 by the former Ministry of Environment and Forestry (MEF), defined objectives, principles and policies related to sustainable development in Turkey. The "Sustainable Development National Commission" was established in 2005 for the purpose of extending sustainable development practices and for monitoring implementation progress. In 2006, the UNDP began implementing the project, "Integration of Sustainable Development into Sectoral Policies" in coordination with the former State Planning Organization (SPO) through European Union (EU) financial support. The main objective of the project was to ensure that sustainable development principles were integrated to Turkey's macroeconomic and sectoral development plans at the national and regional levels, within the framework of the 2002 World Sustainable Development Summit and with the EU's 6th Environmental Action Plan. Within the scope of the project, grants were provided in various regions of the country, and pilot activities were implemented.

Turkey's Eighth Five Year Development Plan (2001-2005) integrated sustainable development across sectors and policy-making. The Ninth Development Plan (2007-2013) stressed within its strategy that "an integrated approach is the basis in economic, social and cultural areas" and "natural resources, cultural assets and environment shall be preserved in consideration of future generations." Accordingly, the Plan establishes the following objective: "Preservation and utilization conditions of natural resources shall be determined in consideration of the needs of future generations. Environmental management systems that shall guarantee equal utilization of natural resources by everyone shall be established." Local and central administrations are responsible for implementing policies and practices in relation to sustainable development.

CLIMATE CHANGE POLICY

In Turkey, policies to combat climate change were included in the Eighth Five Year Development Plan for the first time. The plan indicates that, in addition to the studies to be performed based on its responsibilities under the UNFCCC, Turkey will develop regulations focused on increasing energy efficiency to decrease greenhouse gas emissions from transportation, energy, industry and residences. The Ninth Development Plan calls for the preparation of a "Climate Change National Action Plan" that identifies greenhouse gas reduction policies and measures within Turkey.

In consideration of Turkey's UNFCCC responsibilities, Turkey established a "Coordination Board on Climate Change" (CBCC) in 2001 to coordinate activities and research that address climate change. The Board was restructured in 2004, 2010 and 2012, and now includes representation from public institutions, as well as from the private sector and non-governmental organizations (NGOs).

Turkey's main climate change policy document is the National Climate Change Strategy Document (NCCSD) that was prepared through a participatory process that included members of CBCC, relevant public institutions, private sector representatives, NGOs and universities in coordination with the former MEF. This strategy document focuses on 2010 to 2020 and was approved by the Supreme Planning Council (SPC) in 3 May 2010.

National Climate Change Strategy Document ((2010-2020)

The National Climate Change Strategy Document addresses policies related to emission reductions, adaptation, finance and technology that Turkey will implement through national funds and based on the availability of international financing and grants within the framework of the UNFCCC's "principle of common but differentiated responsibilities."

Box 4.1. National Climate Change Strategy (2010-2020)

Turkey's national vision within the scope of climate change is to become a country fully integrating climate change-related objectives into its development policies, disseminating energy efficiency, increasing the use of clean and renewable energy resources, actively participating in the efforts for tackling climate change within its special circumstances and providing its citizens with a high quality of life and welfare with low-carbon intensity.

The primary objective of Turkey is to integrate climate change policies and measures into its national development plans within the framework of "shared but differentiated responsibilities" principle and Turkey's special circumstances.

The strategy document includes activities that shall be implemented within short (1 year), medium (1-3 years) and long term (3-10 years) time frames in the areas of energy, transportation, industry, waste, land use, agriculture and forestry toward the goal of controlling greenhouse gas emissions. The primary goals in the energy sector are to increase the share of energy efficiency and renewable energy resources. Accordingly, the strategy document includes supporting research and development (R&D) activities, the development and promotion of economic tools related to reducing emissions from buildings, industry and electricity production. Increasing the share of railway and maritime transport, and wide use of alternative fuel and new technologies are the primary goals in the transportation sector. The industrial sector aims to support and promote on-site production systems, such as heat recovery alternatives, use of high efficiency motors in electrical motor systems, speed control and cogeneration and microgeneration in electrical motors. It also aims to develop incentive mechanisms to promote cleaner production technologies and climate friendly and innovative technologies. Waste management goals mainly focus on source reduction, reuse, recycling and ensuring effective implementation of recovery, as well as increasing the number of regular storage facilities. In the agriculture and land-use sectors, studies will be promoted on methods to restrict agricultural emissions and protect and increase forest lands.

In the Strategy Document, objectives related to adaptation to climate change are assessed under the following focal areas:

Table 4.1. Focal Areas under the Adaptation Part of NCCSD

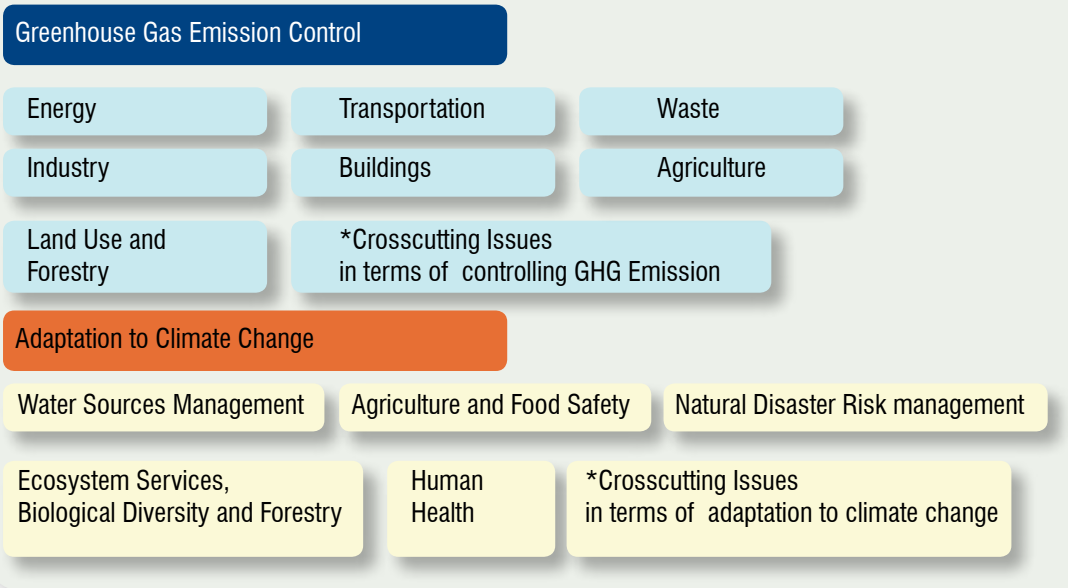
Agriculture	Natural Disasters	Water Resources	Health	Ecosystems	Urbanization
Combat drought Animal diseases Combat plant pests Implementation of effective irrigation systems	Combat flood risks Forest fires Combat erosion and desertification Early warning systems	Preservation of water quality River basin management plans	Monitoring communicable diseases Climate change and health policies Impacts of extreme weather events	Protection of sensitive ecosystems	Infrastructure Architectural and construction materials

The NCCSD also includes assessing technology requirements on sectoral basis, forming various incentive mechanisms to promote technology transfer, increase R&D activities for climate friendly technologies through innovative financing. The strategy also includes increasing public awareness and institutional capacity as medium term objectives, and in the long-term, the strategy aims to support scientific studies on climate change and establish a "Climate Change Research Institute."

National Climate Change Action Plan (2011-2023)

The "National Climate Change Action Plan" (NCCAP) was mandated by the NCCSD and the Ninth Development Plan. It was prepared with the participation of members of the CBCC and a large group of stakeholders in coordination with Ministry of Environment and Urbanization (MEU). It was published in July 2011. The NCCAP presents actions under the main goals of greenhouse gas emission reductions and adaptation to climate change. It also defines the institutions and organizations responsible for implementation and timing. The sectors in the plan are shown in Figure 4.1. Details of the actions in each sectors are not presented here since they are described under sectorial sub-headings in subsequent chapters.

Figure 4.1. Structure of NCCAP



*These includes actions on institutional arrangements and policy making, technology development and transfer, finance and economic tools, data and information systems, awareness raising and capacity building, and monitoring and evaluation of the NCCAP.

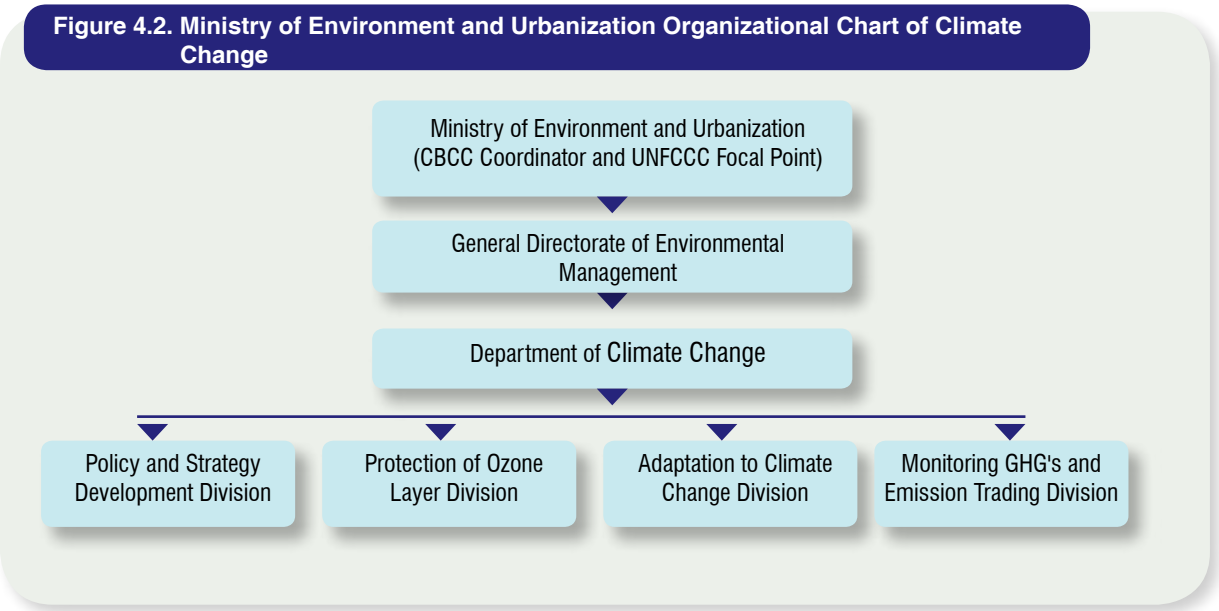
INSTITUTIONAL STRUCTURE IN COMBATTING CLIMATE CHANGE

Since climate change is an interdisciplinary issue, policy implementation requires coordination among sectors and institutions. The "CBCC" was established in 2001 as a result of the Prime Ministerial Circular in order to coordinate climate change activities based on Turkey's responsibilities under the UNFCCC. The following are the members of the CBCC: the Ministries of Environment and Urbanization; Science, Industry and Technology; Foreign Affairs; Economy; Energy and Natural Resources; Food, Agriculture and Livestock; Development; Finance; Forestry and Water Works; Health; Transportation, Maritime Affairs and Communication; the Undersecretariat of Treasury; Union of Chamber and Commodity Exchanges of Turkey (TOBB); and Turkish Industry and Business Association (TUSIAD).

The objectives of the CBCC are to take measures to prevent the detrimental impacts of climate change; to ensure that relevant studies are more effective; to establish coordination between organizations and institutions from the public and private sector; to ensure coordination and work distribution; and to determine suitable internal and foreign policies in consideration of the special conditions of Turkey. The CBCC also has several other responsibilities, such as issuing the National Communications and other relevant studies that the Republic of Turkey must issue based on UNFCCC obligations.

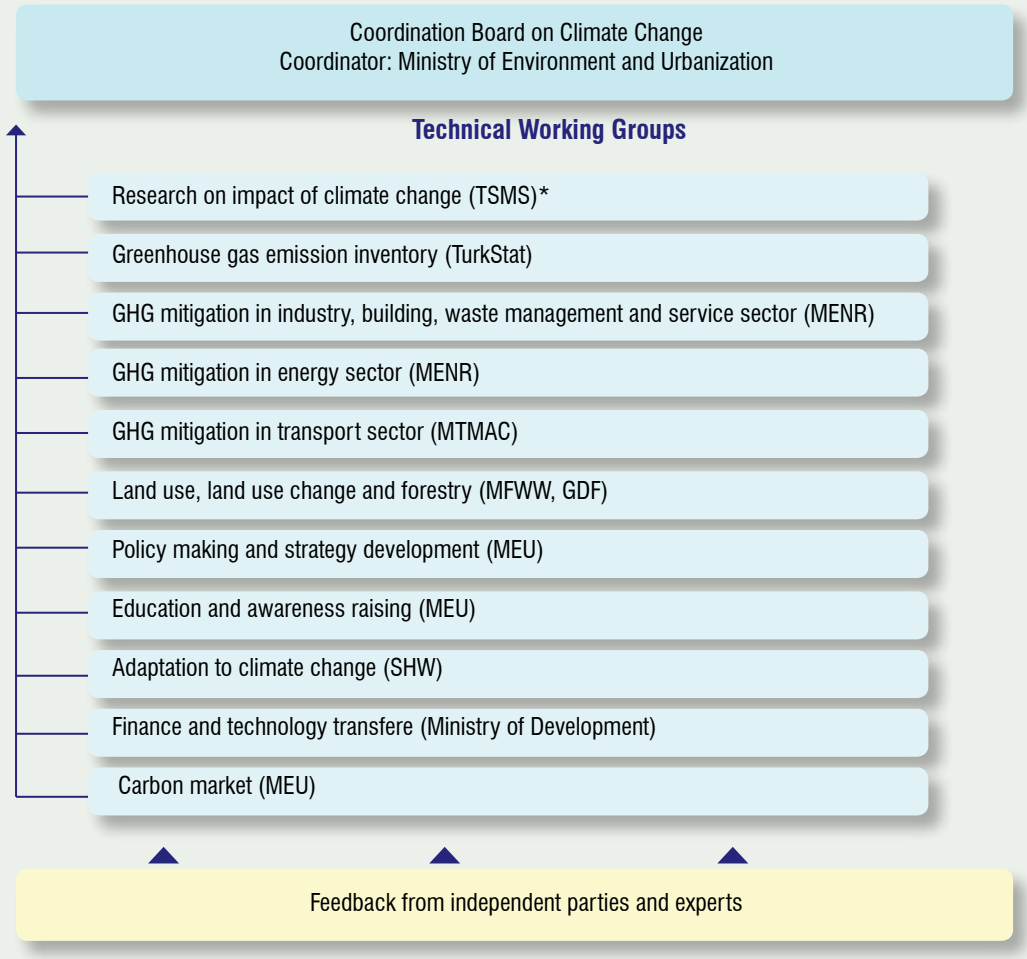
The CBCC's chairmanship and secretariat affairs are implemented by the MEU, which is also the National Focal Point of the UNFCCC. Within this framework, the Department of Climate Change was established on July 2010 within the General Directorate of Environmental Management in the MEU (Figure 4.2). There are various other units and/or specialists relevant to climate change within other ministries and organizations.

Figure 4.2. Ministry of Environment and Urbanization Organizational Chart of Climate Change



There are 11 Technical Working Groups active within the scope of the CBCC with the responsibility to implement sectoral activities (Figure 4.3). These working groups are responsible for preparing national opinions and documents. Some efforts have been started to reorganize the structure of working groups to ensure that they continue their efforts more efficiently. The CBCC engage independent parties such as universities, NGOs, private sector into decision-making processes and technical works.

Figure 4.3. CBCC Technical Working Groups



*Abbrevation of the coordinator institutions for each working group are provided in paranthesis

MONITORING AND EVALUATION

Since Turkey does not have an emission reduction target under the Kyoto Protocol, the monitoring and evaluation activities presented here are based on monitoring and evaluation of implementation of national climate change policies. Legal regulations are implemented by relevant ministries, and monitoring and evaluation activities under current regulations are performed by subject matter ministries.

An online monitoring and evaluation system has been established within the MEU in order to monitor implementation of the actions under NCCAP.

The general strategy and policies to combat climate change are determined by the Government, with both central and local authorities playing critical roles. On the basis of the Municipality Law (No. 5393), municipalities make procurement to provide services, such as urban transportation and waste collection and disposal, as well as services related to urban infrastructure, environment and environmental health, housing, economic development and public works. Internal and external audits of financial transactions of municipalities are performed according to the provisions of Public Financial Management and Control Law (No. 5018). Administrative proceedings of the municipalities are also audited by the Ministry of Internal Affairs for compliance with laws and for administrative integrity. In addition to current emission reduction activities, the NCCAP also includes actions that will be implemented by municipalities through 2020 related to combating climate change, and subject matter actions shall be monitored and assessed within the scope of NCCAP monitoring and assessment structure.

FINANCING

In Turkey, the cost of implementing policies and measures related to climate change are covered by the resources available at the central and local levels, as well as by financial resources from international institutions. Turkey needs to use climate funds and other international funds, as well as national resources, to implement planned mitigation and adaptation measures, and to engage in efforts to extend the scope of measures (see Chapter 7). This is also reflected in the UNFCCC Decisions 1/CP.16 and 2/CP.17 where Turkey's status as different from other countries listed in Annex-I is recognized. These decisions also establish the need to increase the Turkey's capacity to access finance, technology and capacity development facilities to implement its UNFCCC requirements.

4.2. Crosscutting Policies and Measures

Policies and measures adopted within sectors related to combating climate change are presented in Table 4.2. Research and development activities that are implemented by all of the sectors are described in detail in Chapter 8, and issues of education, training and raising awareness of public are described in detail in Chapter 9.

Table 4.2. Crosscutting Climate Change Policies and Measures Among Sectors

Policy/ Measure	Objective	Affected Greenhouse Gas	Type of Policy/ Measure	Status	Executive Institution/ Organization
Economic tools (Voluntary Emission Trading, renewable energy supports, state aids)	Reduction of fossil fuel consumption	All	Economic	Effective	MEU
EU Membership Process	Legislative harmonisation, infrastructure investments and implementation	All	Legal, financial	Effective/ Planned	MEU and relevant ministries
National Climate Change Strategy and Action Plan	GHG emission mitigation in energy, industry, transportation, waste, building and forestry sectors	All	Legal, economic, financial, research, knowledge	Effective	MEU and relative ministries
Local Climate Policies	GHG emission mitigation measures in transportation, waste, energy and forestry sectors	All	Legal, economic	Under implementation	Local governments
Voluntary Activities of the Private Sector and Non-Governmental Organizations	Raising awareness, developing coordination, emission mitigation, making investment to combat climate change	All	Voluntary	Under implementation	Private sector and NGOs

RENEWABLE ENERGY SUPPORTS

The Law Regarding Use of Renewable Energy Resources for Electricity Production Purposes (No. 5346, Renewable Energy Law-REL) of 2005 provides critical incentives and support to renewable energy producers. As a result of the Law, purchase of electricity generated using renewable energy resources is guaranteed by the government, and government support is provided on several

issues relevant to renewable production, such as land allocation. Accordingly, the government guarantees the purchase of renewable energy at the following rates: 7.3 cent (US$) per kWh for energy generated by using wind; 7.3 cent (US$) per kWh for energy generated by hydro-electric power and 10.5 cent (US$) per kWh for geothermal energy. Incentives and support related to electricity generated from renewable energy are explained in the Energy Policies chapter in detail.

STATE AID

In Turkey, a variety of support is provided for investments within the framework of the Council of Ministers' Decision regarding State Aids in Investments (No. 2012/3305) according to the classification of general, regional, large scale and strategic investments. In this context, Value Added Tax (VAT) exemption, customs tax exemption and interest support facilities are provided for environmental investments. In case subject matter investments are made in relatively least developed regions, the investor may also benefit from income tax stoppage and insurance premium support.

CARBON MARKET IN TURKEY

Although Turkey may not benefit from the flexibility mechanisms of the Kyoto Protocol that are related to emissions trading, projects for the voluntary carbon market are being developed and have been implemented since 2005.

The voluntary carbon market represents more than 1% of the total world carbon market. It presents an opportunity of participation of Turkey to use this market effectively and to access carbon markets in the future. Although it has a very small share in the world carbon market, voluntary emission trading systems have become an alternative resource for carbon financing with high standards and high volume potential. Participation in these markets has contributed to the strengthening of Turkey's technical infrastructure since 2012, and it has also made investments in cleaner technologies more attractive.

In spite of Turkey's unique status under the UNFCCC and uncertainties in the international climate regime, the progress that Turkey has made in voluntary carbon markets is encouraging (Table 4.3.).

Table 4.3. Types of Projects that Have Been Developed for Carbon Markets in Turkey and GHG Reductions (January 2012)

Type of Project	Number of Projects	Annual Greenhouse Gas Mitigation (tonnes of CO_2 eq)	Annual Greenhouse Emission Reductions According to the Type of Project (%)
Hydroelectricity	103	3,917,479	33
Wind	57	5,291,229	45
Bio-gas	1	75,000	0.6
Geothermal	5	285,309	2
Energy Efficiency	1	58,328	0.4
Waste to Energy Production (landfill gas)	11	2,218,160	19
TOTAL	178	11,845,505	100

Source: MEU, 2012.

Most of the projects in Turkey are developed according to the Gold Standard. Also, there are projects that are developed according to the standards of Voluntary Emission Reduction Standard (VER+) and Verified Carbon Standard (VCS). In consideration of the similarity of Gold Standard to Clean Development Mechanisms (CDM) and its high market reliability, it is clear that Turkey produces highly credible emission reductions.

The development of emission reduction projects in Turkey has also led to important capacity development opportunities. Consequently, significant technical and human resources capacities have developed in the country. This is particularly true in the private sector. Since 2007, the Turkish private sector has prepared for, implemented and assessed low-carbon projects regarding renewable energy and energy efficiency.

Institutional Structure for Carbon Market

Regarding emissions trading, the Greenhouse Gas Monitoring and Emission Trading Division is established under the Climate Change Department within the body of MEU. Complementing this division is the Carbon Markets Technical Working Group under CBCC, which aims to ensure that Turkey participates in current and future global and regional carbon markets. This working group also performs the technical groundwork to help develop policies and strategies related to establishing and administering a national carbon market. The working group is responsible for: analyzing activities necessary for integration into carbon markets; preparing suggestions on legal and organizational structures; developing organizational capacities to participate in carbon markets; and developing suggestions to raise public awareness.

Registration Procedures for Greenhouse Gas Emission Mitigation Projects

The MEU prepared a communique on Registration Procedures for Greenhouse Gas Emission Mitigation Projects that was published in the Official Gazette number 27665 and came into force on 7 August 2010[1]. This communique requires registration of projects developed for voluntary carbon markets. The registry includes projects that aim to mitigate emission from one or more greenhouse gases within the borders of Turkey, that aim to increase sink areas, and that hold a certified emission reduction certificate or that are developed or being developed to obtain an emission reduction certificate. The registry only covers emission reduction activities that aim to obtain a certificate in carbon markets, and arrangements regarding keeping records of other emission reduction activities are planned to be implemented in the future.

The projects that are within the scope of the registry are officially communicated to the MEU, and are also registered to the electronic registration system of the Ministry that may accessed at the following web address: http://karbonsicil.cevre.gov.tr. This registry system has been Turkey's first step in accessing future carbon markets. This will also help prepare Turkey to raise awareness of carbon markets, to increase knowledge sharing, to promote reliable generation of carbon credits in Turkey and to promote good practices.

Establishment of the National Carbon Market

A Strategy and Action Plan for Istanbul International Financial Centre was prepared by the former SPO and accepted by the SPC became effective after being published in the Official Gazette with No. 27364, dated 02 October 2009. The vision of the Strategy and Action Plan is to transform Istanbul initially into a regional financial centre, and then to transform it into a global financial centre. In Action No. 34 of the plan, the development of a carbon market in 2012 that will be operational in 2015 is envisioned. The Istanbul Gold Exchange is responsible for this plan, and it will be assisted by the MEU, the Capital Markets Board, the Istanbul Stock Exchange (ISE), Takasbank and the Turkish Derivatives Exchange.

Some of the objectives and actions that are available in the NCCAP related to monitoring and trading of greenhouse gas emissions reductions and actions that will be implemented in coordination with the MEU are as follows:

- Monitoring and reporting greenhouse gas emissions in all of the sectors (2012-2016).

[1] Revision published in the Official Gazette dated 22 October 2011 and numbered 28092.

- Establishing infrastructure to enable production and collection of data that may be measured, reported, verified to monitor and evaluate greenhouse gas emissions in all sectors, and to register such data in a database (2012-2014).
- Establishing legal regulations regarding monitoring greenhouse gas emissions and inventories (2012-2014).
- Conducting negotiations related to inclusion of Turkey in new mechanisms that will emerge after 2012 in the most advantageous way, and searching for bilateral opportunities (2011-2015).
- Establishing a carbon market in Turkey by 2015.
- Performing activities that are necessary to develop the current structure and establishing new structures to ensure that carbon assets are traded on the basis of maximum value and that their values increased (2012-2013).
- Developing legislation to ensure that public institutions play a regulatory and supervisory role in the emission trading system (2011-2015).
- Commencing the implementation of infrastructure to establish a National Emission Trading System (2014-2015).
- Increasing awareness and consciousness related to carbon markets.

THE EU MEMBERSHIP PROCESS

Turkey, as a candidate country for the EU, continues to implement legislative harmonization activities since 2005. In the EU accession process, the Environmental Phase negotiations that were begun in December 2009 continue to the present. Environmental legislation is being harmonized across several different areas, such as air quality, water management, waste management, emissions from large-scale incineration plants, prevention and controlling of integrated pollution, environmental impact assessment. In addition to the environmental legislation that contributes to combating climate change, Turkey is working towards legislation consistent with the EU legislation regarding ozone-depleting substances (ODS), fluorinated gases, emission trading, consumer information and carbon capture and storage. Turkey also actively participates in activities relate to climate change within the Regional Environmental Network for Accession of EU.

Regarding ODS, Turkey became a party to the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer in 1991. As a requirement of the provisions of Montreal Protocol, Turkey is listed in the category of "Developing Countries" based on the level of consumption of ODS (Countries where annual ODS consumption per person on any date when the protocol became effective or on any date up to January 1st, 1999 is maximum 0.3 kg). In this context, Turkey benefits from the Multilateral Fund (MLF) that was organized within the scope of the Montreal Protocol.

In spite of the inclination towards removing of ODS from fluorinated gases, technological transformation in the sector has been directed towards the fluorinated greenhouse gases that contribute to climate change. Regulation No. 842/2006/EC and several other regulations on implementation of this regulation in related sectors are effective in the EU in order to control emission of such gases. However, there is no regulation in Turkey that is consistent with these EU Regulations. However, action is underway to request aid from the financial resources of the EU's Support Activities to Strengthen the European Integration Process (SEI).

Several actions have been taken to harmonise Turkish law with the EU emission trading monitoring mechanism. Various stakeholders in the country have taken steps to increase collaboration for emission trading in Turkey, including raising awareness of EU's Emission Trading System[2]. MEU prepared the By-Law on Monitoring of Greenhouse Gas Emissions which was published in the Official Gazette dated 25.04.2012 and no 28274. By this legislation, only the "monitoring, reporting and verification of the GHG emissions that result from the industry sector" part of the Emission Trading Directive (No.2003/87/EC) was harmonized.

Regarding consumer information, the EU Directive 2003/73/EC related to consumer information

[2] EC, 2011. "Turkey 2011 Progress Report", European Commission Report, Sec (2011) 1201 final, Brussel, pg. 101.

on fuel consumption and CO_2 emissions of new passenger cars has been harmonised and is being implemented.
The EU Directive 2009/31/EC on carbon capture and storage and related directives and legislation 1013/2006 has not been harmonised yet. However, several related research projects have been Implemented or are ongoing. In a project Implemented in 2009 in coordination with the Middle East Technical University - Petroleum Research Centre (METU-PRC), Turkish Petroleum Corporation (TPC) and Ministry of Energy and Natural Resources (MENR) and under the sponsorship of the Scientific and Technological Research Council of Turkey (TUBITAK), geological structures where CO_2 may be stored in Turkey were studied. Also, METU-PRC is a member of the "Pan-European Coordination Action on CO_2 Geological Storage" that has been supported by the EU's Seventh Framework Program since 2010. The aim of the project is to construct reliable, independent, long-lasting and representative Pan-European scientific expertise on geological storage of CO_2.

Effects of the EU Membership Process

Within the scope of the EU membership process, legislation harmonisation works continue in several sectors and issues that directly or indirectly impact greenhouse gas emissions. Some of these have begun to be implemented. It is difficult to calculate the total impact of activities performed during the EU membership process on the emissions. However, it is clear that this process will make significant contributions to the sustainable use of resources, mitigating emissions and environmental management.

LOCAL CLIMATE POLICIES

About 75% of Turkey's population lives in cities. Therefore, cities are both important as a source of environmental pollution and as part of the solution. Local governments play a central role in policies and practices, particularly on issues of urban transportation, waste and energy. There are 16 Metropolitan Municipalities in Turkey, and the municipalities' duties and areas of jurisdiction include several services according to the Metropolitan Municipality Law[3], such as: preparation and implementation of urban and main transportation plans; waste collection, disposal and related infrastructure services; water and sewage services; and forestation and environmental preservation. Metropolitan Municipalities have taken significant steps on these issues. Çanakkale and Gaziantep Metropolitan Municipalities have Implemented their Climate Change Action Plans. Several other municipalities are preparing Climate Change Action Plans, as well. Sustainable transportation, waste and energy plans are among the top of the actions within each of these action plans.
The Integrated Urban Development Strategy and Action Plan (2010-2023) (KENTGES) (Official Gazette No. 27749, 04/10/2010) primarily includes strategies and actions on spatial planning, transportation and infrastructure, housing, transformation, preparation for natural disasters, preservation of natural and cultural assets, climate change, energy efficiency and renewable energy resources, settlement and ecology, immigration and social policies, and strengthening economic structure and accession. In effect, KENTGES acts as a roadmap for central and local governments in terms of urbanization and public works. Activities to implement KENTGES at the central and local levels have been pursued strongly since January 2011. KENTGES is being implemented and monitored by the Steering Committee that comprises top level representatives of the MEU and relevant public institutions. Through KENTGES, the following works are being performed: raising awareness at provincial and regional levels; capacity development for local governments; due diligence and training activities; and activities related to the establishment of the KENTGES monitoring system.

Various activities directly addessing climate change are also described in the KENTGES document and are started to be implemented by the responsible institutions such as MEU, municipalities, MENR, Ministry of Forestry and Water Works (MFWW). One of them is: "energy efficient and climate friendly urbanization strategies are to be developed" that is also included in the NCCAP.

Additionally, the NCCAP also includes several actions concerning municipalities indirectly, and several other actions where municipalities are directly responsible for urban transportation and

[3] Metropolitan Municipalities Law numbered 5216, published in the Official Gazette dated 23 July 2004 numbered 25531.

waste. Other responsibilities of municipalities under the NCCAP are developing policies and legal regulations for energy efficiency and climate sensitive settlement/housing, as well as implementing pilot projects.

PRIVATE SECTOR PRACTICES

Representatives of the private sector implement research activities and practices on cleaner and sustainable production. Some of the projects and practices that the private sector participates in general are described below:

- **Carbon Disclosure Project (CDP):** The global project was initiated in 2000 to collect and share information on how companies, investors and governments to take action on climate change. The project includes 551 institutional investors that managed assets with the value of US$71 trillion in 2011.[4]

  Sabancı University from Turkey became a local partner of CDP in 2010. Fifty companies that are included to the Istanbul Stock Exchange-50 index were invited by the CDP Turkey to participate. Ten of these companies and one voluntary company disclosed their risk management policies in relation to greenhouse gas emissions and climate change impacts.[5]
- **İstanbul Stock Exchange (ISE) Sustainability Index Project:** The purpose of this project is to develop an index for companies that are traded in the ISE and that have high institutional sustainability performance levels to increase their level of understanding, and knowledge and practices in relation to sustainability. The project reveals companies approaches to issues related to sustainability, including climate change, consumption of natural resources, water resource management, health, security and employment. The index enables companies to compare their institutional sustainability performance at local and global levels. This project was initiated in 2010, and is currently being implemented[6].
- **Vision 2050 Turkey Report:** This report was issued by TUSIAD in 2011 with the purpose of making a connection between current actions and a sustainable future, providing suggestions on achieving a sustainable Turkey by 2050. The report emphasizes the risks that may emerge on this path, and how they may be overcome. The Vision 2050 Turkey Report was issued with reference to the Vision 2050 report that was introduced at the World CEO Forum by the World Sustainable Development Business Council in 2010.[7]

4 http://www.cdproject.net
5 http://cdpturkey.sabanciuniv.edu
6 http://www.isesi.org
7 http://www.tusiad.org

4.3. Energy

GENERAL POLICIES AND STRATEGIES

According to Turkey's Greenhouse Gas National Inventory, the energy sector contributed to 75.3% of Turkey's total emissions in 2009, with most of the energy sector emissions resulting from the combustion of fuels. In order to control emissions from the energy sector, Turkey is pursuing energy policies focusing on: the assessment of energy efficiency potential; greater use of renewable energy resources; and extending the use of clean coal technologies and the use of nuclear power[8].

Turkey pursues policies and strategies to secure a safe energy supply. Turkey analyses global trends and the policies and strategies of global producers and consumers. Accordingly, Turkey's basic energy policy goals are based on the following:

- Decreasing foreign-source dependency to the lowest level;
- Attaching importance to resource diversity, local and renewable resources;
- Minimising impacts on environment;
- Using energy resources and energy efficiently and rationally from production to consumption;
- Activating public and private sector facilities to promote free market practices; and
- Implementing policies that help meeting the energy needs of the country safely, continuously and with minimum cost and environmental impacts.

Devoting attention to increasing local (coal, petroleum and natural gas) and renewable resource (hydroelectricity, wind, geothermal, solar, biofuel, biomass and biogas) use, as well as increasing energy efficiency, nuclear power and minimising loss and illegal use, are expected to decrease foreign-source dependency.

The Ministry of Energy and Natural Resources (MENR) is responsible for determining energy policies in Turkey. Based on the Electricity Energy Sector Reform and Privatization Strategy Documents[9] that were issued by MENR and that became effective in 2004 after being approved by the Supreme Planning Council (SPC), Turkey aims to diversify electricity energy resources and to increase investments in renewable energy resources, such as hydroelectricity, wind, solar, geothermal, biomass and biogas. In the Electricity Energy Market and Supply Safety Strategy Document,[10] adopted by the SPC in 2009, Turkey plans to change the current production structure significantly towards these objectives by 2023.

In addition, the Energy Efficiency Strategy Document (2012-2023), another document approved by the SPC, describes a target to decrease the amount of energy consumed per unit GDP (energy intensity) in Turkey by a minimum of 20% by 2023.

In the Climate Change Strategy Document and Action Plan, Turkey aims to increase the share of renewable energy resources, increase energy efficiency, as well as decrease CO_2 emissions from energy use by 7% by 2020 according to business as usual scenario (BAU).

8 MENR, 2011a.Bakan Taner Yıldız, 2012 Budget speech.

9 SPC Resolution No. 2004/3 (17 March 2004).

10 SPC Resolution No. 2009/11 (18 May 2009).

Box 4.2. Targets of Energy Sector

The following targets are determined in the Electricity Energy Market and Supply Safety Strategy Document:

- To reduce the share of natural gas to 30%, which meets approximately half of the electricity production with %34 of the current installed capacity;
- To ensure that the share of renewable resources in electricity energy production reaches a minimum of 30% in 2023. The following goals are determined for this purpose:
  - To increase wind energy installed capacity to 20,000 MW by 2023,
  - To ensure that the hydroelectricity potential that is technically and economically feasible is used for electricity energy production by 2023,
  - To ensure the use of 600 MW of geothermal energy potential that has been determined to be suitable for electricity energy production by 2023, and
  - To increase the use of solar energy in electricity production;
- To ensure that the share of nuclear power plants in electricity production reaches at least 5% by 2020.

The Strategy Document also assesses issues related to energy efficiency and conservation. Thus, an additional aim is to decrease emission reductions from energy consumption, as well as to mitigate the load that is created on the economy by the electricity energy costs and to decrease environmental impacts.

LEGAL REGULATIONS AND IMPLEMENTATION

Policies and measures for mitigating greenhouse gas emissions from energy consumption are summarised at the end of this chapter in Table 4.6. Issues related to renewable energy, energy efficiency and clean technologies are assessed in detail in the following sections.

4.3.1. Utilization of Renewable Energy Resources

Activities related to renewable energy are implemented by the General Directorate of Renewable Energy affiliated to the MENR. The Energy Market Regulatory Authority (EMRA) is responsible for regulation and supervision of the electricity market and monitors the progress of the renewable energy market in Turkey.

As of 2010, the share of renewable energy in the total primary power supply in Turkey is only 10.7%. Although approximately 35% of the installed capacity is based on renewable energy, its share in the production of national electricity is 26%[11] as of 2010 since actual use of renewable resources in energy production are based on weather and natural conditions. In the current strategy documents, the goal is to increase the use of renewable resources in the production of electricity to 30% by 2023, foremost hydroelectric and wind.

The REL, provides critical incentives to electricity producers. As a result of the REL, electricity generated by renewable resources is guaranteed to be purchased and tariff support is provided. Support is also provided for land allocation. As a result of the change that was made to the REL in 2011, tariff supports are structured according to resources, additional incentives are allocated according to the ratio of contribution to local production, and the penalties that are imposed on producers that violate the law were increased. Based on this law, a Feed-in Tariff (FIT) will be applied to electricity produced through renewable energy at the following rates:

[11] TEIAS, 2010 Turkey Electricity Production-Transmission Statistics, 2011.

Table 4.4. FIT Values Based on Energy Resources

Type	FIT (USD cent/kWh)
Hydroelectric Energy	7.3
Wind Energy	7.3
Geothermal Energy	10.5
Biofuel Energy	13.3
Solar Energy	13.3

Source: MENR, 2011.

As a result of the REL, the installed capacities for renewable energy electricity production increased significantly. Excluding hydro-electric power generation from dams, the share of the installed capacity of renewable energy resources in the total installed capacity was 2.7% in 2000, and increased to 4.8% in 2009. While electricity production from renewable resources was 34.0 billion kWh in 2002, it increased to 55.8 billion kWh with an increase of 64% at the end of 2010.

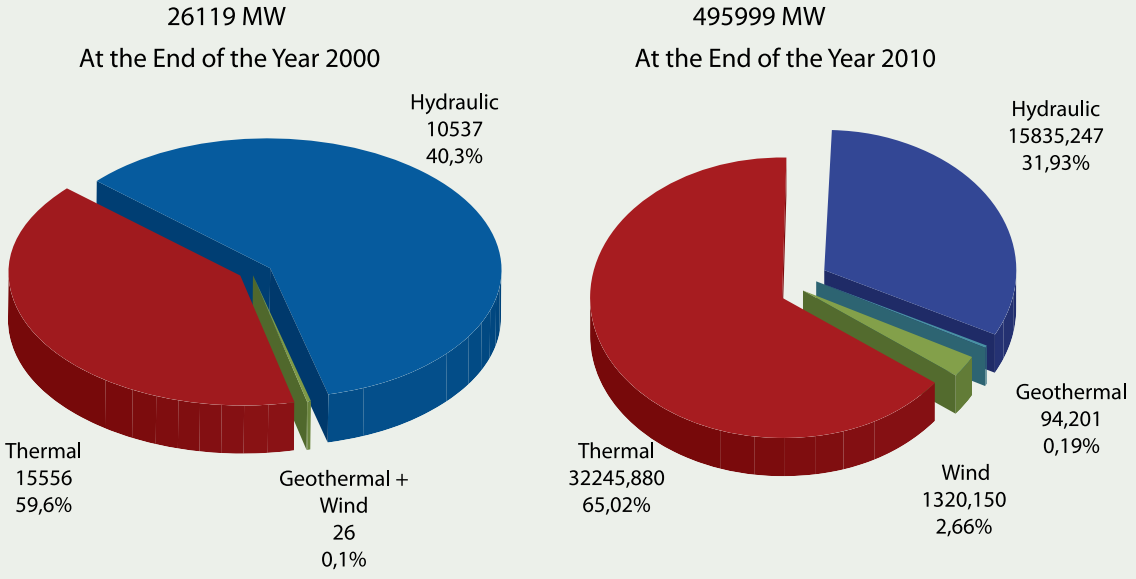
In addition, as a result of the Regulation Regarding Unlicensed Electricity Production in the Electricity Market and in order to support the development of technology to efficiently access renewable energy resources at maximum level, use of local machines and equipment in production facilities has been promoted, and several facilities have been provided for investments made to renewable energy plants with an installed capacity of 500 kW and below. This offer directs surplus energy that is produced in such plants to the system and can be sold by retail sale companies at set prices.

According to regulation entered into force in 2010, however, following arrangements were done; applications for the solar energy projects will be collected, total capacity of solar farms can not exceed 600 MW until 31 December 2013, and each solar energy project can not exceed 50 MW.

As a result of the amendment made to the Law No. 4628 with the Law No. 5784, individuals are exempted from obtaining a license and establishing a company, if they establish a production facility on the condition that it utilizes 500kW renewable energy resources at most.

As a result of the supports under Law No. 5346 Regarding Utilization of Renewable Energy Resources for Electricity Production Purposes, efforts are underway to increase the role of solar energy in national electricity production.

Figure 4.4. Electricity Production from Renewable Energy (2000-2010)



(Source: MENR, 2011)

Wind Energy

Wind power plant (WPP) projects gained momentum in Turkey after the Renewable Energy Law became effective. WPP installed capacity which was 18.9 MW in 2002 reached to 1,720 MW as of 2011 year-end. 99 WPPs were commissioned during this period.

Bandırma WPP

Establishing the Wind Power Monitoring and Prediction Centre in order to generate real-time wind predictions for WPP operators and Turkish Electricity Transmission Company (TEIAS) had been initiated by the former General Directorate of Electricty Works and Survey Management (EIE) of MENR and is now being undertaken by the General Directorate of Renewable (GDRE) Energy of MENR.

Geothermal Energy

Turkey achieved the biggest progress in the world in the last five years in terms of direct use of geothermal energy, and elevated to the 5th order in the world ranking from her previous 11th order. Installed capacity grew from 17 MW in 2002 to 114.2 MW in 2011.

Biofuel

Biofuels are assessed within the scope of renewable energy resources, and according to the Communique on Technical Regulations Regarding Diesel Fuel Types[12], fatty acid methyl esters content of the diesel fuel types that are produced from local agricultural products (biodiesel) must be a minimum of 1% as of 1 January 2014, 2% as of 1 January 2015, and 3% as of 1 January 2016. According to the Communique on Technical Regulation Regarding Fuel Types, ethanol content of the fuel types that are produced from local agricultural products must be minimum 2% as of 1 January 2013, and 3% as of 1 January 2014. These communiques are expected to activate waste biodiesel production facilities with the capacity of 1.5 million tonnes. Therefore, minimum 420 thousand tonnes of diesel fuel shall be substituted as of 2016, and 90 thousand tonnes of fuel biofuel shall be substituted as of 2013.

[12] Published in the Official Gazette numbered 28067 dated 27 September 2011.

Solar Energy

Turkey is located on an area which is named as sun belt because of its position on the earth that allows it to benefit significantly from solar energy.

Solar energy production is monitored thanks to the Regulation Regarding Electrical Production Facilities Based on Solar Energy that became effective in 2011. Accordingly, total capacity of solar power plants (SPP) across Turkey will reach a maximum of 600 MW by the end of 2013. Activities have been initiated to establish a 10-15 MW solar power plant in Birecik Hydroelectric Power Plant site (377,000 m2) as a pilot.

Solar energy is widely used in Turkey for water heating, greenhouse heating purposes and for drying agricultural products. Solar collectors are available in 3-3.5 million residences in Turkey, primarily available in the Mediterranean, Aegean and Southeast Anatolia regions.

The former EIE and State Meteorological Services assessed solar and biomass resources for energy production, and the data generated have been published in the Turkey's Solar Energy Potential Atlas and "Insolation Potential Atlas of Turkey 2010."

Hydroelectric Power Plants

Hydroelectric installed power was 12,241 MW in 2002 in Turkey and grew to 17,036 MW in 2011, an increase of 39.2%. Approximately 37% of Turkey's hydroelectric energy potential (140 billion kWh/year) is managed by private sector. 15% of Turkey's capacity is under construction and evaluations of Turkey's technical and economic hydroelectric potential continue.

4.3.2. Energy Efficiency

Turkey has significant potential to decrease its energy intensity and increase energy efficiency in all stages of the supply and demand chain. Turkey's primary energy intensity, which refers to the amount of energy consumed in order to generate one unit of GDP, has tended to decrease in recent years.[13]

Turkey has implemented strong policies to increase energy efficiency. There are critical measures in the Energy Efficiency Law No. 5627 (18 April 2007) that push for energy efficiency in the industrial, transport, building, services, and electricity sectors. After the Law entered into force, secondary regulations established by various ministries, institutions and organizations between 2008 and 2009.

The Energy Efficiency Coordination Board (EECB) is headed by the Ministry of Energy and Natural Resources and is composed of senior representatives from the Ministries of Interior; Finance; National Education; Transport, Maritime Affairs and Communications; Science, Industry and Technology; Environment and Urbanization; Forestry and Water Works, Development; the Undersecretariat of Treasury, EMRA, Turkish Standards Institute (TSE), TUBITAK, TOBB, Union of Chambers of Turkish Engineers and Architects and Union of Turkish Municipalities. The EECB is an important structure to ensure eefective implementation of the energy efficiency policies that involves multi sectors and large amount of stakeholders.

General Directorate of Renewable Energy of MENR, that replaced EIE, is responsible for implementation of the Energy Efficiency Law.[14]

"Energy Efficiency National Action" was initiated through the Circular Order of Prime Ministry No. 2008/2 (No. 26788, 15 February 2008). Furthermore, the year 2008 was declared as the "Energy Efficiency Year" In Turkey. Critical duties and targets have been assigned to public institutions and organizations through the Regulation on Increasing Efficiency during Utilization of Energy Resources and Energy (No. 28097, 27 October 2011). Regulation includes measures for proper establishment of energy management systems in large industrial enterprises (since 1995), and commercial and service buildings (since 2007) in accordance with the ISO 50001 Energy Management Standard published in 2010.

The Energy Efficiency Law is effective across all energy intensive sectors. For example, Regulation Regarding Energy Performance in Buildings, that entered into force in 2009, stipulates measures, technical criteria and implementation guidelines to bring a more integrated approach for energy efficiency in buildings. Practices are being developed for the full implementation of this regulation. Regulation on Distribution of Heating and Sanitary Hot Water Costs in Central Heating and Sanitary Hot Water Systems, that entered into force in 2008, practices to control the distribution of heating costs based on the amount of heat use and practices to control indoor heat have become widespread.

The Regulation Regarding Efficiency Requirements of Liquid and Gas Fuel for New Hot Water Boilers (92/42/EEC) became effective in 2008 (No. 26897, 05 June 2008). It includes various

13 The Energy Efficiency Strategy Document accepted by the SPC Resolution No. 2012/1 on 20 February 2012.

14 Decree Law No.662 amending the Decree-Law on Organisation and Duties of the Ministry of Family and Social Policies and Certain Laws and Decree Laws dated on 1 November 2011

principles to ensure that liquid fuel and gas are used to fuel new hot water boilers. The regulation proposes a nominal output power of a minimum of 4 kW and maximum of 400 kW to satisfy minimum technical efficiency criteria. This will ensure that environmental pollution is decreased, and that liquid fuel and gas are used in new hot water boilers.

Energy Efficiency Law states several actions on energy efficiency actions for transportation sector such as reduction of fuel consumption per kilometer driven for motor vehicles, increase in efficiency standards of vehicles and widespread the public transportation. In this regard, regulation on Principles and Procedures Regarding Increasing Energy Efficiency in Transportation came into force in 2008.

The regulations on "Energy Labelling of Household Electric Refrigerators, Freezers and Their Combinations", "Energy Efficiency Conditions of Household Electric Refrigerators, Freezers and Their Combinations", and "Energy Efficiency Requirements for Ballasts for Fluorescent Lighting" are other examples of regulations related to secondary legislation that improves energy efficiency. Additional projects related to energy efficiency have been implemented by the public and private sectors, non-governmental organizations and local governments and these are indicated in the end of this chapter in Table 4.6.

Box 4.3. Activities on Energy Efficiency

- **Support Programme for Energy Efficiency Projects:**[15] Projects to increase energy efficiency have been supported since 2009 based on the Energy Efficiency Law. This includes support to 32 projects in 25 industrial enterprises with the total investment amount of 10.5 million TL. This is expected to achieve a saving of approximately 13,141 TEP as a result of implementation of these projects. Twenty of these projects have been Implemented.
- **Voluntary Agreements Program:** Voluntary agreements over the period 2011-2013 have been signed with 22 industrial enterprises that are willing to decrease their energy intensity by a minimum 10% within three years. These efforts will cost a maximum one time investment of 2.2 million TL, and this is expected to result in annual saving of approximately 44,500 TEP/year.
- **Energy Efficiency Support Program for Small and Medium Sized Enterprises (SMEs):** Small and Medium Enterprises Development Organization (KOSGEB) provides training, research and consultancy support to SMEs on the issue of energy efficiency in accordance with the Energy Efficiency Law. These supports improved efficiency in energy consumption of SMEs. An SME that satisfies the required conditions may obtain support of up to 30,000 TL in energy efficiency activities.
- More than 4,500 persons have been certified as "Energy Managers" through the Energy Manager Training Programs that have been organized annually since 2002 in the direction of Asia, Central Eastern and Balkan States.
- The Chamber of Mechanical Engineers is authorized to provide energy manager trainings and education-study-project trainings and to empower energy eficiency consultancy companies. In addition, the Chamber of Electrical Engineers and and Gazi University are authorized to provide energy manager trainings. Also, thirty-eight energy efficiency consultancy companies have been authorized to develop and implement energy manager trainings, energy studies, efficiency increasing projects, and provide energy consultancy services.

Cogeneration /Trigeneration Practices

Cogeneration plants with total cycle efficiency of more than 80% are supported through entitlements to license exemption within the scope of the Regulation Regarding Unlicensed Electricity Generation in the Electricity Market. This has resulted in emission reductions of 54,375 tonnes of CO_2 eq annually as a result of the cogeneration/trigeneration technologies that are being implemented in 3 shopping malls, 6 hospitals, 3 airports, 7 hotels and 1 university within the framework of this support.[16]

[15] The support program was put into effect in August 2009 after being arranged through the Regulation Regarding Amendment of KOSGEB Supports Regulation that was published in the Official Gazette No. 27028, (18 October 2008). It was re-organized on June 2010 within the scope of KOSGEB Support Programs.

[16] Turkey Cogeneration Association, 2010.

Rehabilitation of Public Energy Plant

Efficiency values of the thermal and hydroelectric power plants that are owned by the public and that have been operating for many years have been evaluated in order to increase efficiency in energy production. Efficiency upgrades and retrofits were initiated in 2005 by Electricity Generation Company (EÜAŞ) in order to increase efficiency and production capacity through new technologies. These upgrades are underway in 4 hydroelectric plants and 16 thermal power plants. Under the scope of these activities, the performance, reliability and life span of plants will be increased, and compliance with environmental legislation will be ensured. A production increase of 13.9 billion kWh will be obtained as a result of the upgrades and retrofits projects.

Fuel Conversion Projects

Activities in relation to increased utilization of natural gas as auxiliary fuel which is the fuel with the lowest carbon ratio: are currently being implemented in thermal power plants. Within this scope, a fuel conversion project at Ambarlı fuel-oil plant with the installed power of 630 MW was initiated in 2008. Two units of the plant with the installed capacities of 150 MW have been replaced with two gas turbines each with the installed capacity of 410 MW and a waste heat boiler. Fuel conversion works are also planned to be performed on three units with installed capacities of 110 MW. As a result, installed capacity of the plant shall be increased to 1,150 MW.

Ambarlı Thermal Power Plant, MENR Resources Archive, 2011

Box 4.4. Green Buildings

- Activities related to sustainable architectural design and green building are gradually increasing. The practice of registering green buildings that are constructed throughout the country by the private sector with certificates, such as LEED and BREEAM, is being widely used. There are 70 buildings that have been constructed and gained these certificates, with an expected energy savings of approximately 30%.
- Also, activities related to establishing a green building certificate system that is specific to Turkey are underway within the body of The Turkish Green Building Association, which was established in 2007 to contribute to the development of the construction sector in Turkey. Training and certificate works in this area are being provided by The Turkish Green Building Association and various institutions/organizations and universities.
- There is no green building practice in public buildings yet. However, it is planned to design and construct three buildings, including a service building and two school buildings, as green buildings within the scope of the Project for Increasing Energy Efficiency in Buildings that is implemented by the General Directorate of Renewable Energy and that is supported by the Global Environment Facility (GEF). Green building practice in public buildings is expected to increase in the future. The Energy Efficiency Strategy Document envisages that the number of environment friendly, green and sustainable buildings will increase in coming years.

Projects Implemented on the Basis of Bilateral /Multilateral Agreements

1. Project for Increasing Energy Efficiency in Industry

The five year Project for Increasing Energy Efficiency in Industry started in 2011 and is being implemented by the General Directorate of Renewable Energy, Small and Medum Enterprises Development Organisation (KOSGEB), TSE, Technology Development Foundation of Turkey (TTGV), UNDP and UNIDO in coordination with the Ministry of Science, Industry and Technology. The project is supported by the GEF and as a result of this project, efficiency of legislative practices, legal and institutional infrastructures; popularization of energy management will all be increased. Furthermore, pilot projects will be undertaken to develop and improve energy efficiency services and to demonstrate the benefits of energy management and efficiency.

2. Project Regarding Energy Efficiency in SME's in Turkey

A grant of 1.5 million Euros is envisaged to be provided by the French Global Environment Facility for this project that will be implemented through coordination between the French Development Agency and KOSGEB. KOSGEB will contribute both with in-kind and cash contributions through the use of energy efficiency support during implementation of site activities. As a result of the project, KOSGEB will increase its institutional capacity to provide services on energy efficiency, improve practices at project sites, and raise awareness.

3. Project on Increasing Energy Efficiency in Buildings

The four year Project on Increasing Energy Efficiency in Buildings is implemented under the chairmanship of the General Directorate of Renewable Energy and in coordination with the Ministry of Environment and Urbanization, Ministry of National Education (MNE) and Housing Development Administration of Turkey (TOKİ). It was initiated in 2011 and is supported by the GEF. It includes activities, such as increasing the efficiency of legislative practices (primarily the Regulation Regarding Energy Performance of Buildings), improving legal and institutional infrastructure, and implementing pilot schemes that aim to introduce integrated building design approaches to the public.

4. Project on Efficiency in Buildings

The Project on Increasing Energy Efficiency in Buildings that was applied for by the MEU in 2010 within the scope of the EU Instrument for Pre-Accession Assistance (IPA). The general objective of the project is to increase energy efficiency in Turkey to generate economic gains and make a positive contribution to climate change and energy security. As a result of the two year project, the level of energy efficiency in new building designs and existing building rehabilitations will be increased. In addition to the activities that are performed regarding improvement of legislation and determination of energy efficiency criteria for new and existing buildings, the project also includes training and awareness raising activities for technical personnel employed within provincial organization of the Ministry, municipalities, local architects and engineers. Also, two existing buildings to be selected will be converted into energy efficient buildings by the Ministry. It is envisaged that this will reduce energy use by 10% within 5 years following completion of the project.

5. Project on Market Transformation of Energy Efficient Household Appliances

The four year Project on Market Transformation of Energy Efficient Household Appliances was initiated in 2010 in coordination with the Ministry of Science, Industry and Technology, White Goods Manufacturers' Association of Turkey and Arçelik A.Ş. The General Directorate of Renewable Energy is the implementing agency, through financial support from the GEF. The project will popularise the use of energy efficient household appliances in Turkey and accelerate market transformation.

6. Project on Supporting Energy Efficiency Monitoring and Assessment Infrastructure in Turkey

This two year project is supported by the Government of Netherlands to improve the monitoring and impact analysis capacity of the General Directorate of Renewable Energy. The project will be implemented by the General Directorate of Renewable Energy in Turkey and NL Agency in the Netherlands. The following objectives will be achieved: data transfer on monitoring and assessment of energy efficiency programs; calculation of methods of energy saving potentials; methods on assessment of the effects of energy efficiency policies; and pilot scheme priority sectors.

Box 4.5. Financing Renewable Energy and Energy Efficiency

Turkey has obtained a loan of 600 million USD 500 million USD of which was provided by the World Bank whereas 100 million USD of which was provided by Clean Technology Fund as a result of Loan Agreements signed on 9 June 2009 in order to finance the Renewable Energy and Energy Efficiency Project. The loan is provided under the Reimbursement Guarantee Provided by Treasury and is being used for renewable energy and energy efficiency investments made by the private sector via Türkiye Sınai Kalkınma Bankası A.Ş. (TSKB) and Industrial Development Bank of Turkey (TKB). Supplementary financing of 500 million USD was obtained from the World Bank for the project as a result of the Loan Agreements signed on 5 December 2011, and will be provided by TSKB and TKB.

Private sector investments for renewable energy and energy efficiency have also been supported by the European Investment Bank (EIB), European Bank for Reconstruction and Development (EBRD), German Development Bank (KfW), French Development Agency (AFD) and Islamic Development Bank.

Furthermore, energy efficiency and renewable energy projects are also supported by several other sources, such as TTGV, and the UNDP GEF-Small Grants Program.

Also, Turkey is among the countries that benefit from the technical support program titled Partnership for Market Readiness that is implemented by the World Bank in order to ensure that developing countries and rising economic powers benefit from flexibility mechanisms that are within the scope of the UNFCCC climate change regime.

Monitoring and Evaluation

A database has been established by the General Directorate of Renewable Energy within the scope of the Energy Efficiency Law. This database is based on data obtained from industrial enterprises with a total annual energy consumption of 1,000 TEP and above, from the commercial buildings or service buildings with the total construction area of 20,000 m^2 and above or with the annual total energy consumption of 500 TEP and above, and from the public buildings with the total construction area of 10,000 m^2 and above or with the annual total energy consumption of 250 TEP and above. This data helps identify the sectoral distribution of fuel use statistics, energy intensity, comparisons based on sectors and regions, sectoral distribution of CO_2 emissions and fuel consumption based on sectors and enterprises.

Another project to be implemented by the General Directorate of Renewable Energy supports the information management system that is based on up-to-date and reliable databases. Consequently, the project will generate performance indicators that will enable comparison between years and with other countries. This will also support the determination of achievable objectives and the establishment of a Measurement and Evaluation System that will enable regulatory impact assessments for the projections, integrated resource planning and legislative regulations. Such

analysis will shed light on legislation improvement requirements to achieve these objectives. It will base performance indicators and simulations of policy and legislation practices, technological, economic, social and environmental factors.

4.3.3. Other Practices

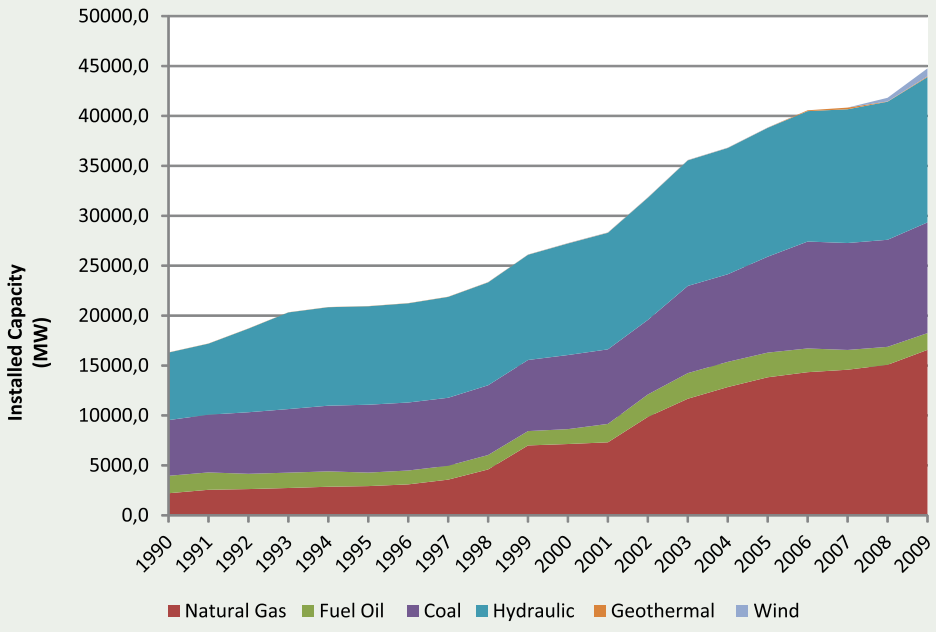
Nuclear Energy

In order to ensure national energy security, Turkey aims to increase the share of nuclear energy to 5% by 2020.[17] In this context, efforts are underway to establish a nuclear energy plant in Akkuyu Region, Mersin Province.

Natural Gas

Large increases have been observed in the consumption of natural gas and its share in the total energy consumption of natural gas since the 1970s. (Figure 4.5). This increase has mainly been caused by the fact that natural gas that is used for energy, transportation and utilization purposes has a lower environmental impact in comparison with other types of fuel. However, the current natural gas consumption suggests that Turkey is beginning to reach its highest possible level of emission reductions through natural gas by fuel recycling. Additional measures shall be taken in order to popularise the use of natural gas in electricity production, which is a relatively cleaner fuel and is plentiful.

Figure 4.5. Change in the Installed Capacity Shares of the Types of Electricity Production (1990-2009)



17 Electric Energy Market and Security of Supply Strategy Document

Clean Coal Technologies

In Turkey, energy policies have been established to diversify resources and concentrate on local resources for energy production that contribute to security of energy supplies. However, since Turkey does not possess sufficient amount of resources in terms of natural gas and petrol and since the alternative cost of renewable energy resources is high in comparison with fossil fuels, Turkey has mainly concentrated on lignite, which is plentiful in Turkey. Although this situation may be perceived as negative in terms of GHG emissions, the strategy documents note the goal of reducing emissions by using clean production technologies. This reflects a balance between benefiting from maximizing use of local resources, guaranteeing security of supply, and meeting climate change objectives.

Regarding utilization of local lignite resources, it is determined in the National Climate Change Strategy Document that Turkey will continue to maximize its use of lignite but will employ cleaner production technologies and best techniques within the framework of internal and foreign finance facilities in short term.

Regarding clean coal technologies, approximately 20 R&D projects have been implemented since 2007 on issues such as underground or surface gasification/liquefaction to produce chemical materials from local coal reserves. Some of these projects are presented in Table 8.3.

Carbon Capture and Storage

There is no legislation in Turkey on carbon capture and storage. However, researches are undertaking work on carbon capture and storage in geological areas.

Box 4.6. Geological Storage of CO_2

In the geological capture storage capacity assessment project that is implemented by METU-PAL, TPAO and Ministry of Energy and Natural Resources, potential geological storage areas for CO_2 are being assessed in relation to emissions from thermal plants, refineries, cement, steel-iron and sugar refineries with capacities higher than 500 MW. In the study, it has determined that only small sized plants may be suitable for storage of CO_2 emissions since known petrol and natural gas sites are small scaled. It has also been determined that it is necessary to study storage potentials of deep aquifers.

On the other hand, feasibility studies have been Implemented, and a site has been found suitable for storage of CO_2 on the basis of current technology and prices.

Smart Grid Practices

Consultancy activities on smart grids have been implemented by means of World Bank grant to establish systems to connect renewable energy plants to the national electrical grid.

ASSESSMENT ACCORDING TO THE TYPE OF GREENHOUSE GAS

The burning of fossil fuels is the source of 99% of Turkey's energy emissions. CO_2 is the main greenhouse gas that is released by the energy sector. Policies and measures to mitigate CO_2 are provided in the above chapters.

4.4. Industry

GENERAL POLICIES AND MEASURES

The manufacturing industry accounts for 32% of national energy consumption and 24% of GDP[18]. Greenhouse gas emissions that source from the industrial sector are based on burning fuel and industrial processes.

Policies and measures on energy consumption in the industrial sector are explained in the Energy Chapter (4.3), and are mainly focused on increasing energy efficiency and renewable energy use. Therefore, policies and measures that focus on process based emissions are presented here. The development and wide use of cleaner production and clean technologies rank at the top of the list of such measures.

As a result of the Decree-Law No. 649, the Ministry of Energy and Natural Resources is responsible for "preparing efficiency policies and strategies so that the economy may develop in accordance with the principles of efficiency, increasing and developing efficiency of industrial enterprises and supporting cleaner production projects." As a result of the same decree-law, the General Directorate of Efficiency is assigned "to perform activities that are in the direction of providing assistance to the enterprises during preparation and implementation of cleaner production programs and projects." General policies that will be implemented in the industrial sector in the future are available in the Turkey's Industrial Strategy Document issued by the Ministry of Science, Industry and Technology (MSIT) and covering the period from 2011-2014[19]. The objective of the strategy is "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." The environmental policy within the Strategy Document also includes supporting the transition to a low carbon economy and cleaner production processes in industry, and concentrating on information activities, to implement eco-efficiency programs throughout the country.

Box 4.7. Industry – Climate Change Policies Presented in the National Climate Change Strategy Document

Regarding the industrial sector within the framework of the NCCSD published in 2010:

- In the short-term, intensive information activities will be implemented.
- In mid-term, targets focus on implementing management tools and energy studies that enable monitoring greenhouse gas emissions, R&D and technology activities, promotion of heat recycling, speed control in motors, and cogeneration systems, and cleaner production resources.
- In long-term, Turkey aims to implement mechanisms that promote cleaner production technologies, and realize savings potential through policies to increase the competitiveness of the industrial sector through energy efficiency practices.

NCCAP that is issued within the framework of these strategies includes issues such as increasing energy efficiency in industrial sector, mitigating the intensity of CO_2 eq to the GDP per capita, and increasing sector capacity in the direction of the fight against climate change. The plan also aims to complete a needs assessment on low emission technologies and to remove the barriers for technology transfer in this area

18 MENR 2009 Energy Balance Tables.

19 Approved as a result of the Resolution No. 2010/38 of the SPC (7 December 2010).

The Industrial Strategy Document also states that increasing efficiency in production processes will be promoted for firms and particularly Small and Medium Enterprises (SME) and that R&D activities and innovation will be promoted to design unique products and processes. A new R&D Law was passed to ensure that Turkey achieves its R&D objectives for 2013. Under this law, the Techno-Initiative Capital Support practice was initiated in 2009, and 114 enterprises obtained R&D Center Certificates as of 2011. In addition to this support, a variety of other assistance is available, such as Technology Development Zones and Industry Thesis-Projects.

LEGAL ARRANGEMENTS AND PRACTICES

Environmental legislation imposes several restrictions and sanctions on industrial plants to prevent air, water and soil pollution and to protect biological resources.

The harmonization and effective implementation of the Integrated Pollution Prevention and Control Directive (IPPC; 2008/1/EC), within the scope activities toward full EU membership, is critical for strengthening the competitiveness of industries in foreign markets. The Directive is based on the principles of mitigating pollution at the source, minimizing raw material and energy consumption, and implementation of best existing techniques for increasing industrial production by increasing efficiency. Various projects have been implemented toward this harmonization. The Large Combustion Plant Directive (LCP; 2001/80/EC) includes provisions for controlling emissions and use of best technologies.[20]

The Regulation Regarding Environment Friendly Design of Products related to Energy [21] (2009/125/EC; Eco-design), the Regulation Regarding Energy Labelling and other communiques that have been issued by the MSIT have contributed to mitigating greenhouse gas emissions. Legal activities in relation to eco-design include harmonization of relative EU directives within the scope of EU harmonization process. Eleven implementation communiques related to the Eco-design Regulation were published in the Official Gazette No. 28038 (27 August 2011), and Official Gazette No. 28063 (23 September 2011), and Official Gazette No. 28197 (7 February 2012). With respect to energy labelling, in parallel with the Energy Labelling Regulation of the EU, the Regulation Regarding Indication by Labelling and Standard Product Information of the Consumption of Energy and Other Resources by Energy-Related Products (2010/30/EU) became effective in 2010 (Official Gazette No. 28130, 2 December 2011).[22] Four implementation communiques in relation to this Regulation that went into effect in the EU will also be implemented in Turkey.

Box 4.8. Implementations of Industrial Plants

- Industrial plants have begun to implement carbon management, carbon footprint calculation and ISO 16064 practices.
- Practices such as ISO 14000 and EMAS to improve the environmental performance of plants have been implemented for a number of years.
- Industries are actively working on issues such as waste mitigation, mitigation of energy consumption in production, energy efficiency, use of waste heat recycling, and they have obtained carbon credit certificates for emissions mitigation.
- Best available technology handbooks have been issued for various sectors, such as iron-steel sector, in order to promote implementation of best available technologies.

20 Official Gazette No. 27605, dated 8 June 2010.
21 Official Gazette No. 27722, dated 7 October 2010.
22 Official Gazette No.28130, dated 2 December 2011.

Approximately 88% of industrial emissions source from the production of mineral products. Mineral products include cement, lime, asphalt road, roofing and glass production. The cement sector possesses the biggest share among these industries, with approximately 91% of process based CO_2 emissions sourcing from cement production. This calculation does not consider another large energy user, the iron-steel sector. CO_2 emissions from iron-steel production are calculated within the energy sector to avoid double counting of CO_2 emissions. In future years, the iron-steel industry will be accounted within the industrial sector instead of the energy sector.

Some of the activities that are implemented in cement sector to improve sustainable production are as follows:

- Co-processing projects: Despite being different types, these projects are based on using the different sources of emissions like wastes together in cement production.
- Reduction of klinker share in cement: CEM III type cement that is produced with furnace slag is an example.

According to values from 2009, private sector has been implementing carbon footprint reporting activities to support and monitor mitigation in the iron-steel sector which holds smaller share of greenhouse gas emissions. In the Sustainable Steel Plan Certification Study that is being implemented by the private sector, direct and indirect impacts of the sector on carbon footprints and on recycling and recovery activities are reported annually.

The cement, iron-steel, glass, ceramic, paper, textile and chemical sectors have been prioritized for mitigation activities. Enterprises that are active particularly in the fields of paper, ceramic and cement renew their technologies rapidly in order to protect their competitive capacities. This frequent replacement of technologies provides opportunities for emission reductions. Working groups of the representatives and experts from Ministry of Science, Industry and Technology, industrial sub-sectors, other relative institutions and organizations were established in coordination with the EIE in order to determine energy saving potentials in industrial sub-sectors.

When the greenhouse gas emissions of iron-steel, cement and paper sectors are compared with the current situation of the same sectors in other countries, Turkey is in a better situation than many other developed or developing countries[23]. Considering the new technologies used in these sectors, an even better picture is expected to appear. Direct and indirect CO_2 emissions of 12.66 million tonnes in the iron-steel sector is below the world average, but is above average for countries that use nuclear and renewable energy resources. In terms of global greenhouse gas efficiency averages, the paper sector is also below the average of most of the other countries with the direct and indirect CO_2 emission totalling of 1.12 million tonnes.

There are several practices in these industries that are mitigating emissions (Table 4.6). Detailed explanations in relation to some of these practices are described below:

Project for Preparing a KOSGEB Road Map on Environment

This project has been implemented by KOSGEB since August 2011 within the framework of national environmental awareness and international obligations. It aims to determine the difficulties that SMEs will face during implementation of environmental legislation, and helps KOSGEB to determine its road map in relation to environmental activities, for example by analysing and solving pollutant impacts of SMEs. The following four main activities will be implemented by the project over two years:

a) Increasing KOSGEB's institutional capacity,
b) Determining the sectors that pollute the environment the most, as well as the sectors that are impacted economically from national and international legislation,
c) Determining pollution loads by performing site practices in the SMEs that are located in specified sectors and regions, and
d) Sharing information and experiences on the environment and climate change, and expanding on progress.

23 TNO, 2009.

Eco-Efficiency Project

Activities related to climate change in industry have been performed within the scope of the UN Joint Program on Enhancing the Capacity of Turkey to Adapt to Climate Change (MDGF-1680), implemented by UNIDO and TTGV. Under this framework, several pilot projects have been implemented in the Seyhan Basin. The scope of the pilot projects includes initiating best pratice examples in the food, beverage, metal processing and machinery, metal coating and painting, chemical and textile sectors. The project also provides information and experience for expanding activities and increasing awareness and capacity.

Eco-efficiency (cleaner production) pilot schemes have been undertaken by 6 firms that are located in 5 different provinces operating in various sectors with the total budget of $264,800 US. Annual financial gain for these firms as a result of such practices is approximately $1.35 million USD. In consideration of these issues, return on investment was achieved within a short period of 2.3 months. As a result of pilot projects, 784,550 m^3 of water, 207.8 tonnes of chemical and 4,946,970 kWh of energy are saved annually, and 978 tonnes of CO_2 emissions are mitigated.

In addition, the development of a documentary film is one of the most important elements of expanding impact. Through this activity, the stories of pilot projects are told. Cleaner production practices that were performed by 6 firms were filmed in the documentary. The film has been developed through the contribution of UNIDO, TTGV and Middle East Technical University (METU), and included interviews with key stakeholders within the industries and firms.

Box 4.9. Establishing a Cleaner Production Centre

As one of the objectives of the Enhancing the Capacity of Turkey to Adapt to Climate Change Program (MDGF-1680) implemented in 2008-2011, the activities related to establishing a National Cleaner Production and Ecoefficiency Centre have been carried out by UNIDO, TTGV and MSIT in coordination with MEU in Turkey. Within the framework of the Program, a collaborative dynamic model of Centre was established under the coordination of MSIT and the former National Productivity Centre was assigned by MSIT to host this centre. The National Productivity Centre was closed down as a result of the restructuring of Ministries after June 2011. Activities to establish National Cleaner Production and Ecoefficiency Centre continue to be implemented by the General Directorate of Efficiency which was constituted under MSIT.

Industrial Symbiosis Project

The Industrial Symbiosis Project was implemented in the Iskenderun Gulf by UNDP with the financial support of the Former SPO and The Baku-Tbilisi-Ceyhan Pipeline Company (BTC Co.), in coordination with the Adana Industrial Chamber (ADASO). The objective of the project is to develop sustainable management of natural resources that are used as inputs in production activities of the private sector and public production facilities in the Iskenderun Gulf. There are opportunities to improve inter-enterprise resource productivity through joint activities in the areas where there are various economic activities that are similar to each other. In practice, these activities generally include swapping energy carriers and water and material resources, sharing process development and use, logistics infrastructure, and sharing information and human resources.

ASSESSMENT ACCORDING TO THE TYPE OF GREENHOUSE GAS

According to the 2009 greenhouse gas inventory, 88% of the emissions from industrial processes is CO_2 and 12% is fluorinated gases. The cement sector is responsible for 91% of CO_2 emissions in the industrial sector. Therefore, opportunities to control CO_2 emissions are primarily in the

cement sector. As noted above, most cement factories now possess new technology to reduce emissions, and efficiency activities are ongoing, such as use of alternative fuels and mitigation of clinker ratios in factories. However, emissions derived from raw materials are inevitable sources of CO_2, as they are generated from baking of the raw material used in production. As emphasized above, CO_2 emissions derived from iron-steel sector, which is presently accounted for under the energy sector, shall be listed under the heading of industry in the following years, and this will change the current ratios.

Regarding fluorinated gases, Turkey became a party to the Montreal Protocol in 1991, and has agreed to all of the amendments of the Protocol. According to the provisions of Montreal Protocol, Turkey is listed in the category of "Developing Countries," based on its consumption of Substances That Deplete the Ozone Layer (ODS)[24]. As a result, Turkey benefits from the Multilateral Fund (MLF) under the Montreal Protocol.

National and international activities related to the Montreal Protocol are monitored under the coordination of MEU, which acts as the National Focal Point. The Regulation Regarding Mitigation of Substances That Deplete the Ozone Layer became effective in 2008[25]. Accordingly, chlorofluorocarbon (CFC) use has been reduced to zero, and imports of CFCs have been prohibited. Also, imports of HCFC group gases have been subject to a quota starting from 1 January 2009 on the basis of 2007 imports. Use of these substances is decreased according to a schedule, and imports will be suspended on 1 January 2015, except for service utilization. Various projects that are being implemented related to suspension of HCFC utilization are presented in Table 4.6.

In spite of the progress towards removing of ODS in relation to fluorinated-gases, technological transformation in the sector has been focused on fluorinated greenhouse gases that cause climate change. Regulation No. 842/2006/EC and several other regulations on implementing this regulation across relative sectors are effective in the EU. However, there are no regulations in Turkey consistent with this legislation. However, a bid for a project is underway to request aid from the EU's Support Activities to Strengthen the European Integration Process (SEI).

The amount of investment that must be made by industries to make the transformation to environmentally friendly technologies to eliminate HCFC use has been estimated based on 2009 HCFC gas consumption amounts through information obtained from HCFC industries. This information is used for the development of the HCFC Phase-out Management Plan (HPMP). At present, manufacturers of XPS thermal insulating boards use a HCFC 142/HCFC 22 gas mixture as bulging gas, and manufacturers of polyurethane thermal insulating boards use HCFC 141b gas as bulging gas. The project has calculated the approximate cost of conversion for XPS and polyurethane manufacturers. As a result of meetings held between Secretary of the MLF and UNIDO, as well as based on the resolution adopted by the ExCom 62nd that was held in Montreal, it has been decided that a grant of $8,292,002 US will be provided to Turkey by the MLF. Activities in relation to this project are ongoing.

[24] Countries where annual ODS consumption per capita is below 0.3 kg on the date when the protocol became effective or on any date until 1 January 1999.

[25] Official Gazette No. 27052, 12 November 2008.

4.5. Transportation

GENERAL POLICY AND MEASURES

Greenhouse gas emissions from the transportation sector constitute 12.83% of Turkey's total emission according to the 2009 emission inventory. There has been a large increase in load and passenger transport due to increased income levels from 1990-2008. Accordingly, greenhouse gas emissions that source from transportation increased by 80.1% over this time period. Road transport is responsible for 85% of the CO_2 emissions from transportation sector.

The Ninth Development Plan covering 2007-2013 describes transportation policy: "system shall be assessed on the basis of an integrated approach while establishing a balanced, rational and effective transportation infrastructure where types of transportation are used in the most appropriate places technically and economically; policies that ensure haulage services to be carried over to railways and that ensure developing critical ports as logistic centres, and that prioritise safety in transportation modes." The plan sets the strategic target of performing load haulage mainly on railways, and it aims to increase domestic railway load haulage annually by 12%, and increase international railway haulage by 25%.

The Ninth Development Plan also includes extensive policy suggestions on urban transportation. The plan aims to establish an extensive national urban transportation strategy that: is consistent with environmental, economic, housing, land and plot policies; is sustainable; binds the public sector; and leads the private sector. It also stresses the establishment of urban transportation planning that provides equal opportunities to all parts of society, that is participatory, that protects the interests of the public, that minimizes foreign-source dependency by paying attention to the use of domestic sources, that is environment friendly, that is economically efficient, and that ensures reliable and sustainable passenger movement. It emphasizes that to establish a sustainable urban transportation system; passenger and bicycle transport will be prioritised and promoted in mass transportation.

Turkey's Transportation and Communication Strategy Document (2011-2023) was issued to identify the objectives and activities that must be implemented primarily to provide cheaper, faster and safer service in the transportation sectors at a higher quality. Targets with respect to the share of the total transporation distribution for 2023 related to the National Climate Change Strategy are to increase railway load haulage above 15%, and to increase passenger transportation above 10%.

Turkey aims to decrease the share of road haulage to 60%, and to decrease the share of road passenger transportation to 72%. Details on the types of infrastructure projects that will be implemented between 2011-2023 in the road, railway, maritime, aviation, logistics and combined transportation, urban transportation and pipeline sectors, the locations where they will be constructed and costs will be determined via the Transportation Master Plan, which will be issued in participation with institutions across the sector. Objectives, priorities and projects that are developed at the 10th Transportation Council will also be included the action plan of this document.

Objectives, targets and action areas for the transportation sector in the Climate Change National Action Plan have been prepared in line with strategies in the Turkey Transportation and Communication Strategy Document and the National Climate Change Strategy Document.

Box 4.10. Policies in NCCAP on Emission Mitigation in the Transportation Sector

- To increase the share of railways from 5% in 2009 to 15% in 2023 in terms of load haulage, and to increase the share of passenger transport through railways from 2% to 10% in the same period.
- To decrease the share of road load haulage from 80% in 2009 to below 60% in ton-km in 2023, and to decrease the share of the same from 89% to 72% in terms of passenger transportation in the same period.
- To control the emission increase rate sourcing from use of personal vehicles in urban transportation.
- To establish the legislation, organizational structure and guidance documents related to urban transportation until 2023 in order to ensure that sustainable transportation planning approaches are implemented in cities.
- To make legal regulations that are in the direction of increasing utilization of alternative fuel and cleaner vehicles and to develop capacity until 2023.

LEGAL REGULATIONS AND PRACTICES

There are several legal regulations in the transportation sector that directly or indirectly contribute to emission mitigation (Table 4.6). Some of these regulations are provided in detail below:

- Regulation Regarding Principles and Procedures on Increasing Energy Efficiency[26] in Transportation became effective in 2008. The regulation determines the principles and procedures for establishing systems that decrease unit fuel consumption of motor vehicles, increase efficiency standards in vehicles, extend mass transportation and increase traffic flow. The regulation is implemented by Ministry of Transport, Maritime Affairs and Communication (MTMAC).
- Regulation on Establishment and Operation of Vehicle Inspection Stations and Vehicle Inspection[27] became effective in 2004. The objective of the regulation is to perform technical inspection procedures on motorized and non-motorized vehicles. The Regulation Regarding Providing Information to Consumers on the Fuel Economy and CO_2 Emission of New Passenger Cars[28] is aims to ensure that consumers obtain information on the CO_2 emission and fuel economy of new passenger cars that are marketed or rented to allow consumers to make informed choices. The MSIT is responsible for implementing the regulation, and fuel consumption and emission values of all of the cars sold in Turkey are available on the website of the Ministry. The number of visitors has reached 5,748 as of March 1, 2012.
- Special Consumption Tax (SCT) exemption that was initiated in coastal shipping in 2004 to ensure that cargo, passenger, fishing, scientific research vessels and commercial yachts and service vehicles that provide services on the coast purchase fuel without paying any SCT. This will help increase maritime transportation. Public cargo and passenger vessels that provide services in inland waters were also included to the scope of regulation in 2009.
- General Railway Draft Law aims to develop and improve railways and will ensure that railway services are provided to consumers continuously, safely at quality and a suitable and competitive price. This will establish a strong, stable and transparent structure by liberalising the sector, and ensure that independent regulations and inspections are performed.
- The By-law on Reducing the Percentage of Sulphur in Certain Types of Fuel Oil[29] became effective in 2009, and contributes to mitigation of emissions from the transportation sector. The regulation is implemented by Energy Market Regulatory Authority (EMRA).

26 Official Gazette dated 9 June 2008 and numbered 26901.
27 Official Gazette dated 6 October 2009 and numbered 27368.
28 Official Gazette dated 23 September 2004 and numbered 25592.
29 Official Gazette dated 28 December 2003 and numbered 25330.

- Within the framework of the The By-law on Reducing the Percentage of Sulphur in Certain Types of Fuel Oil that was issued within the scope of activities for harmonisation to EU's Directive 99/32/EC, the use of maritime fuels with sulphur amounts greater than 0.1% by mass (1000 ppm) is prohibited in inland maritime vehicles and vessels that are moored in port. Also, while sailing in the maritime shelf of Turkey, all of the passenger vessels that sail regularly can not use a maritime fuel with a sulphur amount greater than 1.5% by mass.
- The Recreational Craft Regulation[30] limits CO, nitrous oxide and hydrocarbon ratios in the exhaust emissions of the motors of personal maritime vehicles and is related to harmonization with the EU Directive 2003/44/EC. Based on this, all of the motors that are assembled on a recreational or personal craft after 31 December 2011 must comply with the provisions of the Regulation.
- Investments were made on a large-scale new airport in the first half of 1990's, and more recently, practices have been performed to modernize and increase the capacity of existing airports rather than making new investments. As in the case of road transportation, these investments increased the efficiency of the aviation sector as well. Another continuing airline transport activity is the flight track reduction works. It aims to ensure energy efficiency within the scope of SMART project that is modernizing the air traffic system. The Green Airport Project, initiated by the General Directorate of Civil Aviation in 2010, is being implemented in airports in coordination with the General Directorate of State Airports Authority.

Economic Instruments

- The vehicle taxation system is one of the fundamental methods in Turkey to promote the use of vehicles with low greenhouse gas emissions. Low engine sizes with lower greenhouse gas emissions are supported by imposing vehicle taxes on the basis of engine sizes.
- A regulation based on calorific efficiency values and environmental impacts of fuels exists in taxation of fuels. It is permitted to add biofuel to fuels up to 5%, and a 2% tranche of the biodiesel and ethanol that is obtained from domestic agricultural products and is blended with conventional fuel (diesel, gasoline) is exempted from SCT.

Infrastructure Investments

- Investments continue to be made in the recent years to improve and rehabilitate railway infrastructure and develop infrastructure by constructing new lines. Regarding railways, electrification, high speed train projects and the Marmaray Project, which creates rail tube tunnel to cross the Bosphorous related to the renewal of tractive and hauled stock, continue to be implemented in the railway sub-sector.

Marmaray Project

30 Official Gazette No. 26390, dated 28 December 2006.

- Projects related to construction and modernization of ports to develop maritime transportation and particularly increase its share in load haulage, as well as project to reinforce railway connections of ports continue to be implemented. Projects such as integration of ports with other types of transportation, logistic centres and inland ports are other critical developments in this area.
- An EU financial cooperation process was launched as a result of the Instrument for Pre-Accession Assistance for the 2007-2013 period. The MTMAC implements the Transportation Operational Program as the Program Authority responsible for management of the IPA funds provided to the transportation sector. A program has been prepared to finance transportation infrastructure projects via IPA funds within the scope of "Regional Development." There are five sub-components of IPA funds approved by the European Commission on 7 December 2007. The Transportation Operational Program includes three basic priorities: 1) Improvement of railway infrastructure, 2) Improvement of port infrastructure, and 3) Technical support. Projects that developed related to these priorities continue to be supported by IPA funds.
- Dual carriageway practices in highways have been critical investments made in 2000's and have improved traffic safety and road haulage practices, and have contributed to decreasing the increase of greenhouse gas emissions.

Urban Transportation

- Critical investments have been made in developing mass transportation systems in urban areas. Urban rail systems (metros, light rail systems and street tramways) have been commissioned in Ankara, İstanbul, İzmir, Bursa, Antalya, Eskişehir, Konya and Kayseri, and planning is underway to make similar investments in several other cities. Metrobus, which is a Bus Rapid Transit (BRT) with low costs in comparison to rail systems, was commissioned in Istanbul in 2006. Another critical practice for bus systems used in mass transportation has been to replace bus fleets with vehicles that run on natural gas. Such vehicle purchases have been made in Ankara and Istanbul. These practices improve air quality of cities and that support greenhouse gas mitigation strategy.
- By providing free or low priced car park facilities at mass transportation stops and stations in the country as a result of the system established by ISPARK that was established by the Metropolitan Municipality of Istanbul, personal vehicle users are encouraged to travel to the city centre by using the mass transportation system.
- Positive developments have emerged in Istanbul and Izmir in terms of ticket integration and joint ticket practices. Such practices also make mass transportation attractive and encourage users, and therefore, make a contribution in the decrease of greenhouse gas emissions in urban transportation. However, such practices are not very widespread yet.

- In cities where it is possible to provide sea and water transportation services, projects for improving services provided by ferries and similar vehicles are being implemented within the scope of mass transportation. The following works have been performed as a result of the Transformation in Transportation Project that was initiated in Izmir in 2001: new ferry ports were constructed, new ferry purchases were made, integration of bus lines to ports were reinforced and consequently, the share of maritime travel has been increased in urban transportation. In Istanbul, improving quality of services that are provided by ferries and sea buses and increasing number of cruises have made positive impacts.

Box 4.11. Good Practices of Local Governments

The Sustainable Urban Mobility Planning Adapted to Mediterranean (SUMPA-MED) Project was initiated in 2009 under the leadership of the Gaziantep Metropolitan Municipality. The EU provided financial support to the project (650,000 Euros). The project aims to mitigate environmental impacts by meeting increasing transportation requirements through environmental-friendly transportation modes, and aims to transfer modern planning instruments and measurement methods to these cities and to adapt the same to achieve their objectives (www.sumpa-med.net).

Regarding sustainable transportation, the following projects have been particularly significant: "Konya Bicycle Festival", "Green Nilüfer Week" celebrations organized by Bursa Nilüfer Municipality and "Street is Ours Once in a Month Campaign" that was initiated in coordination with non-governmental organizations, universities and supported by the Istanbul Metropolitan Municipality.

- Practices and investments regarding bicycle and pedestrian transportation are limited. A bicycle plan has been made in Konya and implementation has begun; however, no extensive and safe bicycle network has yet to be established. Investments have been made on bicycle paths and bicycle park areas in the light rail system (Bursaray) in Bursa Nilüfer Municipality. Investments are also being made on bicycle roads in Gaziantep, and a system that is known as "public bicycles" practice has been initiated in the university campus.
- Green wave practices are being implemented in certain cities in order to contribute to greenhouse gas mitigation objectives by making traffic management practices to decrease traffic jams in city centres. Mobile Electronic System Integration (MOBESE) has been implemented as intelligent transportation system, and the number of Automatic Toll Collection Systems (OGS) has been increased.
- A policy for banning vehicles older than 16 years has been established by the Ministry of Transportation, Maritime and Communication (MTMAC). In this scope, MTMAC continues to work on banning commercial and light commercial vehicles from traffic regularly every year.

Box 4.12. Transport Infrastructure Needs Assessment (TINA)

TINA is implemented by the EU to connect candidate countries to the networks of the EU countries (TEN-T- Trans European Network-Transport). TINA Turkey Project was initiated on 2 December 2005, and Implemented on 23 May 2008. The objective of the project was to determine the strategy that Turkey will follow to connect to the Trans-European Network and to determine the main routes that will connect Turkey to the Trans-European Network and that will ensure multi mode transportation to be performed, and to determine the investments that must be made for this purpose. All of transport modes were reviewed in the project, and core networks that are envisaged for the years between 2006 and 2020 were defined, and projects and order of priority of the same were determined. TINA-Turkey work formed the basis for the technical criteria closing meeting negotiations of the transport section, Trans-European Networks, 21st Chapter held in Brussels on December 13, 2010.

- Projects have been developed by the Short Sea Shipping Promotion Center available within the body of TOBB and information has been provided on obtaining financial support. Conferences and meetings organized on transportation and particularly in the area of sustainable transportation, and various events such as National Transport Council and Urbanization Council also make positive impacts.

Research & Development

Critical R&D studies have been made in the transportation sector by public institutions, the private sector and universities, particularly on the issue of alternative fuel technologies. R&D studies are being carried out on fuel cells and hybrid vehicles. The number of studies and investments made, particularly on electric vehicles by the private sector, has increased in recent years. A selection of studies that are being implemented in relation to these issues are as follows:

- Studies on "environmental friendly vehicles" continue to be performed by the automotive industry. Research and practices for promoting environment friendly vehicle technologies with high energy efficiency are also supported by the Automotive Industry Association.
- Although activities in relation with production of rail system vehicles in Turkey are limited, activities that are performed by the Istanbul Ulaşım A.Ş. are very important. Rail system works are also implemented by various municipalities, such as Bursa and Gaziantep municipalities.
- Seferihisar sub-province in Izmir has become the first town in Turkey to obtain a "slow city" certificate - by supporting sustainable transportation types and not fast car driving - within the framework of an urbanization policy based on walking and bicycle. Motorcycle practices that run on solar energy have been developed within this scope. Activities are being implemented to popularise this practice.

ASSESSMENT ACCORDING TO GREENHOUSE GAS TYPE

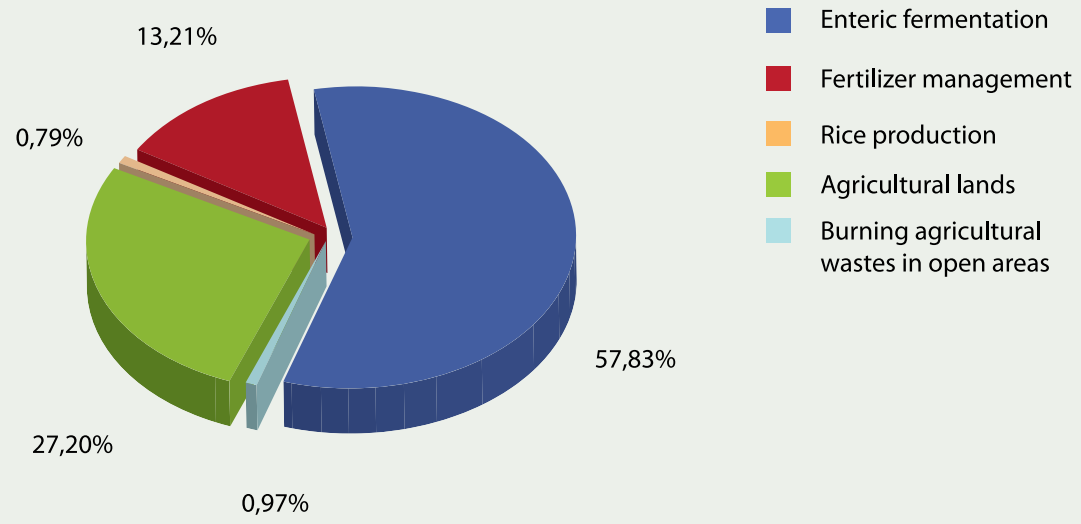
CO_2 emissions are the largest source of GHG emissions from the transportation sector. Policies and measures to decrease CO_2 emissions have been provided in the above chapters. Also, there are several legal regulations and technology development projects in the direction of decreasing emissions caused by emissions of nitrogen oxide (NOx), non-methane volatile organic compounds (NMVOC), CO and sulphur dioxide (SO_2) that source from burning fuel in transportation sector

4.6. Agriculture

GENERAL POLICIES AND MEASURES

Greenhouse gas emissions from agricultural production represent 7% of the total amount of emissions in Turkey in 2009. This ratio was 16% in 1990, demonstrating a tendency to decrease over time as a proportion of total emissions in Turkey. Greenhouse gas emissions source from agricultural activities such as from production and processing of agricultural products, livestock (enteric fermentation, fertilizer management), rice production, burning agricultural wastes in open areas and agricultural lands. Enteric fermentation is the sub-sector that contributes the most to the total amount of agricultural emissions (Figure 4.4). However, methane emission in this sector decreased significantly after 1990 because of the decrease in the number of livestock in Turkey.[31]

Figure 4.6. Contribution of Agricultural Sub-Sectors to the Total Amount of Agricultural Emissions (2009)



Source: MENR, 2011

The fight against climate change in the agricultural sector is implemented both directly by imposing emission limits and indirectly through sinks in agricultural lands. Therefore, in addition to fertilizer management and good agricultural practices, policies that protect agricultural lands are also effective in combatting climate change.

The following objectives were presented for the agriculture sector in the Ninth Development Plan (2007-2013): ensuring food safety and assurance, using highly fertile agricultural lands for agricultural purposes, prioritising activities to manage resources, as well as effective use of water, consolidating agricultural lands, increasing the scale of agricultural enterprises, improving production techniques and increasing competitiveness in livestock farming.

The following issues have been emphasized in the Strategic Plan of the Ministry of Food, Agriculture and Livestock (2010-2014): rural development in agriculture; sensitivity towards human health and environment; biological diversity and protection of natural resources; protection and development of genetic resources and ecosystems; establish energy farming; and take necessary measures against climate change.

[31] TÜİK, 2011. National Greenhouse Gas Inventory Report (NIR 2011).

During the period of Ninth Plan, the following activities are top policy priorities to combat climate change:

- Environmentally Based Agricultural Land Protection Program,
- To identify agricultural basins to inform sustainable agricultural management, and to ensure increased fertility, and protection of an ecological balance, and
- To develop organic agriculture to decrease negative impacts of agriculture on the environment and ensure sustainable use of natural resources.

The Fight Against Drought Strategy and Action Plan of the Ministry of Food, Agriculture and Livestock (MFAL) (2008-2012) aims: to develop sustainable agricultural water use planning by increasing public awareness; to take all types of measures in non-drought periods; and to ensure that the impacts of drought are minimised by implementing effective programs during crisis periods.

The Organic Agriculture Strategy Document of the MFAL (2006-2020) aims to increase the competiveness and effectiveness of the organic agriculture sector to establish a sustainable agriculture sector that considers environmental impacts in Turkey.

Examples of agricultural measures that must be taken in Turkey include: management of soil and water resources; modernization of irrigation; support for policies that produce herbal products; policies that support livestock farming and forage plants; and support for policies that improve and develop agricultural infrastructure.

LEGAL REGULATIONS AND PRACTICES

According to the Agricultural Law No. 5488[32], the MFAL is authorized to: determine policies for the agricultural sector; plan and coordinate these policies; and implement these policies in coordination with other institutions and organizations. Law No. 5488 is the basis for agricultural policies, and establishes the objectives of: improved agricultural production in parallel with domestic and foreign demand; the protection and development of natural and biological resources; increased efficiency; strengthened food assurance and safety; the development of producer organizations; strengthened agricultural markets; and increased welfare level of the agricultural sector by ensuring rural development.

The Land Protection and Land Utilization Law No. 5403[33] calls for complete inventories of land, the prevention of use of agricultural lands for non-agricultural purposes, and actions related to protection and sustainable use of agricultural lands. Similar regulations are also available in the Agricultural Reform Law No. 3083 Regarding Land Arrangement in Irrigation Areas. Pasture Law No. 4342 establishes regulations for determining, allocating, and sustainable use of meadows, pasture and grasslands, in a way that increases and improves productivity. These regulations support policies to combat climate change.

- **Regulation on Good Agricultural Practices**[34]

Control and certification activities are implemented by private organizations authorized by the MFAL in accordance with the Regulation Regarding Good Agricultural Practices (amended in 2005 and 2006). Under this scope, 12 private organizations are authorized by the Ministry to perform control-certification activities. Also, these authorized organizations must be accredited by Turkish or foreign accreditation bodies according to EN 45011 or ISO/IEC Guide 65.

- **Regulation Regarding Principles and Implementation of Organic Agriculture**[35]

The Regulation determines the principles and procedures regarding protection of ecological balance, implementation of organic agricultural activities, and the development organic agricultural production and marketing.

32 Official Gazette No. 26149, dated 25 April 2006; Amendment: Official Gazette No. 28091, dated 21 October 2011.
33 Official Gazette No. 25880, dated 19 July 2005.
34 Official Gazette No. 25577, dated 08 August 2004.
35 Official Gazette No. 27676, dated 18 August 2010.

Several projects and practices have been implemented related to aforementioned laws and regulations. A selection of such practices are given below:

Good Agricultural Practices

A Good Agricultural Practices (ITU) Certificate has been conferred to producers in Turkey since 2007 within the framework of the provisions of the Regulation Regarding Good Agricultural Practices. ITU Certificates were given to 651 producers in 18 provinces covering a total area 5,360 ha by 2007. By 2010 4,540 producers in 48 provinces received certificates covering an area of 78,174 ha (with an increase of 1,458%). Turkey aims to have certificates in 81 provinces by 2023.[36] ITUs aim to produce agricultural products that do not damage the environment, human and animal health, ensure traceability and sustainability in agriculture, while ensuring reliable product supply.

The Expansion of Good Agricultural Practices in Fruit-Vegetable Production was implemented with the support of the Food and Agriculture Organization of the United Nations to establish capacity and expand good agricultural practices in the fresh fruit and vegetable sector in Turkey.

Organic Agricultural Practices

Organic agricultural practices have been implemented based on the objectives in the Organic Agricultural Strategy Document that covers 2006-2020.[37] Implementation principles have been determined by the Regulation Regarding Principles and Implementation of Organic Agriculture, which was finalized in 2010. One of the projects implemented in organic agriculture is the Project on Cluster Development of Organic Farming in Southeastern Anatolia Project (GAP), which was initiated by the GAP Regional Development Administration in 2009. The project aims to assess agricultural potentials in the region and to make the organic food, organic beverage and organic textile sectors more competitive.

Organic agricultural production grew from 458 thousand tonnes in 2006 to 1.3 million in 2010.[38]

Environmentally Based Agricultural Land Protection Program (ÇATAK)

ÇATAK was initiated in 2006 and includes innovative practices in the field of agriculture, such as those that decrease the negative impacts of climate change and those that remove negative impacts from agricultural activities.[39]

The program, aims to ensure sustainability of renewable natural resources, to expand suitable cultivation, fertilization, irrigation and similar cultural measures, to prevent erosion, and to inform producers about agricultural and environmental issues.

Agriculture-Climate Change Interactions Research Program

The objective of the Agriculture-Climate Change Interactions Research Program, initiated by the General Directorate of Agricultural Researches and Policies (TAGEM), Ministry of Food, Agriculture and Livestock in 2011, is to determine interactions between agriculture and climate change, to research adaptation of agriculture to climate change and to research agricultural environmental problems. The contribution of the agricultural sector to the greenhouse gas profile of Turkey will also be evaluated.

Project on the Effects of Cultivation Techniques on Carbon Capture and Sustainability of Lands

Although the amount of carbon captured in the land varies on the basis of climate and cultivation techniques, sequestration in agricultural lands plays a significant role in decreasing

36 Data obtained from Ministry of Agriculture and Rural Affairs, 2011.
37 Ministry of Agriculture and Rural Affairs, 2006.
38 Data obtained from former Ministry of Agriculture and Rural Affairs, 2011.
39 Former Ministry of Agriculture and Rural Affairs, 2011.

atmospheric CO_2 levels. The Project on the Effects of Cultivation Techniques on Carbon Capture and Sustainability of Lands is implemented in coordination with TAGEM, TİGEM and Faculty of Agriculture, Ankara University, to impact the productivity of lands over the long term by organizing physical, chemical and biological characteristics of lands, and to obtain data that ensures soil conservation by improving erosion control.

Implementation of Nitrates Directive

This project will harmonise the Nitrates Directive of the EU by preventing agricultural activity based pollution. The following outputs will be achieved: updating the Nitrates Directive, establishing secondary legislation, establishing Good Agricultural Practice Code to be implemented voluntarily, determining Nitrate Sensitive Areas, and issuing Actions Plans for these sensitive areas. Restrictions may be imposed on fertilizer practices within the scope of the action plans. By the end of the process, underground and surface water pollution that sources from agricultural activities will be prevented and use of good agricultural practices will be ensured.[40]

Land Consolidation

The amount of energy used in agriculture may be decreased through land consolidation. As a result of 30 projects implemented since 2006, total area of 345,442 ha has been consolidated in accordance with the Cabinet Decree. Land consolidation activities have been undertaken by the Ministry of Food, Agriculture and Livestock in accordance with the Land Protection and Land Utilization Law No. 5403.

Box 4.13. Best Practices

- ÇATAK: As a pilot project within the scope of agricultural activities performed between 2006 and 2008, a grant program with the budget of 9 million USD was initiated in Seyfe Lake (Kırşehir), Kovada Lake (Eğirdir/Isparta), Ereğli Reedfield (Konya) and Sultan Reedfield (Kayseri) covering a total area of 5,000 hectares, which have experienced environmental problems and which have been defined as "Wetlands of International Importance."
- Land Consolidation: The General Directorate of Agricultural Reform (GDAR) initiated activities to turn land consolidation into an instrument that is also used to solve other rural problems. Land consolidation activities were initiated in Turkey in 1961, and it was implemented on approximately 1 million hectares of land by the end of 2008. Also, activities implemented on approximately 2 million hectares of land between 2009 and 2010 within the framework of GAP Action Plan are currently ongoing. In addition to the GAP areas, activities were initiated on approximately 450,000 hectares of area over the same period. The total area of the land where land consolidation works will be performed initially is approximately 14 million hectares.

Turkey Agricultural Basins Project

Within the scope of this project, agricultural products are encouraged to be cultivated in one of the 30 basin most suitable for their ecological requirements based on climate, soil and topographic data, defined by the Cabinet Decree No. 2009/15173. The objectives of the project are to: maximize total welfare; ensure sustainability in agriculture by developing and implementing agricultural projects - with the participation of local populations - that do not damage environment throughout the production chain; increase rural commercial capacity to expand commercial opportunity areas of producers; and increase productivity of products that can assist in combating climate change. Data with the total of 527,782,613 are registered to the system by establishing a database

[40] MFAL, 2011.

(agricultural inventory) in relation with specified agricultural basins. A decision support system to determine optimal product support and agricultural imports and exports has been established. As a result of this project, products shall be produced in optimal locations and in suitable amounts. This will result in better protection of natural resources and reduction of greenhouse gas emissions by minimizing the amount of energy used in agriculture.

No-Till Farming or Minimum Till Farming Practices

No-till farming refers to planting crops directly by using grain drills (seed drill machines) without disturbing the soil through tillage. When farming is performed by using these methods, tillage is decreased and therefore, energy that would have been used in agriculture also decreases. Sink capacity of the soil will also increase significantly based on the increase in the organic material content. Activities are implemented in a variety of locations supported by the Ministry of Food, Agriculture and Livestock.

RESEARCH & DEVELOPMENT

Fifty-eight research institutes exist within the Ministry of Food, Agriculture and Livestock (8 centres that implement research on plant and animal production and soil and water, 17 basins centres and 33 research centres) perform various R&D works. In these institutions, R&D works related to climate change are implemented on issues, such as decreasing use of energy in agriculture, sustainable resource use, improving irrigation methods and tools, improving land treatment methods and tools, conscious fertilizer utilization, cattle rearing, management of animal-based fertilizer, and prevention of stubble burning.

ASSESSMENT ON THE BASIS OF GREENHOUSE GAS TYPE

Agricultural activities mainly cause CH_4 and N_2O emissions. N_2O, CO and NOx emissions are also released as a result of stubble burning. Policies and measures that are in the direction of methane (CH_4) and nitrous oxide (N_2O) are explained in the above chapters.

4.7. Forestry

GENERAL POLICIES AND MEASURES

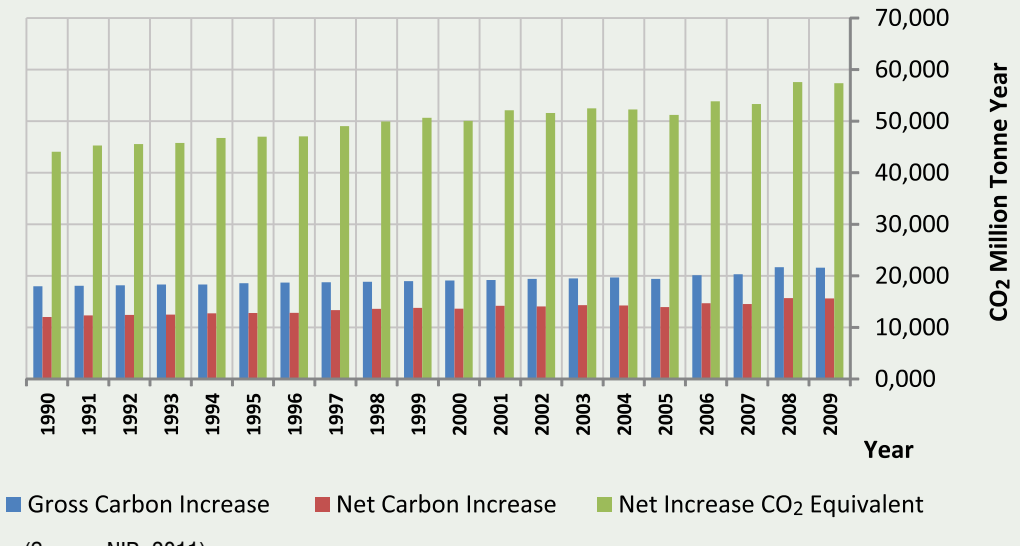
According to data provided by General Directorate of Forestry (DGF), total forest land in Turkey is 21.6 million hectares as of 2011, and the amount of stock available on this land is 1.4 billion m3. The annual increase of this stock is 37.41 million m^3.[41] As of 2009, half of the forest lands in Turkey are degraded forest lands with tree crown cover of 10% or less. Ninety-four percent of total growing stock and annual increase is located in productive forests, and 6% is located in degraded forest lands. Ninety-nine percent of Turkish forests are owned by the government. Approximately 4.1 million ha (19%) of total forest lands are within national parks, protected areas with special status and umanaged forests that include other protected forests. The remaining area of 17.1 million ha is composed of managed forests.

Annual carbon capture potential of Turkish forests increase regularly (Figure 4.7). The net carbon stock increased from 12.02 M ton/year in 1990 to 15.64 M ton/year in 2009. CO_2 eq intake to these amounts also increased from 44.08 M ton/year to 57.36 M ton/year. Forest lands are the most important sinks for greenhouse gases, and they absorb 25% of the overall CO_2 released to the atmosphere on average, together with agricultural areas, meadows, wetlands and green areas in residential areas.

Since the early 2000's, forests in Turkey have been managed through an approach that considers sustainable forest management criteria and indicators and that envisages multi-purpose use. Forests that were managed only for removal of roundwood in various dimensions and qualities are now used for various protection and service functions.

The Ninth Development Plan aims: to protect natural forest ecosystem from various factors such a fires and pests; and to manage the forests for multiple purposes that meet the objectives of: developing a protection-utilization balance; biological diversity; germplasm; forest health; non-wood products and services; and ecotourism. The importance of following issues are also emphasized in the Plan: desertification and community health; industrial and soil conservation plantations on a basin basis; rehabilitation activities that make use of lands in a better way by promoting urban forestry and agricultural forestry activities; developing private plantations; and raising awareness across society on such issues.[42]

Figure 4.7. Annual Net Carbon Stock in the Forests of Turkey and Change in CO_2 eq Intake (1990-2009)



(Source: NIR, 2011)

41 GDF, 2009.

42 Former SPO, 2006. Ninth Development Plan, p. 85.

Long term plans are also being issued to include the forestry sector in Development Plans. In this context, the sector has had two Forestry Plans over the duration of 25 years (1973-1993 and 1990-2009). Preparations for issuing the Turkish National Forestry Program were initiated in 2001, and these preparations were finalised in 2004. The program was developed with contributions from the FAO, forest villagers, non-governmental organizations, academics, the forestry sector, experts and public organizations . It is envisaged that the actions and strategies to expand forest areas, protect biological diversity and particularly develop forest communities within the scope of Turkish National Forestry Program will also increase the number of sink areas and shall mitigate greenhouse gas emissions caused by the people living in forestlands and in the vicinity of forestlands. Additional forestry actions are also described in the NCCS and NCCAP.

Box 4.14. National Climate Change Action Plan

The following objectives are proposed to increase the sink capacity of the forestry sector;

- To increase the amount of carbon capture in forestlands by 15% until 2020 in comparison to 2007 (2007: 14,500 Gg, 2020: 16,700 Gg),
- To decrease deforestation and degradation by 20% by 2020 in comparison with 2007
- To set numerical goals that limit negative impacts of land-use and land-use change on climate change.

The National Climate Change Strategy Document includes several objectives in line with mitigation of carbon emission in the forestry sector: to expand the use of compressed wood (pellet) instead of coal; to increase the amount of carbon captured in forest land through afforestation and rehabilitation of 2.3 million hectares of land between 2008 and 2012; to expand agricultural and forestry activities as a source of energy; to develop a monitoring model that covers all land use classes; to plan forestry activities in line with “Upper Basin Management” in order to protect water resources; to manage forests within the framework of sustainability principles; to increase open and green area systems in urban areas; and to develop urban forestry.

Box 4.15. Turkey’s National Strategy on Climate Change and Protected Areas

In the Strategy published in 2011, the objectives are determined in line with increasing the effectiveness of protected areas in the fight against climate change. Areas that are protected within the scope of climate change are important from following perspectives:

- Emission mitigation: Maintaining areas which include ecosystems that absorb carbon, like forests and peatlands and establishing new protected areas.
- Adaptation to climate change: Maintaining ecosystem services, as well as ecosystem distributions within protected areas.
- Building resilience of ecosystems and species to climate change by means of existing protected area network.

The strategy includes actions toward the following objectives: research and implementation; experience and information sharing; capacity building; communication; policy; coordination and implementation.

The Afforestation and Erosion Control Mobilisation Action Plan (2008-2012) was issued in coordination with the private sector and non-governmental organizations within the framework of National Afforestation and Erosion Control Mobilisation.[43] Within the scope of the Action Plan,afforestation, erosion control and forest rehabilitation activities are planned in 2.3 million hectares of land between 2008 and 2012.[44] These activities will also expand sink areas.

LEGAL REGULATIONS AND PRACTICES

The General Directorate of Forestry has been implementing rehabilitation (improvement) and reforestation activities in degraded forests. The primary objective of this work is to increase crown density of forests and to develop forest structure.

The following policies are the main greenhouse gas mitigation measures that are available in the documents related to forestry: combat desertification and erosion; protect forest lands and water resources; use renewable energy instead of fossil fuel; and promote private afforestation.

Chain of Custody Certification (CoC) is among the certificates issued by the Forest Stewardship Council (FSC) and refers to the uninterrupted road map of how a product reaches the consumer starting from the forest. This includes transformation and distribution processes. The FSC-CoC seal, applicable to all wood products is a sign that the forest where the product is obtained is managed sustainably, and that this has been approved by independent auditors to international standards. FSC Certificate practice is included to the Report on Suggestions for a Competitive Economy that was issued by Turkish Exporters Assembly (TIM) in July 2011, but is currently only being implemented in the Bolu Aladağ Forestry Department in Turkey.

Project for Strengthening Management of Forest Protection Areas

The Project for Strengthening Management of Forest Protection Areas was initiated in 2008 executed by the General Directorate of Nature Conservation and National Parks in the Ministry of Forestry and Water Works (MFWW) in coordination with the General Directorate of Forestry and World Wildlife Fund (WWF)-Turkey. The GEF-supported project aimed to improve the position and administrative effectiveness of the forest management in Turkey within the system of national protected areas. This aimed to establish an effective and integrated management model based on the participation principle in the Küre Mountains National Park (one of the nine hot spots in Turkey) and its buffer zone for the purposes of nature conservation and sustainable resource management. As a result of the practices implemented in the project, the process for obtaining an international protected area certificate is in its final stage thanks to the establishment of monitoring and visitor management infrastructure. Planning works were performed for sustainable management of forests in the buffer zone, and works were initiated to expand utilization of the established model in eight other spots in Turkey.

The National Park's carbon balance and oxygen production ratio were calculated as a result of the ecosystem based functional forest management plan of Küre Mountains National Park. The national park has a potential of sequestering 48,270,068 tonnes of CO_2 in total, and its annual oxygen production is 301,522 tonnes.

Thanks to loan support provided to more than 300 families by the General Directorate of Forestry in relation to solar water heating systems, coppice oak forests with the total area of 14.6 hectares have been prevented from being cut, and 821.82 tonnes of CO_2 has been prevented from being emitted over two years.

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43 Circular Order of Prime Ministry published on 1 November 2007.

44 Former MEF 2008.

4.8. Waste

GENERAL POLICIES AND MEASURES

The waste sector is the second largest contributor to Turkey's greenhouse gas emissions since 1995. According to the 2009 national emission inventory, the waste sector contributes 9.2% of total emission. The waste sector includes the following types of emissions: direct greenhouse gas emissions; and emissions that are the result of landfills and sewage sludge from waste water treatment plants. Hazardous wastes and waste incineration facility emissions were not included in the 2009 inventory. In Turkey, 89% of the greenhouse gas emissions from the waste sector come from controlled and uncontrolled solid waste storage areas, and the remainder sources from household waste water procedures. Ninety-five percent of the greenhouse gases that source from the waste sector are CH_4 and 5% are N_2O.

Sanitary landfills collected 24,360,863 tonnes/year (1.15 kg/per person/day, 420 kg/per person year) in Turkey in 2008. Eighty-two percent of the country's population benefits from waste collection service and 99% of the municipal population benefits from waste collection service. Forty-six percent of the waste collected from municipalities are disposed of by using methods that are consistent with waste management legislation, such as controlled storage and composting. Approximately 46% of the municipal population benefits from such facilities, and 54% of the municipal population disposes of waste by using uncontrolled storage and other methods.

The framework of the policy related to the waste sector in Turkey is available in the Ninth Development Plan (2007-2013). The Development Plan includes the following objectives in the waste sector: to support establishment of the Local Administration Unions (Waste Management Unions); to plan waste management within the framework of integrated management using treatment/disposal technologies consistent the country's conditions; to decrease the production of non-household wastes; and to establish appropriate collection, handling, recovery and disposal systems.

The Waste Management Action Plan was issued by the Former MEF in 2008.[45] In the Action Plan, objectives consistent with the waste policies stipulated in the Ninth Development Plan have been suggested, and supplementary objectives are suggested. Objectives in the plan related to emission mitigation include:

- Establishment of regional and national waste plan and to ensure sustainability,
- Promotion of the use of technologies to minimize waste formation during production stage, and
- Harmonization of policy and implementation of international trade of wastes with the EU criteria.[46]

The Action Plan emphasizes of the prioritization of: prevention; mitigation at source; reutilization; recycling/recovery; pre-treatment (including incineration); and disposal.[47] Also, information on the current waste management situation and projections and objectives for the future are presented in the Action Plan. Practices that must be implemented both at the central and provincial levels are identified.

The sector contributed to the preparation of the National Climate Change Action Plan, published in 2011.

45 Waste Management Action Plan includes the following outputs related to harmonisation of Turkey's waste management planning to the EU criteria: EHCIP; Solid Waste Master Plan; and the EU Integrated Environmental Approximation Strategy (2007-2023).

46 MEU, 2011; MEU, 2010a.

47 Former MEF, 2008a.

Box 4.16. Climate Change Action Plan

Actions in NCCAP in line with the waste sector are provided below:

- Reducing the quantity of biodegradable wastes admitted to landfill sites, taking year 2005 as a basis, by 75% in weight till 2015, by 50% till 2018 and by 35% till 2025.
- Establishing integrated solid waste disposal facilities across the country, and dispose 100% of municipal wastes in these facilities, until the end of 2023.
- Termination of uncontrolled disposal of wastes 100% by 2023.

LEGAL REGULATIONS AND PRACTICES

There are several regulations in Turkey's EU membership negotiations process that have become effective within the scope of the waste sector and that also support greenhouse gas emission mitigation[48].

The following activities have been implemented particularly after 2010 based on the EU harmonisation process: infrastructure has been developed to enable rapid greenhouse gas mitigation; packaging wastes will be recycled in high ratios (≥60%); acceptance of biodegradable wastes to the controlled storage facilities is limited; uncontrolled storage areas are being rehabilitated; and stored gases are being flared and/or recovered to ensure renewable energy from gas.

Controlled Storage of Solid Wastes

Municipalities in Turkey are responsible for waste management. The Solid Waste Master Plan that was issued in 2006 and second stage of the same plan that was issued in 2009 were issued by the Former MEF to facilitate the establishment of waste management facilities in sub-provincial/ town municipalities that are not within the borders of Metropolitan Municipalities. Preparation of this plan is critical since it provides support to establishment of Local Administrative Unions (Waste Management Unions) that are mentioned in the Ninth Development Plan and several other strategy documents[49].

There has been a significant increase in the number of landfills since the since the Initial National Communication. Fifty-nine landfills that have been constructed and commissioned in Turkey provide services to a population of 41 million via 756 municipalities. Thirteen of the existing landfills include a solid waste leachate treatment plant. The amount of investment that must be made for rehabilitation and shut down of approximately 1400 uncontrolled storage sites[50] is estimated to be 350,000,000 Euros.[51]

The Project for Determination and Mitigation of Methane Emissions that Source from Controlled and Uncontrolled Storage Sites in Waste Management and the Energy Efficiency Support Policies and Project for Management of Uncontrolled Storage Sites in Turkey were initiated by Ministry of Environment and Urbanization in 2010 within the scope of acronym to mitigate methane emissions from controlled and uncontrolled storage areas. Several solid waste management projects are supported by the IPA-Environment Program. Five municipal projects as well as feasibility assessments of five additional projects have been completed within this scope, and Technical Support Project for Preparation of Integrated Solid Waste Projects has been initiated to support sixteen unions.

48 NCCAP, 2011
49 MEU, 2008c; MEU, 2010a
50 MEU, 2006.
51 MEU, 2005.

Waste to Energy

The recovery of packaging wastes, organic waste composting and biomethane recovery, as well as the development of low emission incineration and gasification technologies have had a significant place as a greenhouse gas mitigation strategy in the waste sector.

In Turkey, there are several projects implemented both by municipalities and the private sector in relation to assessment of landfill gas released from controlled storage sites in Turkey. Biogas energy production plants are available in Ankara, İstanbul, Bursa and Gaziantep. Activities related to this issue are currently ongoing in Samsun and Konya provinces. Installed power and current capacities of these plants are provided in Table 4.5.

Table 4.5. Installed Power and Capacities of the Biogas Energy Production Plants in Turkey

Plants	Planned Installed Power	Current Capacity
Ankara Mamak Biogas Energy Production Plant	22.6 MW	22.6 MW
İstanbul Hasdal Biogas Energy Production Plant	4 MW	
İstanbul Odayeri Biogas Energy Production Plant	28 MW	7 MW
İstanbul Kömürcüoda Biogas Energy Production Plant	7 MW	3.45 MW
Gaziantep Biogas Energy Production Plant	3.939 MW	1.13 MW
Konya Metropolitan Municipality	4.2 MW	

Source: MEU, 2011.

Research and practices on the use of waste as fuel are also ongoing. One of the projects that is implemented within the body of TUBITAK and that supports integrated solid waste management and greenhouse gas emission mitigation is the Project for Researching Granule Conversion of Recycled Plastic Wastes and Utilization of Other non-Recycled Wastes as Additional Fuel in Cement Factories (2006-2009). The objective of the project was to separate wastes that are collected by İSTAÇ, a Municipal Economic Enterprise that is affiliated to the Istanbul Metropolitan Municipality. It will convert plastics into granules following the stages of washing, breaking, grinding and melting, and will produce acronym by mixing non-recycled wastes with plastics that are granulated directly or at a certain ratio. This product will be used as an alternative or additional fuel in cement kilns. As a result of the project, plastic wastes are collected and recycled regularly and other plastic wastes are used as alternative fuel in the kiln.

Hazardous Wastes

Hazardous Waste Management Regulation has been harmonised with the Hazardous Waste Directive of the EU (91/689/EC) and includes all types of issues related to safe management of hazardous wastes, from production to disposal.[52] Under this scope, natural and legal entities that are willing to recover hazardous wastes must apply to Ministry of Environment and Urbanization and must obtain a license. Eighteen plants were licensed by 2003, and this figure increased significantly in 2009 to 140.[53] Final disposal plants that are licensed by Ministry of Environment and Urbanization are as below:

- Izmit Waste and Residue Treatment, Burning and Reuse Co. (IZAYDAS) (storage and incineration, capacity of 790,000 m^3 and 35,000 tonnes/year),
- PETKIM (incineration, 17,500 tonnes/year),

52 Official Gazette No. 25755, dated 14 March 2005; Amendment: Official Gazette No. 27721, dated 06 March 2010.

53 Ministry of Environment and Urbanization(MEU), 2010a.

- TÜPRAŞ (incineration of its wastes, 7,750 tonnes/year),
- ERDEMİR (incineration of its wastes, 6,084 tonnes/year) and
- İSKEN (storage of its wastes, 115,000 m3)[54]

IZAYDAS is listed among the plants that accepts domestic and hazardous wastes to the controlled storage site, and transfers wastes to different sections by initially separating wastes. Electricity production in the plant was planned to begin in 2012 to incinerate gases that are released at the domestic storage site. Thus, it aims to produce a minimum of 132,804,000 kWh of electricity for 16 years, and to prevent 750,000 – 1,000,000 tonnes of CO_2 from being released to the atmosphere.[55]

ASSESSMENT ACCORDING TO THE TYPE OF GREENHOUSE GAS

According to the 2009 national greenhouse gas inventory of Turkey, 95% of the greenhouse gases that source from the waste sector are composed of CH_4 and 5% is N_2O. Solid wastes and waste water treatment plants are included in calculations of the inventory.

54 MEU, 2008a.

55 IZAYDAS, 2011.

4.9. International Air and Maritime Transport

The entire Turkish airplane fleet participates in emissions trading within the scope of the EU Emission Trading Directive. On the other hand, international transport activities performed by air and maritime sectors are now subject to emission trading and monitoring within the scope of United Nations Framework Convention on Climate Change (UNFCCC).

Turkey has participated regularly and systematically in the meetings and negotiations on emissions from the international air and maritime transport sub-sectors at UNFCCC. Turkey is also following developments by the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO).

General Directorate of Civil Aviation under the MTMAC is the responsible body for following issues relating to GHG emissions from the international civil aviation sector, ensuring the country's participation at the various international fora.

The former Undersecretariat of Maritime Affairs (currently MTMAC) has been directly involved in the IMO through meetings of the Marine Environment Protection Committee.

4.10. Minimization of adverse impacts in accordance with Article 3, Paragraph 14 of the Kyoto Protocol (based on Decision 15/CMP.1)

The policies and measures that are presented in this Communication and that are in line with the fight against climate change have no negative impact on developing countries and underdeveloped countries.

4.11. Policies and Measures No Longer in Place

There are no policies or measures that have been no longer in place since submission of the Initial National Communication.

Table 4.6. Policies and Measures regarding GHG Emission Mitigation

ENERGY						
Name of Policy or Measure	Objective and/or Activity Affected	GHG Affected	Type of Instrument	Status	Implementing Agency/Institutions	Estimate of Mitigatoin impact (thousand ton CO_2 eq)
						2010
Legislative Regulations	Improvement and development of the Energy Efficiency Law and Regulation Regarding Increasing Efficiency of Energy Resources and Utilization of Energy	CO_2	Administrative, Support, Information and Raising Awareness	Adopted	MENR	
Project Support	Increasing energy efficiency of the current systems of industrial enterprises	CO_2	Finance	Implemented	MENR	NA
Project for Increasing Energy Efficiency of Turkish Industry by Voluntary Agreements	To expand voluntary agreements that are included in the Energy Efficiency Law No. 5627 with the implementation of pilot schemes in the Turkish industrial sector, and to strengthen energy efficiency infrastructure	CO_2	Information	Implemented	MENR	NA
Voluntary Agreement Support	To decrease the energy intensity of industrial enterprises	CO_2	Finance	Implemented	MENR, private sector	NA
Legal Regulations Regarding Energy Performance of Buildings	Regulations and communiques regarding effective and efficient utilization of energy and energy resources in buildings	CO_2	Legal Regulation	Adopted	MEU	NA
Regulation Regarding Distribution of Heating and Sanitary Hot Water Costs in Central Heating and Sanitary Hot Water Systems	Regulation for obtaining efficiency in heating and sanitary hot water utilization activities in buildings	CO_2	Legal Regulation	Adopted	MEU	
Project for Improving Capacity of the Former Ministry of Public Works and Settlement for Increasing Energy Performance of Buildings	Analysis of the energy efficiency legislation and practices implemented in the EU and Turkey, preparation of an action plan, to make feasibility works to establish energy efficiency laboratory	CO_2	Training, Capacity Building	Implemented	MEU	

Table 4.6. Policies and Measures regarding GHG Emission Mitigation

ENERGY						
Name of Policy or Measure	Objective and/or Activity Affected	GHG Affected	Type of Instrument	Status	Implementing Agency/Institutions	Estimate of Mitigatoin impact (thousand ton CO_2 eq)
						2010
Project for Improving Energy Efficiency of Buildings	Increasing energy efficiency in new building designs and existing building rehabilitation works to make a positive contribution to climate change and security of energy supply by establishing economic gains	CO_2	Information, Improvement	Planned	EU,IPA, MEU	
Project for Improving Energy Efficiency of Buildings	To organize training programs for relevant institutions, municipalities, architects and engineers to ensure effective implementation of the Regulation Regarding Energy Performance of Buildings, and to organize training and awareness raising activities to introduce integrated building approaches to the public		Training, Improvement	Implemented	MENR, MEU, TOKİ, MNE , UNDP	
100 Public Building Project	To make energy audits on 100 public buildings located in Ankara, and to issue energy ID's, to increase energy efficiency levels, to decrease energy consumptions and to mitigate greenhouse gas emissions on the basis of these reports	CO_2	Improvement	Implemented	MEU,	
Energy Efficiency Project for SME in Turkey	To finance capacity improvement, including audit and energy efficiency investments, in coordination with AFD, that shall be made by KOSGEB	CO_2	Training, Finance	Planned	KOSGEB	NA
Energy Efficiency Services Supports	To increase energy management in SME's and to determine energy efficiency measures and potential	CO_2	Training, Finance	Adopted	KOSGEB	NA
License Exemption for Cogeneration and Trigeneration Practices	To mitigate transmission and distribution losses and to make energy savings by expanding cogeneration and trigeneration practices	CO_2	Administrative	Adopted	EMRA	54 (per year)
Rehabilitation of Public Power Plants	To improve energy production efficiency of thermal and hydroelectric power plants that are operated by public enterprises for a long time	CO_2	Improvement	Implemented	MENR	NA
Eco-credit Investment Loan Practice	To improve heat insulation and energy performance of existing buildings	CO_2	Finance	Implemented	Associations and Banks	52 (per year)
Fuel Conversion Projects	Utilization of natural gas in thermal power plants as auxiliary fuel	CO_2	Improvement	Implemented	MENR	700 (per year)

Table 4.6. Policies and Measures regarding GHG Emission Mitigation

ENERGY								
Name of Policy or Measure	Objective and/or Activity Affected	GHG Affected	Type of Instrument	Status	Implementing Agency/Institutions	Estimate of Mitigatoin impact (thousand ton CO_2 eq)		
						2010	2015	2020
International Projects	To improve energy efficiency of industrial facilities and buildings, and to accelerate market transformation of energy efficient products	CO_2	Administrative, Information and awareness raising, Finance	Implemented	MENR			16,650
Energy Efficiency Training and Certification Programs	To increase information and awareness on energy efficiency	CO_2	Training	Implemented	MENR	NA		
Energy Management	To ensure that energy management and energy resources and energy are used more efficiently and rationally in buildings and industrial enterprises that are above a certain scale	CO_2	Training	Implemented	MENR	NA		
Legal Regulations Regarding Electricity Production from Renewable Energy Resources	To increase the amount of electricity produced from renewable energy resources by providing purchase guaranteed tariff supports	CO_2	Administrative, Finance	Adopted	MENR	NA		
Biofuel Utilization	To increase use of biofuels in transportation	CO_2	Administrative, Finance	Adopted	Ministry of Finance	NA		
R&D Projects Support Program	Increasing information and backlog of the country by scientific and technological R&D projects that are made in the direction of the needs and priorities of energy sector	CO_2, CH_4, N_2O	Finance	Adopted	MENR	NA		
Energy Labels	To inform consumers and raise awareness on the products that consume energy	CO_2	Administrative, Information and Awareness Raising	Adopted	MSIT, MENR	NA		
Awareness Raising and Introduction	To increase the level of information and awareness on energy efficiency and environment in the public and to introduce benefits of the same by good practices		Information and Awareness Raising	Adopted	MENR	NA		
Project for Improving Energy Efficiency in Industry	To increase effectiveness of legislative practices, to improve legal and organizational infrastructures, to expand energy management and project practices, to develop and improve energy efficiency services, to show benefits of energy management and efficiency by pilot schemes		Training, Improvement	Implemented	MENR, KOSGEB, TSE, TTGV, UNDP, UNIDO			

Table 4.6. Policies and Measures regarding GHG Emission Mitigation

INDUSTRY					
Name of Policy or Measure	Objective and/or Activity Affected	GHG Affected	Type of Instrument	Status	Implementing Agency/ Institutions
Legal Regulations on Eco-design	To determine minimum requirements for sensitive and energy efficient design of energy consuming products during utilization	All gases	Administrative, Information	Implemented	MSIT
Project for Preparation of KOSGEB Environmental Road Map	To establish a road map on the measures and criteria that shall be adapted for SMEs	All gases	Information	Implemented	KOSGEB
Project for Determination of Environmental Conditions and R&D Needs to Expand Cleaner Production Practices in Turkey	To assess the current status of cleaner (sustainable) production in Turkey in the context of capacity, resource, legal regulation, promotion mechanisms and works implemented, and to compare this with international practices, and to generate suggestions in line with the needs and conditions of Turkey	All gases	Information	Implemented	TTGV, former MEF
UNIDO Eco-efficiency (Cleaner Production) Project	To improve the capacity of clean production and eco-efficiency in industry, and to implement pilot schemes in Seyhan Basin and to expand such schemes on national basis.	All gases	Information	Implemented	MSIT, TTGV, UNIDO
Project Regarding Industrial Symbiosis in Iskenderun Gulf	To improve intercompany industrial common life in areas that are close to each other and where various economic activities are performed	CO_2	Information	Implemented	UNDP, former SPO, BTC, Adana Chamber of Industry
Institutional Strengthening Works on ODS	To take actions in the direction of developing implementation capacities of the National Ozone Unit and relative institutions, and to make studies on an domestic legislation that is consistent with the requirements of the EU	ODS	Policy, Legislation	Implemented	MEU, UNIDO
HCFC Termination Investment Project in Cooling Sector	To prepare investment project documents necessary for disposal of HCFC gases that source from products and services provided by the firms in ventilating and air conditioning sector	HCFC	Plan	Implemented	MEU, UNIDO

Table 4.6. Policies and Measures regarding GHG Emission Mitigation

INDUSTRY					
Name of Policy or Measure	Objective and/or Activity Affected	GHG Affected	Type of Instrument	Status	Implementing Agency/Institutions
HCFC Termination Investment Project in Foam Sector	To issue the Rigid Polyurethane Foam and XPS sub-sectors umbrella investment project document for disposal of HCFC gases in the foam sector	HCFC	Plan	Implemented	MEU, UNIDO
Project for Preparation of HCFC Gases Termination Management Plan	To prepare HCFC Gases Termination Management Plan and to prepare a National Strategy and Action Plan that support the same	HCFC	Plan, Strategy	Implemented	MEU, UNIDO
HCFC Termination Sectoral Umbrella Project	To terminate HCFC's that source from production of XPS and Polyurethane solid foam in the selected nine companies	HCFC	Finance, Implementation	Implemented	MEU, UNIDO
Legal Regulation Regarding Cleaner Production within the scope of the Decree Law No. 649, dated 17/07/2011	To ensure that enterprises prepare and implement cleaner production programs and projects	All gases	Policy, Legislation	Adopted	MSIT
Turkish Industrial Strategy Document (2011-2014)	Action output No. 44: To implement a national eco-efficiency program throughout Turkey and to establish a "National Eco-efficiency Centre"	All gases	Policy, Legislation	Implemented	MSIT
Development of Industrial Efficiency and Environmental Platform at the level of SMEs	To raise awareness and to improve capacity by pilot cleaner production/eco-efficiency practices that are performed in enterprises	All gases	Information	Implemented	General Directorate of Efficiency, former National Productivity Centre
HCFC Termination Investment Project in Cooling Sector	To prepare investment project documents necessary for disposal of HCFC gases that source from products and services provided by the firms in ventilating and air conditioning sector	HCFC	Plan	Implemented	MEU, UNIDO

Table 4.6. Policies and Measures regarding GHG Emission Mitigation

TRANSPORTATION								
Policy/ Measure	Objective and/or Activity Affected	Exposed Greenhouse Gas	Type of Policy/ Measure	Status	Implementing Agency/Institution	Estimated Greenhouse Gas Mitigation Effect (thousand tonnes CO_2-equivalent)		
						2010	2015	2020
Legal Regulations	To improve energy efficiency to mitigate emissions in transportation sector	CO_2	Legal	Adopted	MTMAC, MSIT, EMRA			
Tax Regulations	To promote utilization of vehicles with lower greenhouse gas emissions by imposing lower Excise Duty on electric cars within the scope of vehicle taxation system during initial acquisition, and to mitigate fuel consumption and CO_2 as a result of fuel taxation, and to promote biofuel utilization	CO_2	Economic	Adopted	Ministry of Finance			
Bosphorus Railway Tube Crossing Project	To mitigate urban greenhouse gas emission with a tunnel with the length of 54 km (two storey single-tube tunnel, 2 x 2 lanes) that shall only be used by light vehicles, such as cars and minibuses	CO_2	Implementation Project	Implemented (2011-2015)	General Directorate of Infrastructure Investments, MTMAC, Private Sector			
Marmaray Project	To connect Turkey to the Trans-European Network by establishing an uninterrupted railway connection between Asia and Europe via tube tunnel, and to mitigate air pollution that source from the exhaust gases that are emitted by the motor vehicles in order to make a positive impact on Istanbul's daily traffic	N_2O, NMHC, CO, CO_2	Implementation Project	Implemented (2004-2013)	MTMAC, Private Sector		130*	
Ankara İstanbul High Speed Train Project	To construct a double line, electrical, signalized high speed railway between Ankara and Istanbul suitable for 250 km of speed, and to create safe and comfortable transport facilities, to increase the share of railways to 78% in terms of passenger transport, which is currently at 10%, and to decrease the travel time between Ankara-Istanbul, and to mitigate air pollution emissions	N_2O, NMHC, CO, CO_2	Implementation Project	Implemented (2009-2015)	MTMAC, Turkish State Railways (TCDD)	59**		

Table 4.6. Policies and Measures regarding GHG Emission Mitigation

TRANSPORTATION					
Policy/ Measure	Objective and/or Activity Affected	Exposed Greenhouse Gas	Type of Policy/ Measure	Status	Implementing Agency/Institution
High Speed Train Extensification Works	Ankara-Konya High Speed Train Project, Ankara-Sivas High Speed Train Project	NO2, NMHC, CO, CO_2	Implementation	Implemented	MTMAC, TCDD
TINA Turkey Study	To determine multi mode main transportation routes and relative priority corridors in order to ensure that the transport networks in Turkey are connected to Trans European Network, and to determine transport networks infrastructure needs related with the same	CO_2	Project	Implemented (2005-2008)	MTMAC, Ministry of Development
Transportation Sector Greenhouse Gas Mitigation Project	To develop biodiesel fuel combustion modelling and hybrid electric buses within the scope of measures taken for mitigation of greenhouse gases	CO_2	Research	Implemented (2006-2009)	TUBITAK MAM Energy Institute
Establishment of a Hybrid Vehicle Technologies Centre of Excellence	To design and develop software and hardware for 36 kV SVC and DSP based control systems and self-feeding thyristor control unit	CO_2	Research Centre	Implemented (2007-2010)	TUBITAK MAM Energy Institute
Project Regarding Generation of an Inventory on Emissions from the Transportation Sector	To take inventory of vehicle activity, diesel vehicle emission and gasoline-powered vehicle emission	CO_2	Research	Implemented (2006-2009)	İTÜ Euro-Asia Institute of Earth Sciences
Light Rail System Practices in Urban Transportation	To mitigate greenhouse gas emissions that source from urban transportation in several provinces, such as Adana, Bursa, Trabzon, Kayseri, and Gaziantep	CO_2	Implementation Project	Implemented	Relevant Municipalities

Table 4.6. Policies and Measures regarding GHG Emission Mitigation

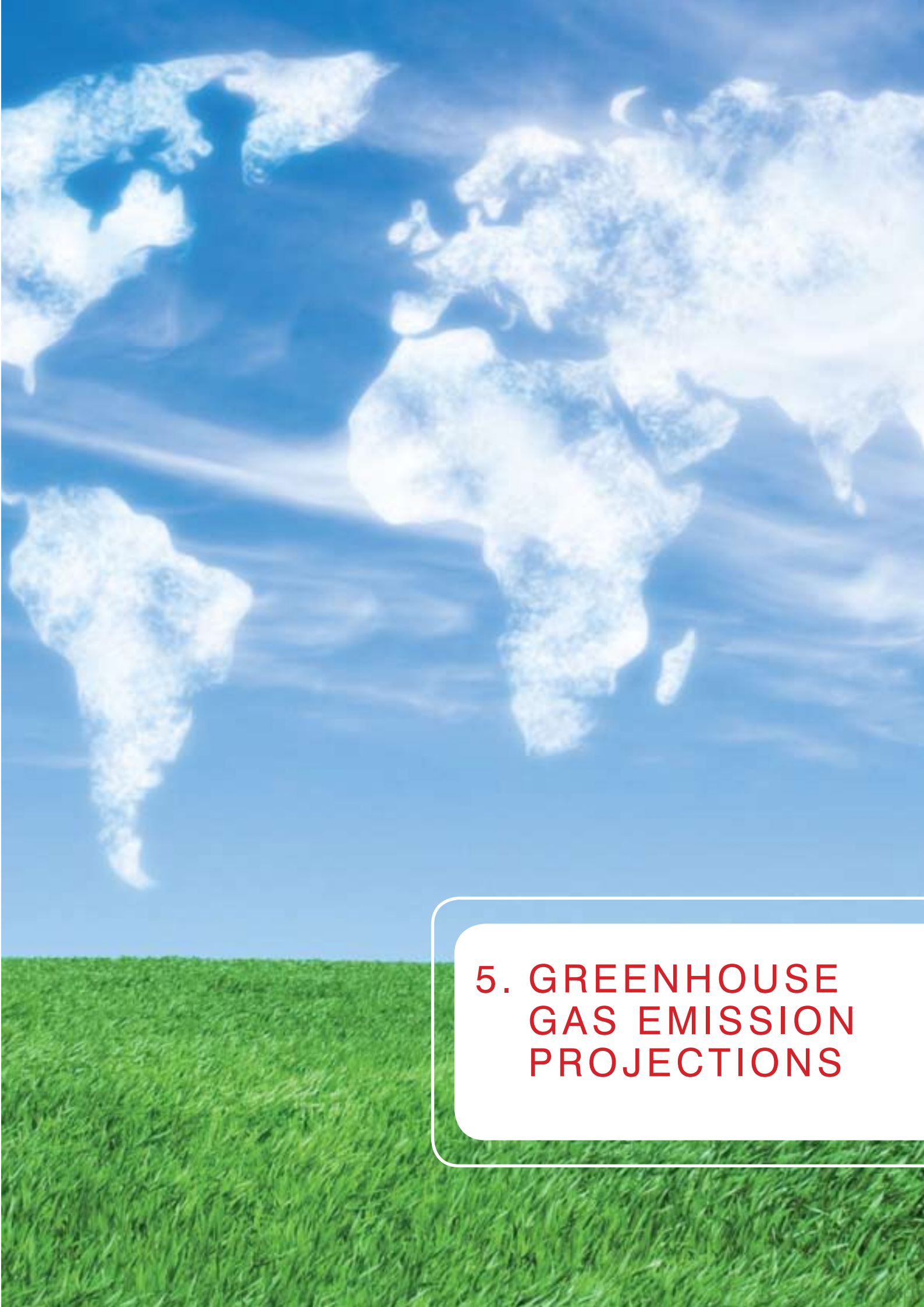
AGRICULTURE					
Policy/ Measure	Objective and/or Activity Affected	Exposed Greenhouse Gas	Type of Policy/ Measure	Status	Implementing Agency/ Institution
Legal Regulations	To ensure mitigation of greenhouse gas emission and protection of sink areas by ensuring implementation of good agricultural practices, arrangement of organic agriculture, effective utilization of water, improvement of production techniques, protection and sustainable utilization of agricultural lands	CH_4, N_2O, CO_2, NOx, CO	Legal	Adopted	MFAL
Good Agricultural Practices	To make products that do not damage environment, human and animal health, to protect natural resources, to ensure reliable product supply via agricultural traceability and sustainability	CH_4, N_2O, CO_2, NOx, CO	Practice	Implemented (2007-)	MFAL
Organic Agriculture Practices	Extensification of organic agricultural production	CH_4, N_2O	Practice	Implemented (2006-2020)	MFAL
Effects of Tillage Techniques on Carbon Capture and Sustainability of Soil	To make an impact on soil fertility in long-term by arranging physical, chemical and biological characteristics of soil, to obtain data from soil conservation by controlling erosion	CO_2, CO	Project	Implemented (2010 -)	MFAL, Faculty of Agriculture, Ankara University
Agriculture-Climate Change Interaction Program	To determine the interaction between agriculture, global warming and climate change, to research agricultural adaptation to climate change, as well as agricultural environment problems	CH_4, N_2O, CO_2, NOx, CO	Program	Implemented (2010 -)	MFAL
Project on Implementation of Nitrates Directive	To strengthen the infrastructure of MFAL in line with implementation of the EU Nitrates Directive, to mitigate nutrient pollution that source from agricultural activities	N_2O	Project	Implemented (2009-2013)	MFAL
ÇATAK	To ensure sustainability of renewable natural resources, to expand suitable tillage, fertilization, irrigation and adaptation of similar cultural measures, to prevent erosion, to raise awareness in producers in terms of agriculture-environment	CH_4, N_2O, CO_2,	Program	Implemented (2006 -)	MFAL
Project on Extensification of Good Agricultural Practices in Fruit-Vegetable Production	To expand good agricultural practices in fresh fruit and vegetable sector in Turkey and to establish capacity in this regard	N_2O	Project	Implemented (2009-2010)	MFAL
Anatolia Water Basins Rehabilitation Project	To make sustainable natural resources management and participatory planning in Central Anatolia and Black Sea Regions	CH_4, N_2O	Project	Implemented (2004-2012)	MEU, MFAL

Table 4.6. Policies and Measures regarding GHG Emission Mitigation

FORESTRY					
Policy/ Measure	Objective and/or Activity Affected	Exposed Greenhouse Gas	Type of Policy/ Measure	Status	Implementing Agency/ Institution
GDF Strategic Plan	Protection of forests, sustainable forest management, and capacity development	CO_2, CH_4, N_2O, NOx, CO	Plan	Planned	GDF
Afforestation and Erosion Control Mobilisation Action Plan	Afforestation and rehabilitation of forests	CO_2, CH_4, N_2O, NOx, CO	Plan	Adopted (2008-2012)	GDF
Regulation Regarding Organization, Implementation, Supervision and Renewal of Forest Management Plans	Determination of principles and procedures regarding implementation, amendment, supervision	CO_2, CH_4, N_2O, NOx, CO	Legal	Adopted	GDF
Regulation Regarding Emission Trading	Determination of principles and procedures in line with emission trading within the framework of harmonisation to the EU	CO_2, CH_4, N_2O, NOx, CO	Legal	Planned	MEU, MENR, MSIT, Ministry of Finance
Regulation Regarding Greenhouse Gas Monitoring	Determination of principles and procedures in the direction of monitoring greenhouse gases within the framework of harmonisation to the EU	CO_2, CH_4, N_2O, NOx, CO	Legal	Planned	MEU, MENR, MTMAC
Regulation for Harmonisation of Spatial Data Infrastructure Regulation	To establish regulatory authorities in this field within the framework of harmonisation to the EU and to constitute national spatial data/ information	CO_2, CH_4, N_2O, NOx, CO	Legal	Planned	MEU
AGORA	The EU 7th Framework Program, to improve available forestry research, implementation and technological capacity in selected Mediterranean countries and specific strategic areas, and to develop new capacities	CO_2, CH_4, N_2O, NOx, CO	Research	Implemented 2010-2012	Universities
Strengthening Management of Forest Protection Areas	To strengthen forest protection, and management of the buffer zone with the area of 117,000 ha that is located in Küre Mountains National Park and its vicinity.	CO_2, CH_4, N_2O, NOx, CO	Project	Implemented 2008-2011	MEU, MFWW, UNDP, WWF
Integrated Forest Planning	To develop integrated planning approach for planning high conservation value forests in the Mediterranean Region.	CO_2, CH_4, N_2O, NOx, CO	Project	Initiated Recently 2011-2014	MFWW, UNDP, WWF

Table 4.6. Policies and Measures regarding GHG Emission Mitigation

WASTE					
Policy/ Measure	Objective	Exposed Greenhouse Gas	Type of Policy/ Measure	Status	Implementing Agency/ Institution
Waste Management Action Plan	To reveal the current situation of waste management and projections on the same, and to determine works that must be implemented	CH_4,N_2O, CO_2 and others	Plan	Adopted	MEU
Solid Waste Master Plan	To plan waste management unions by territorializing Turkey	CH_4,N_2O, CO_2 and others	Plan	Adopted	MEU
Regulation Regarding Basic Principles of Waste Management	To determine general principles in the direction of ensuring management of wastes without damaging environment and human health, starting from formation of wastes through disposal	CH_4,N_2O, CO_2 and others	Legal	Adopted	MEU
Regulation Regarding Control of Packaging Wastes	To prevent the damage that packaging wastes shall give to the environment, as well as formation of the same, and to make regulations on recycle and recycle and etc. of the same.	CH_4,N_2O, CO_2 and others	Legal	Adopted	MEU
Regulation Regarding Regular Storage of Wastes	To determine general rules on regular storage facilities	CH_4,N_2O, CO_2 and others	Legal	Adopted	MEU
Regulation Regarding Waste Incineration	To prevent and limit negative effects of waste incineration on environment	CH_4,N_2O, CO_2 and others	Legal	Adopted	MEU
Waste Management and Methane Emissions	To determine and mitigate methane emissions that source from uncontrolled and controlled storage sites in waste management and energy efficiency support policies	CH_4	Project	Implemented (2010 -2011)	MEU, Government of Netherlands
Management of Uncontrolled Storage Sites in Turkey	To develop a national strategy and general method on uncontrolled storage site management in Turkey, and to implement and expand pilot project, training support and method.	CH_4,N_2O, CO_2 and others	Project	Implemented (2010 - 2011)	MEU, Government of Netherlands
Utilization of Wastes as Fuel	Research project on converting recycled plastic wastes into granule product and utilization of other non-recycled wastes as additional fuel in cement factories.	CH_4	Research	Implemented	İstanbul BB., İSTAÇ A.Ş., Akçansa, TUBITAK-MAM
Waste Water Action Plan	To determine the current status, objectives, goals and strategies related with waste water management, and to determine responsive activities.	CH_4,N_2O, CO_2 and others	Plan-Strategy	Adopted	MEU



5. GREENHOUSE GAS EMISSION PROJECTIONS

5. GREENHOUSE GAS EMISSION PROJECTIONS

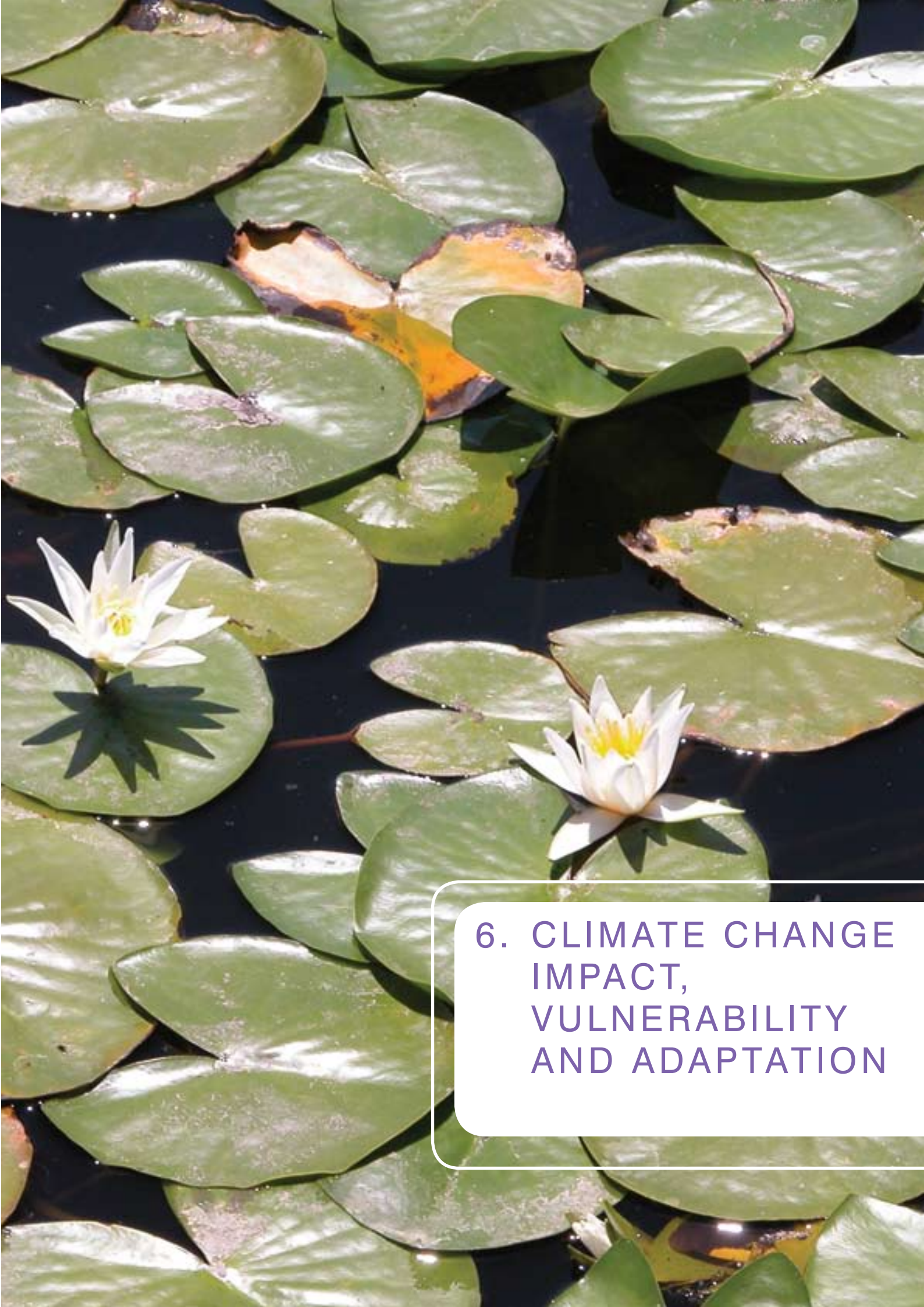
Turkey, as a country included in Annex I list of UNFCCC, yet excluded from the Kyoto Protocol's Annex B list, has no greenhouse gas reduction commitment. In addition, Decisions 26/CP.7 and 1/CP.16 of the Conference of the Parties indicate that Turkey has a different status from other Annex I countries and underline its "special circumstances."

In Chapter 2 and 3 of this National Communication, it is stated that Turkey has the lowest levels of greenhouse gas emissions per capita, the least historical responsibility and the least primary energy consumption per capita among OECD and Annex I countries of the UNFCCC. Furthermore, as of today, Turkey falls behind other OECD countries, many UNFCCC Annex I countries and some non-Annex I countries with respect to development and industrialization levels. Likewise, Turkey's emissions per unit GDP is below the OECD and world average. On the other hand, Turkey's historical contribution to atmospheric accumulation of greenhouse gas emissions is extremely small. Therefore, Turkey has not entered into any commitments, and it is not able to provide any projections that can be deemed as a future commitment at this stage.

Turkey is conscious of its responsibilities in combating climate change. In this context, it conducts detailed studies on emission growth trends, mitigation potentials and the effect of implementing these actions on sustainable development.

Although Turkey has no GHG reduction commitment, it decreased its emissions by 20% and achieved 1.4 billion tonnes of reduction against the business as usual scenario (BAU) in the policies and projects it implemented at the national level between 1990 and 2007. Within this period, Turkey increased its GDP by 171% and dropped its emission intensity to 0.36. This is an indicator that Turkey will maintain its contribution to combating climate change by continuing to reduce emissions from business as usual.

Turkey continues its technical studies to develop projections of greenhouse gas emission.



6. CLIMATE CHANGE IMPACT, VULNERABILITY AND ADAPTATION

6. CLIMATE CHANGE IMPACT, VULNERABILITY AND ADAPTATION

6.1. Situation Analysis

6.1.1. Climate Change Parameters Trend Analysis (Observations)

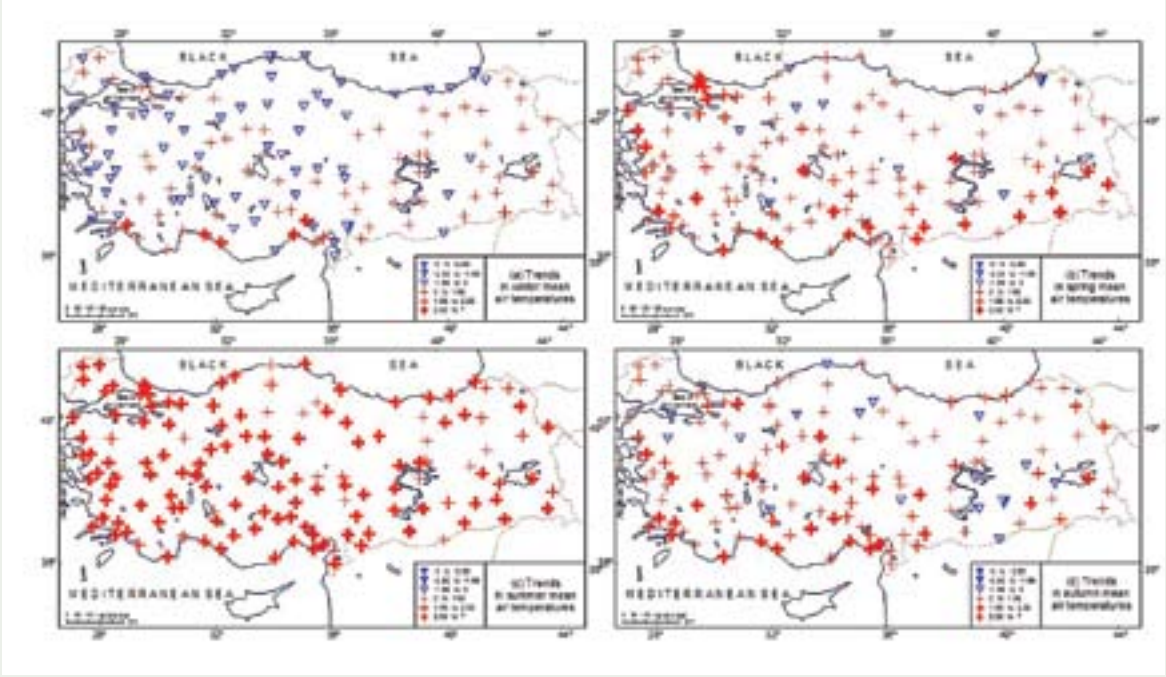
This section focuses on an analysis of trends in monthly mean air temperature (°C) and monthly total precipitation (mm or kg/m2) data, which were recorded at primary and secondary climatological and synoptic meteorological stations operated by the Turkish Meteorological Services from 1950 to 2010. Statistical analysis on variations and long-term trends in the station-based time-series data was undertaken using the Mann-Kendall rank correlation coefficient test.[1]

Air Temperature Trends

Both increasing and decreasing trends are observed in the seasonal average mean air temperature series, with only some stations demonstrating statistically significant trends in winter (Figure 6.1a). Statistically significant warming trends were generally experienced over the Mediterranean Region of Turkey. Cooling trends, only a few of which are statistically significant, are seen in the Black Sea Region and in the central and western regions of Turkey. Spring mean air temperatures experienced an increasing trend across the majority of Turkey, except few stations (Figure 6.1b). Trends observed particularly in the Marmara, Aegean, Mediterranean, Central Anatolia and South-eastern Anatolia region are statistically significant. Warming trends are statistically significant at 1% level in the İstanbul district, which has experienced rapid and widespread urbanization, at the coastal stations of the Aegean and Mediterranean regions, and at the stations of the South-eastern Anatolia Region. In summer, almost all stations in this analysis experienced a marked increasing trend (statistically significant at 1% level) in air temperature over the time-series (Figure 6.1c). Autumn mean air temperatures also revealed a warming trend (Figure 6.1d). Observed cooling trends at some stations were only statistically significant at 1% level at one station, whereas observed warming trends in the Aegean, Mediterranean and Central Anatolia region are mostly highly significant.

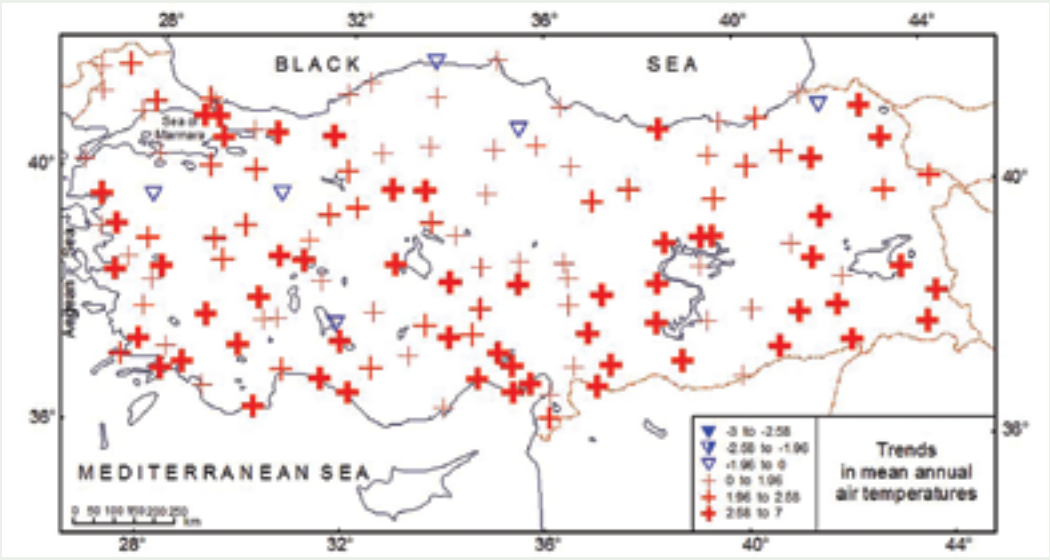
[1] Sneyers, 1990; Türkeş et al., 2002

Figure 6.1. Long-term Seasonal Temperature Variation (1950-2010)



As with the seasonal average maximum and minimum air temperatures (trend results for the seasonal maximum and minimum air temperatures are not provided here), trends in annual mean air temperatures and annual average maximum and annual average minimum air temperatures have increased in comparison with the trends described in Turkey's Initial National Communication on Climate Change[2] (Figure 6.2). Warming trends were observed in the annual mean, annual average maximum and annual average minimum air temperatures at a majority of the stations. Warming was statistically significant at the majority of stations. Weak warming and cooling trends were experienced over the Black Sea Region and in northern parts of the Central and Eastern Anatolia region of Turkey. These figures indicate a significant trend of warming across Turkey

Figure 6.2. Spatial Variation of Observed Long-term Annual Average Air Temperatures in Turkey

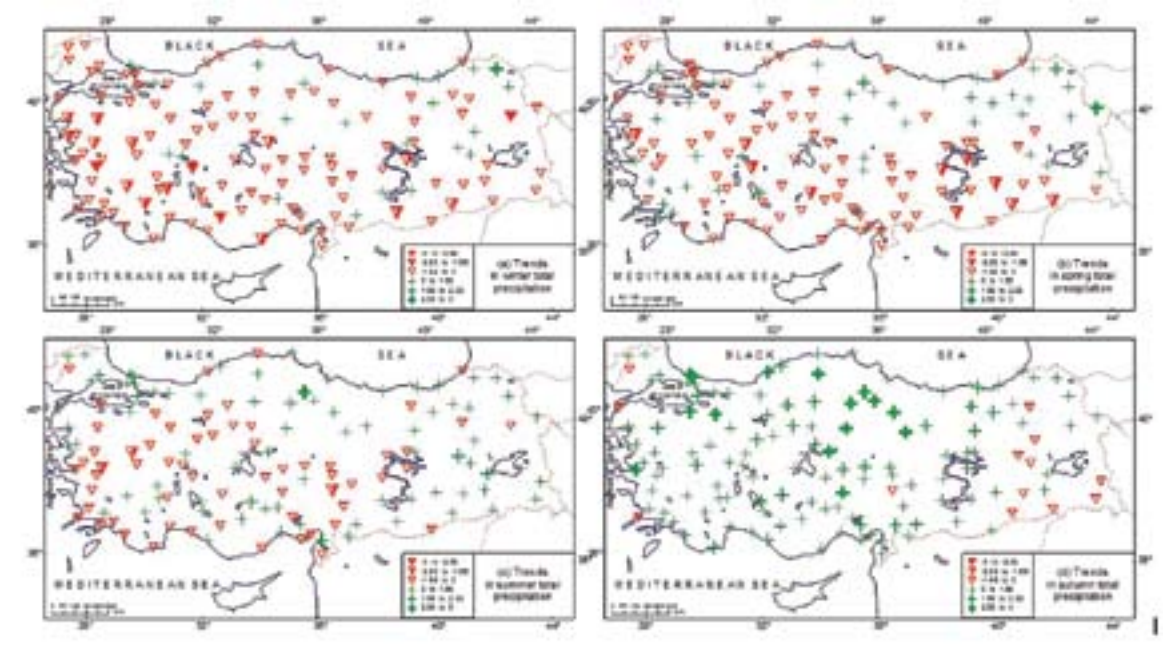


2 MEF, 2007

Precipitation Trends

General trends of decreasing precipitation (drying) in the winter and spring totals were observed in the Marmara, Aegean, Mediterranean and South-eastern Anatolia regions, which are dominated by the Mediterranean rainfall regime, and in the inner and southern sub-regions of the Central and Eastern Anatolia regions (Figure 6.3a and 6.3b). In winter, some of the drying trends observed in the Aegean, Mediterranean and South-eastern Anatolia regions are statistically significant. This result is generally consistent with the results of previous studies dealing with precipitation trends and variation performed in Turkey. Winter trends of decreasing precipitation observed particularly in the west, south and continental interior-south regions of Turkey have continued despite the wetter than the long-term average conditions in these same regions over the last two years (2008/2009 – 2009/2010).

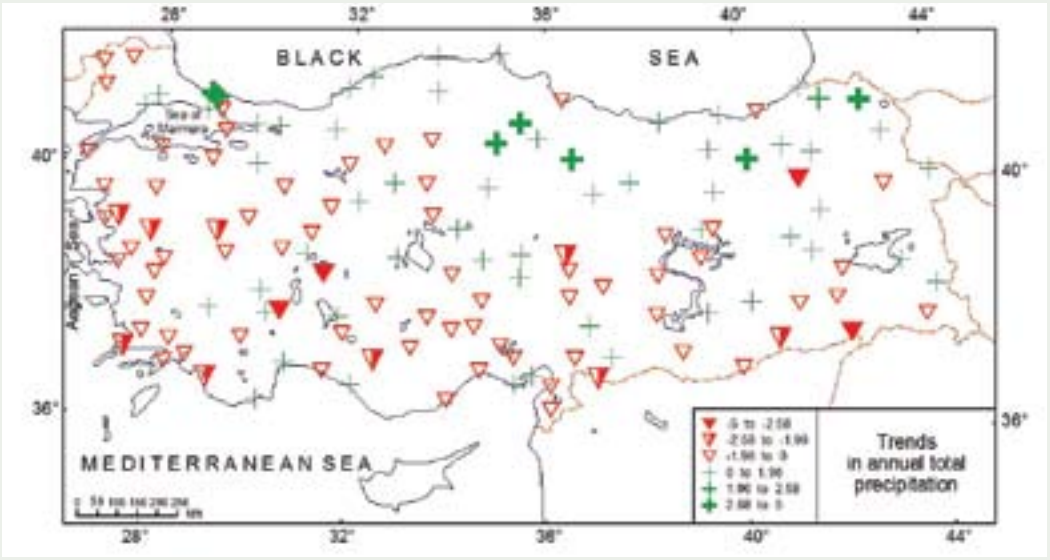
Figure 6.3. Variation in Long-term Seasonal Precipitation (1950-2010)



In summer, consistent with previous studies both increasing and decreasing trends of precipitation have been experienced. However, only a few of these are statistically significant (Figure 6.3c). However, increasing precipitation in autumn has strengthened and the number of stations demonstrating an increase has risen. These results differ from previous trend studies for the autumn season (Figure 6.3d). In autumn, increasing precipitation has dominated across Turkey with the exception of the south-eastern corner. These increasing trends are statistically significant mostly at the 1% level in the Central Anatolia Region, western Black Sea, southern Marmara and the northern Aegean sub-regions of Turkey.

Annual total precipitation has decreased over the western and southern regions of Turkey, which are characterized mainly by a Mediterranean rainfall regime (Figure 6.4). On the other hand, annual total precipitation amounts have tended to increase in the Tekirdağ and İstanbul districts of the Thrace sub-region and in the northern and eastern sub-regions of the Central and Eastern Anatolia regions.

Figure 6.4. Spatial Variation of Long-term Annual Total Precipitations in Turkey (1950-2010)



Trends in Sea Level Rise

Sea level data collected from coastal tide gauges remain one of the most essential climate and climate-related parameters to aid climatology, geosciences and maritime engineering. In order to adequate estimates of sea level, observation networks and data centers have been established at global, regional and local scales. The Global Sea Level Observing System (GLOSS)[3], the Permanent Service for Mean Sea Level (PSMSL)[4] and the European Sea Level Service (ESEAS)[5] are examples of the global and regional scale sea level observations and data centers. The need for real-time sea level data, particularly for understanding climate variability and informing early warning systems, has increased over recent years. In order to serve this purpose, a real-time data exchange service has been established with the support of 15 international organizations. World-wide, 78 countries send real-time sea level data free-of-charge, which is obtained from the national sea level observation network. These data should be distributed freely to all users in the world through the internet. Many coastal countries with local scale observations within the national sea level observation network also support these global and regional networks under various program and projects. Sea level observations in Turkey have been maintained by the General Command of Mapping (GCM) under the Turkish National Sea Level Monitoring Network (TUDES)[5].

According to the results of a recent study performed by using climatalogical and sea level data from 11 tide gauge stations in the Levantine Sea, Cretan Sea and south of the Aegean Sea of the Eastern Mediterranean Sea Basin (Öztürk, 2011), there are statistically significant trends in sea level rise across all sites. These trends represent an average increase of +1.57 mm/year with a +1.89 mm/year increase in the average maximum and +1.36 mm/year increase in the average minimum. According to the long-term averages, annual amplitude is 14.9 cm, while the highest and the lowest levels of amplitude are reached in August and March, respectively. However, the amplitude of 36.5 cm dominates over the inter-annual average maximum and minimum sea level values (Öztürk, 2011).

6.1.2. Climate Projections for Turkey

Context and Previous Work

This section summarizes recent efforts in Turkey to provide decision makers at all levels with climate projections at a higher spatial resolution than those available through the IPCC 4th Assessment Report (AR4) archives.

3 http://www.gloss-sealevel.org
4 http://www.pol.ac.uk/psmsl
5 http://www.eseas.org
6 http://www.hgk.msb.gov.tr/

Human influence on the Earth's climate is now well accepted and both mitigation and adaptation are essential at all levels of society. The starting point of any adaptation effort is information on projections of the future environment. There is a need for assessments of how natural and human-built systems will behave under climate change. This requires information on climate projections at appropriate spatial scales and over several time horizons. The climate simulations that IPCC AR4 is based upon provide relevant information on several atmospheric greenhouse gas concentration scenarios from the Special Report on Emissions Scenarios (SRES).

The main shortcoming of the information that one can derive from these global circulation models (GCM) is low spatial resolution (usually on the order of several hundreds of kilometers). Spatial scale issue can be resolved by 'downscaling' the output of a GCM to resolutions that are useful/meaningful for climate impact assessment studies. This 'downscaling' can be achieved either through the help of a regional climate model (dynamic downscaling) for a given region, or by relating large-scale information from global models to station data through a statistical model (statistical downscaling). Most of the 'regionalization' efforts of the last five years in Turkey have concentrated on dynamic downscaling. High resolution regional climate models can reproduce many physical aspects of the regional climate phenomena, bringing in a higher-level realism alongside better spatial information.

In 2006, few results from a regional climate model (RegCM3) were available for the last 30 years of the 21st century, and this was only under one SRES scenario. Substantial progress has been made since 2006. Besides the increasing availability of funding, the most crucial factor that has contributed to advances has been the rapid development of computing resources in Turkey, including the High Performance Computing Laboratory at the ITU Informatics Institute, and the resources at the National Center for High Performance Computing[7]

In recent years, substantial climate simulation studies focusing on Turkey and its surrounding region have been developed. Regional climate change simulation based on the IPCC A2 scenario over the Eastern Mediterranean for the last 30 year of the 21st century were developed by Önol and Semazzi (2009) and some of the highlights from this study were reported in the Initial National Communication of Turkey on Climate Change (2007). According to this study, the highest seasonal temperature increase across Turkey (4.3°C) is expected in summer. In addition, very distinct changes in future precipitation during the winter are projected for the Black Sea region (increase) and the Mediterranean region (decrease)[8]. A similar projection of precipitation has also been reported by Gao and Giorgi.[9] Sensitivity analyses[10] have been carried out to understand projected impacts in the seas surrounding Turkey. This study suggests that warmer summer and autumn sea surface temperatures in the seas surrounding Turkey will probably increase the occurrence of flash floods and extreme precipitation events. Also, the significant warming trend in summer temperatures during the last two decades over Turkey has been confirmed in the model simulation by Önol.[11]

Future water availability in Middle Eastern countries has been analyzed based on several climate simulations. Hemming et al.[12] noted that the projected magnitude of precipitation decrease (5-25%) for all the model ensembles is highly consistent across western coasts of Turkey during the first-half of 21st century. Moreover, projected annual discharges simulated by Kitoh et al.[13] indicate that substantial decrease for the Euphrates River is projected (30-70%) for the end of the 21st century due to a reduction in precipitation over the basin. In addition, a detailed hydrological study of the Seyhan River Basin has been applied to determine the potential impacts of climate change.[14] This study calculated that runoff from precipitation and evapo-transpiration variables of two different global climate models will decrease between 50% and 60% for the entire basin. Evans[15] examined future predictions of 18 GCMs over the Middle East and projected that the largest precipitation decreases (of annually more than 25%) will be caused by reduced storm activity over Eastern Mediterranean and over Southwestern Turkey through 2095.

7 www.uybhm.itu.edu.tr
8 Önol and Semazzi, 2009
9 Gao and Giorgi 2008
10 Bozkurt and Sen, 2011
11 Önol 2012
12 Hemming et al 2010
13 Kitoh et al 2008
14 Fujihara et al., 2008
15 Evans 2009

Recent Results

During the last four years, Turkey has gained momentum in developing detailed regional climate projections. Two efforts, both conducted at the Istanbul Technical University (ITU), are particularly relevant in this context. TUBITAK has funded the "Climate Change Scenarios for Turkey" project and to increase the reliability of climate simulations over Turkey, many climate simulations have been produced under the UN Joint Program (MDGF-1680) project on "Enhancing the Capacity of Turkey to Adapt to Climate Change."

As described above, GCMs are the primary tools used to obtain climate change projections, which in turn need to be based on emission scenarios. In a model-based climate change study, it is conventional to carry out a 20th century simulation in addition to a future simulation, using the same GCM to demonstrate the performance of the GCM against available observations. This provides a reference simulation over which the future simulation can be evaluated (Bozkurt et al., 2011). The latter is crucial as it helps eliminate some of the uncertainties inherent in GCMs by allowing the subtraction of outputs of simulation of a past time series from those of the future simulations. In this report, climate change projections are presented as changes in the climate variables in the future instead of presenting the exact future values estimated by the models. The climate research group of the Eurasia Institute of Earth Sciences at ITU has carried out a downscaling experiment for Turkey using the outputs of the emission scenario simulations of three different GCMs. For downscaling, the group used the regional climate model ReCM3 of the International Centre of Theoretical Physics. This section of the report will provide information on the outputs of these simulations.

Performance of the Models

The performance of the three GCMs (ECHAM5, CCSM3 and HadCM3) used in this report is given in Bozkurt et al. (2011). This paper suggests that these GCMs perform well in simulating winter precipitation and surface temperature in Turkey. Both ECHAM5 and HadCM3 are also good at reproducing the magnitude and distribution of the summer precipitation and surface temperature. The CCSM3 model produces relatively dryer and warmer summer conditions for Turkey compared to past observations. Bozkurt et al. (2011) suggest that the projections of all three models could be used in the climate change and impact assessment studies as long as their strengths and weaknesses are taken into account.

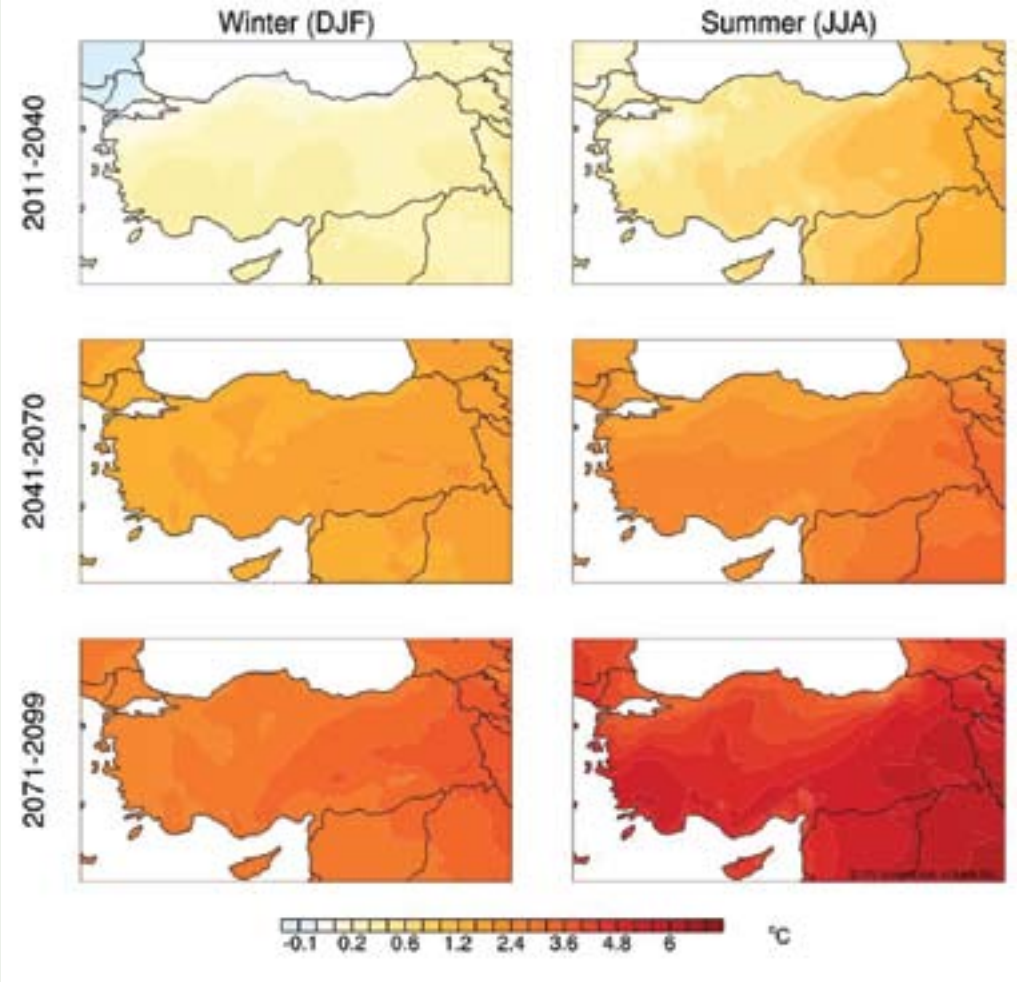
Climate Change Projections for Turkey

Temperature

Downscaled climate change projections obtained by the climate research group of the Eurasia Institute of Earth Sciences involve three GCMs and different scenarios. In this report we only illustrate the projections obtained using the ECHAM5 model's A2 scenario simulation. The seasonal results of all models and scenarios are summarized in Table 6.1 for the last 30-years of the 21st century.

Surface temperature is projected to increase across Turkey for the 2011-2040 period (Fig. 6.5), but the increases are usually small (less than 0.5°C in winter and 1.0°C in summer). Substantial increases in surface temperature start to appear in the period 2041-2070. They amount to an approximately 1.5°C increase in winter and an increase of approximately 2.4°C in summer. By the end of the 21st century, surface temperature increases are projected to increase by around 3.5°C in the winter and 6°C in the summer. The model simulation suggests that the increase in surface temperature in Turkey will not be uniform. The eastern interior parts of Turkey will experience the greatest rise in temperatures in winter, and southern and southeastern parts will experience the greatest temperature rise in summer. It is interesting to note the north-south gradient in the summer surface temperature changes becomes stronger by the end of the century. For this period, the summer temperature increases are expected to increase by around 6°C in places in the southeastern and southwestern parts of Turkey, while they only increase by approximately 3°C in much of the Black Sea and Marmara regions.

Figure 6.5. Projected Changes (1961-1990 period) in Surface Temperature (°C) for Winter (left column) and Summer (right column) (based on the A2 scenario simulation of the ECHAM5 general circulation model).



As Table 6.1 indicates, there are a total of five downscaled simulations available for Turkey for the period between 2071 and 2099. These are based on the A2 simulations of ECHAM5, HadCM3 and CCSM3, the A1FI simulation of CCSM3 and the B1 simulation of CCSM3. All three models exhibit similar behaviors in surface temperature change. For instance, the changes are relatively small in winter but they increase in transition seasons and experience peaks in the summer. This mostly indicates larger increases in the eastern Turkey than in the western Turkey. The differences between model simulations arise primarily in the magnitudes of their projections. The magnitude of differences is usually pronounced between different scenario simulations of the same GCM or between different GCM simulations of the same scenario. With the combination of the GCMs and scenarios available in Table 6.1, it is possible to make two comparisons: the first one between three GCMs for the same scenario (A2); and the second one between the three scenario simulations with the same GCM (CCSM3). For the former, the increases estimated by all three models in the A2 scenario are relatively close to each other in all seasons. The noticeable differences to mention are the smaller summer increase (about 5°C) estimated by ECHAM5 compared to the estimations of other models (about 6.5°C) and relatively larger winter increase (about 3.6°C) estimated by HadCM3 compared to the estimation of CCSM3 particularly (about 2.7°C). The CCSM3's estimate of fall temperature increase for Turkey (about 5.4°C) is relatively larger than those of the other two models (about 4.2°C). The A1FI simulation of CCSM3 provides larger temperature increases of 0.5-1.4°C more than the A2 simulation of the same model. It produces an average summer

increase of 7.3°C for eastern Turkey. The projected increases of the B1 scenario simulation of CCSM3 model lie in a range between about 1.4°C in winter and 3.35°C in summer for the whole of Turkey. These values are, as expected, much smaller than those estimated in the A2 or A1FI scenario simulation using the same model.

Table 6.1. Projected Seasonal Surface Temperature Increases (°C) in 2071-2099 over 1961-1990 based on Scenario Simulations (W indicates the western half of Turkey and E indicates the eastern half of Turkey).

Scenario	GCM	Winter		Spring		Summer		Fall	
		W	E	W	E	W	E	W	E
A2	ECHAM5	2.9	3.4	3.1	4.1	4.7	5.2	4.0	4.4
	HadCM3	3.4	3.8	3.7	4.1	6.9	6.1	4.0	4.3
	CCSM3	2.5	2.9	3.6	3.5	6.4	6.8	4.9	5.9
A1FI	CCSM3	3.5	4.0	4.8	4.9	6.9	7.3	5.5	6.8
B1	CCSM3	1.3	1.5	1.7	1.7	3.3	3.4	2.5	3.0

Precipitation

Turkey receives much of its precipitation in winter and spring. Therefore, only projections from these seasons are described in this report. Thus, similar to the way the temperature results are presented, we include Figure 6.6 to demonstrate precipitation changes based on the A2 scenario simulation of the ECHAM5 model. Seasonal projection results based on all GCM-scenario simulations are summarized in Table 6.2 for the last 30-year period of the 21st century.

Figure 6.6 indicates that ECHAM5 A2 simulation project up to a 30% increase in winter and spring precipitation for much of Turkey for the first 30-year period (2011-2040). In the second period, however, winter precipitation is projected to decrease in the southern and western parts of Turkey by up to 20%. Spring precipitation is also simulated to decrease in the southern and central parts of Turkey. Nevertheless, precipitation is projected to increase in the northern parts in both seasons. The projected winter precipitation pattern change in the period 2071-2099 is similar to that of the previous period. The most significant difference is the strengthening of the changes; i.e., the areas that expect a reduction in precipitation are projected to become much dryer and the areas with precipitation increase are projected to become much wetter in the last period. The areas with precipitation reduction in spring cover much of Turkey in the last period. Only the Black Sea region is expected to experience increased precipitation. The ECHAM5 simulation indicates two areas with important changes (they may be called as 'hot spots') in precipitation. The Mediterranean and southeastern Anatolia regions expect significant reductions and Black Sea region expects significant increases. Outside of these areas the expected changes are relatively small.

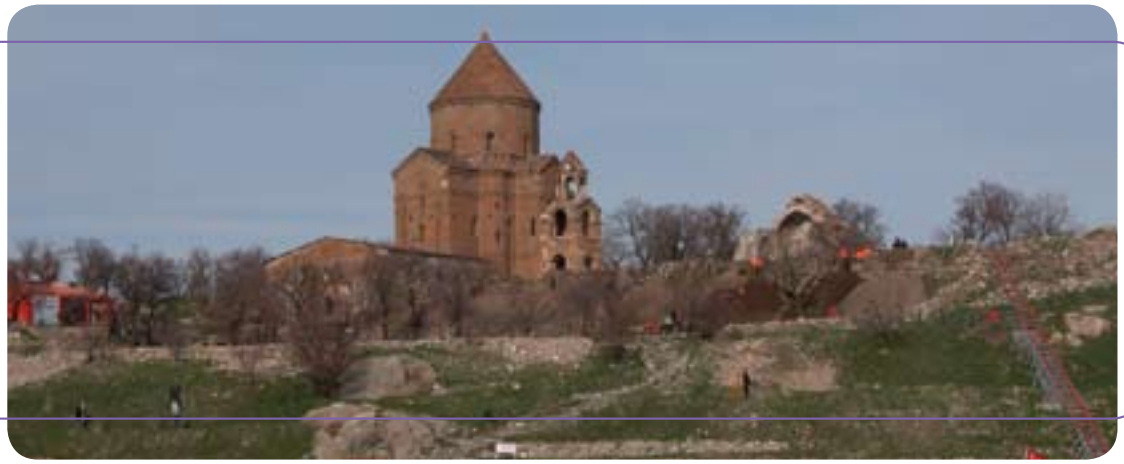


Figure 6.6. Projected Changes (over 1961-1990 period) in Precipitation (%) for Winter (left column) and Spring (right column) (based on the A2 scenario simulation of the ECHAM5 general circulation model).

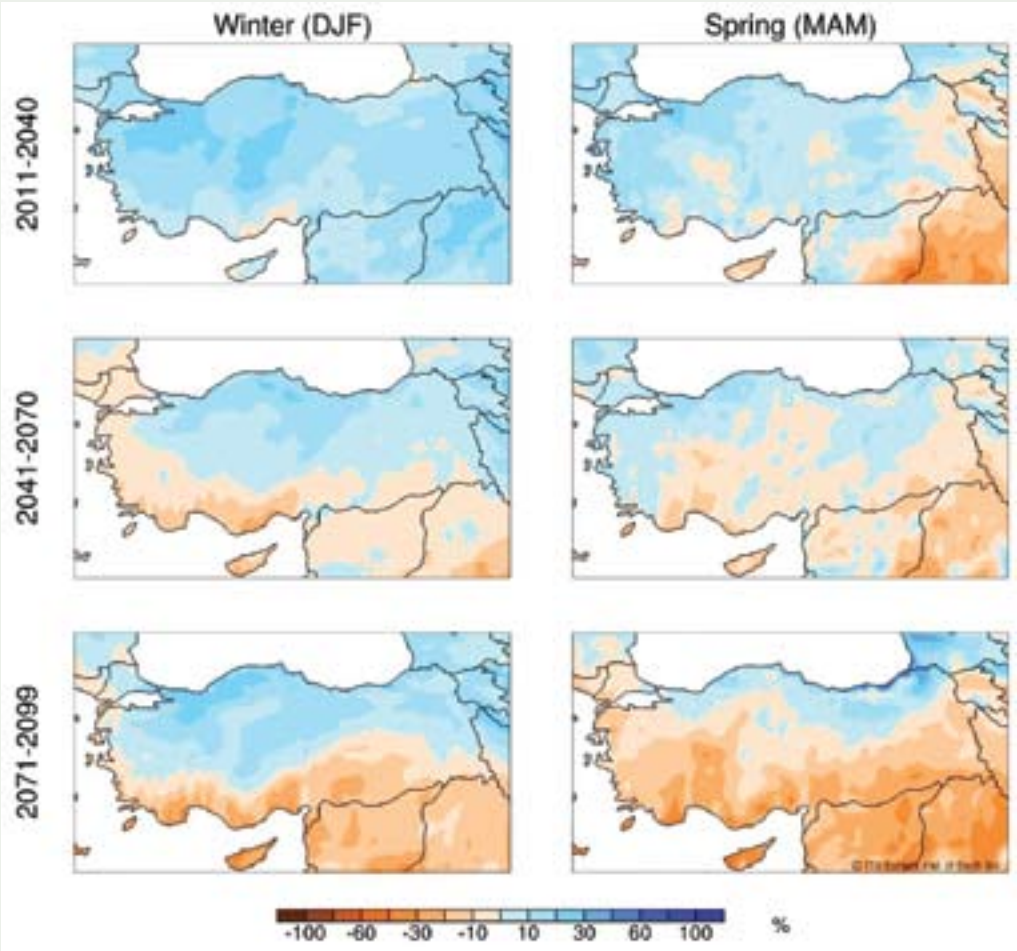


Table 6.2 provides the projected seasonal changes in precipitation from five different simulations for 2071-2099. There is broad agreement between in the direction of precipitation change estimates for the models under each scenario (i.e., A2). However, the magnitude of the changes may not be fully consistent because areas outside of the 'hot spots' demonstrate different sensitivity to the increased emissions in different models, and this affects the average values. The projected changes in precipitation are usually larger in the CCSM3's A1FI simulation than those in its A2 simulation. Its B1 simulation, however, yields much lower changes than the other two simulations, as expected. All models broadly agree that Turkey will have less annual precipitation over the last 30-year period of the 21st century compared to current precipitation

Table 2. Projected Seasonal Precipitation Changes (%) in 2071-2099 over 1961-1990 based on Scenario Simulations (N indicates the northern half of Turkey and S indicates the southern half of Turkey).

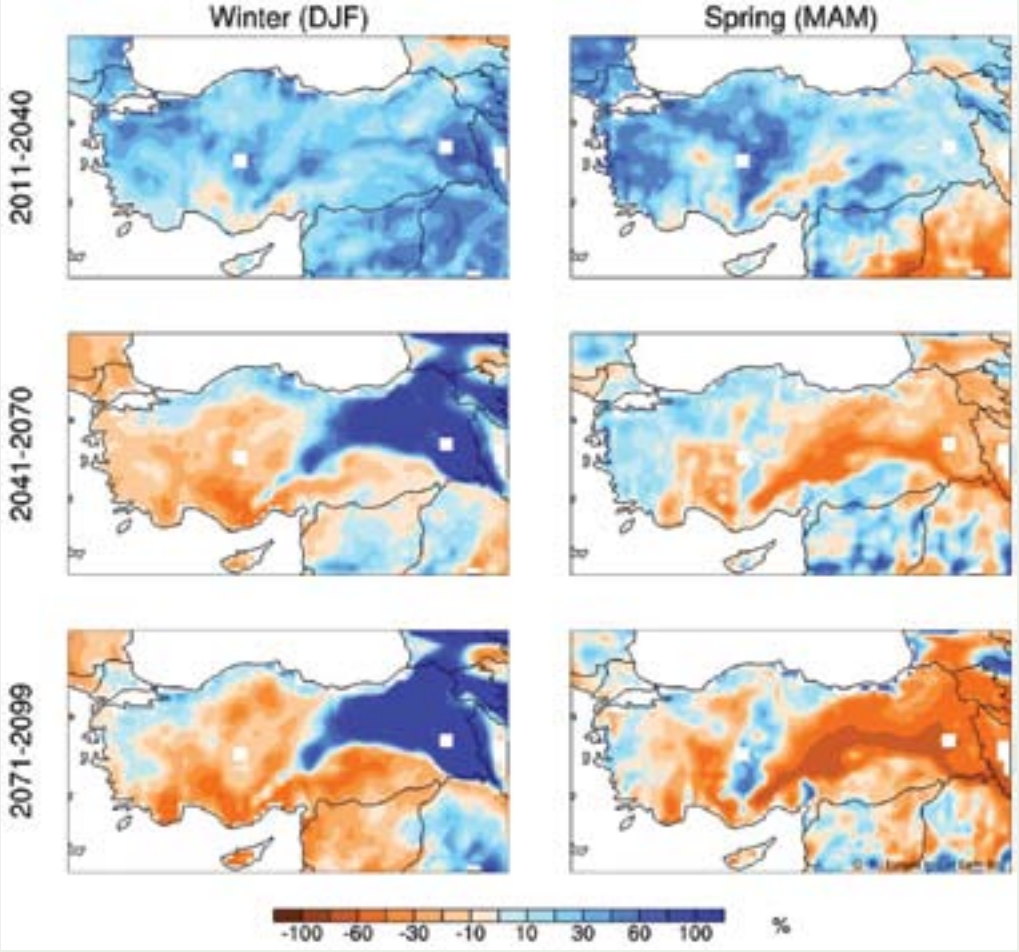
Scenario	GCM	Winter		Spring		Summer		Fall	
		W	E	W	E	W	E	W	E
A2	ECHAM5	+13	-17	+1.5	-23	-23	-30	-4	+4
	HadCM3	-2.5	-26	-1	-28	-48	-61	+3	+21
	CCSM3	-6	-32	-21	-36	-33	-62	-6	-23
A1FI	CCSM3	-0.6	-35	-30	-47	-57	-70	-1.5	-10
B1	CCSM3	-0.6	-14	-10	-28	-19	-40	-7	-16

Surface Runoff

Turkey has a relatively high variation in topography (about 1000 m) and the elevation increases towards eastern Anatolia. In the winter, especially eastern parts of Turkey receive much of the precipitation in the form of snow and therefore the major rivers originating from these areas are characterized as snow-fed (Sen et al., 2011). Peak flow in these rivers occurs in the spring. Because snow cover is sensitive to the temperature increases, the projected temperature increases are expected to shift the peak flows towards winter. Figure 6.7 illustrates the changes in runoff in the 21st century as estimated by the ECHAM5 model simulation of the A2 scenario. The seasonal results from all simulations for the 2071-2099 are given in Table 6.3.

For 2011-2040, the ECHAM5 A2 simulation predicts increased surface runoff for almost all parts of Turkey for both winter and spring. The pattern starts to change for 2041-2070. Surface runoff in this period is projected to increase in winter while it is projected to decrease in spring in the eastern Anatolia. This is most likely an indication of early snow melting in response to increased surface temperatures. In the same period, surface runoff is estimated to increase in the western Black Sea region in both seasons and in the Aegean and southeastern Anatolia regions in spring. The Mediterranean region is projected to have less runoff in 2041-2070 compared to present. The changes projected over 2071-2099 are expected to be similar to those experienced from 2041-2070.

Figure 6.7. Projected Changes (over 1961-1990 period) in Surface Runoff (%) for Winter (left column) and Spring (right column) (based on the A2 scenario simulation of the ECHAM5 general circulation model).



All simulations indicate substantial reductions in winter and spring runoff for western Turkey (Table 6.3). They all demonstrate significant reductions in spring runoff for eastern Turkey as well. For the same region, ECHAM5 and HadCM3 A2 simulations show large increases in winter runoff, but CCSM3 simulations do not show large changes in winter runoff. The very large changes in summer runoff are due to very small rates of runoff in summer, as even small changes amount to large percentages

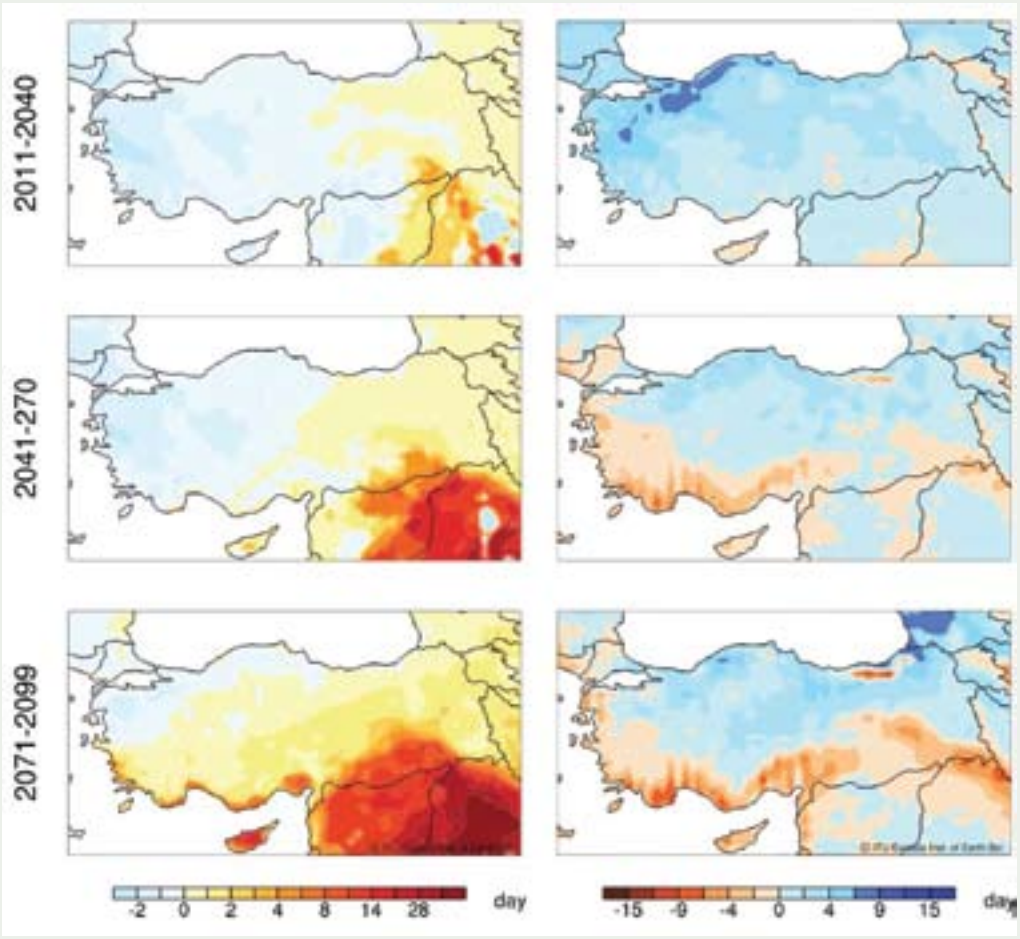
Table 6.3. Projected Seasonal Surface Runoff Changes (%) in 2071-2099 Compared to 1961-1990 based on Scenario Simulations (W indicates the western half of Turkey and E indicates the eastern half of Turkey).

Scenario	GCM	Winter		Spring		Summer		Fall	
		W	E	W	E	W	E	W	E
A2	ECHAM5	-16	+27	-18	-45	+71	-413	-15	+7
	HadCM3	-32	+39	-49	-48	-137	-169	+25	+6
	CCSM3	-47	-1	-63	-63	+14	+18	-65	-18
A1FI	CCSM3	-42	+4.5	-68	-74	+15	+22	-20	-17
B1	CCSM3	-24	-4	-44	-42	+8	+14	-31	-48

Climate Indices

Climate indices provide information about the extreme events that might affect daily life in a negative way. They are usually calculated using the daily values of the climate variables such as daily maximum and minimum temperatures and daily precipitation. Figure 6.8 illustrates the annual changes in two of these types of indices that are based on the ECHAM5 A2 projections. The hot spell index is defined as the longest number of consecutive days where daily maximum temperature is higher than 35°C. The heavy precipitation days index is defined as the number of days where the daily precipitation is at least 10 kg/m^2. The changes are relatively small in the hot spell days in the first period (2011-2040). However, they increase substantially (up to 10 days) in the southeastern Anatolia region and coastal areas of the Mediterranean region by the end of the 21st century (Fig. 6.8). The changes in the heavy rain days on annual basis look similar to the winter precipitation projections. For the first 30-year period, the number of the heavy precipitation days is projected to increase all over Turkey, but the largest increases (up to 10 days) lie in the northwestern parts of the Anatolian Peninsula. In the second and third periods, the number of the heavy rain days is projected to decrease (up to 10 days) in the Mediterranean and southeastern Anatolia regions while it is projected to increase in the Black Sea, central and eastern Anatolia regions.

Figure 6.8. Projected Annual Changes compared to 1961-1990 in Hot Spell (left column) and Heavy Rain (right column) Days (based on the A2 scenario simulation of the ECHAM5 general circulation model).



Conclusions

Despite some differences in magnitudes, there are consistent trends found in all the model simulations. All simulations agree on a temperature increase in Turkey in the 21st century. They also indicate larger temperature increases in the interior and eastern parts of Turkey. Almost all simulations agree on a reduction in precipitation in winter in the Mediterranean region of Turkey. They consistently indicate an increase in winter precipitation in the Black Sea region. All simulations agree on a reduction of spring runoff and an increase of winter runoff in the eastern Anatolia.

In the last few years progress has also been made in offering simulation results to the end user community. As an integral part of the commitment of the ITU/EIES team to MDGF-1680, a software system has been designed and implemented to disseminate downscaled climate projections for Turkey and its regions. The system[16] allows registered users to make spatial (latitude-longitude boxes, provinces, hydrological basins, etc.) and temporal selections and to undertake simple statistical analyses on climate variables and retrieve results in graphical, textual or netcdf formats.

Despite these positive achievements in applied climate science, some serious issues still plague the climate change scientific community in Turkey. The primary problem for climate modelers is the underdeveloped state of the climate impact assessment community in Turkey. This results in very limited demand for climate projection products. Therefore only a small set of variables/ statistics is often made available.

Furthermore, at present the climate research community is very small and processes that will encourage its development (such as a national climate research program or a national research agenda) are not envisioned.

[16] accessible at http://agora.itu.edu.tr

As the application of dynamical downscaling to NNRP data has clearly shown, the resolution of station data is not a high as the model output. Consequently, it is very difficult to assess the performance of downscaling for variables with high spatial variability such as precipitation, especially in regions of variable topography. More effort is needed to improve the network of climate stations, particularly in mountainous areas.

As of the writing of this report, plans are underway to continue regional climate projection-based studies. Global model outputs prepared for AR5 (CMPI5) efforts will be dynamically (with RegCM4 and WRF-ARW) and statistically downscaled to update information about Turkey's future climate. These regional simulations will have a higher resolution (< 10 km) and a richer set of statistics will be produced, with special attention given to extreme events. It is hoped that in the coming years the climate impact analysis community will expand and consequently climate data products can be tailored to their specific needs.

6.2. Expected Impacts, Vulnerability and Adaptation Measures

Participatory Vulnerability Analysis (PVA) has been carried out at the local level to identify impacts of climate change and vulnerable areas in the context of the UN Joint Programme on Enhancing the Capacity of Turkey to Adapt to Climate Change. In the process of undertaking the PVA in 2009 and 2010, vulnerabilities to climate impacts were determined at the local level in 11 provinces; the impacts on relevant sectors or themes were assessed; and preparedness to climate impacts was identified. The fact that Turkey is a particularly geographically diverse country has required that a variety of studies be carried out at the local level.

At local level and in all provinces the following information has been collected: trends in climate change; variables regarding populations who have been impacted by changing climate; adaptive measures taken by institutions; and the existing capacities and needs (needs related to policies, legislation and implementations etc.) of local institutions. This information has guided the general principles, priorities and measures of the National Climate Change Adaptation Strategy.

The results of the PVA suggest the increasing prominence of the following five climatic hazards:

- Warmer winters with less snow;
- Greater drought frequency;
- Greater occurrence of sudden and heavy rainfall causing floods;
- Increasing irregularity in rainfall patterns; and
- Gradual shifting of the seasons.

Across the 11 provinces it was consistently reported that climate change was having a number of significant impacts. Common adverse impacts observed throughout the country included:

- Reduction in surface and fresh water resources;
- Lowering of the groundwater table in almost all regions;
- Increase in the number of forest fires; and
- Decline in fauna population.

There were eleven key vulnerable groups, systems, and livelihoods that emerged from the stakeholder consultations. These are summarized in the bullets below:

- Vulnerable livelihoods: Farmers, pastoralists, bee keepers, fishermen, shop keepers/traders;
- Vulnerable groups: Forest villagers, urban dwellers, and industrialists;
- Vulnerable systems: Tourism (including tourists), wildlife and habitats (both marine and terrestrial ecosystems), and public administration.

As expected, farmers were overwhelmingly reported to be the most vulnerable and most exposed group to current climatic variability and future climate change. Any significant fluctuations in temperature or rainfall were said to have adverse effects on farmers' crop yields and hence incomes. Those households and communities practicing animal husbandry and fishing for their livelihoods were also found to be vulnerable. After a severe climatic event or disaster, pastoralists

tend to actually leave the sector or take up an alternate type of employment. Some even migrate to urban areas if circumstances remain persistently unfavorable to generating income.

Urban areas and populations face different challenges than rural populations from the same climate events. Urban areas are particularly vulnerable to erratic precipitation regimes as sudden and heavy rains can overload a city's infrastructure and lead to flash flooding in the streets, destroy sewer and water infrastructure, and inundate low-lying houses and businesses. On the other extreme, in times of drought, the lack of rain over extended periods results in the over-exploitation of water resources and induces chronic water shortages. This further aggravates the existing problem of inefficient water distribution systems in Turkish cities. On the other hand, warmer winters and less snowfall were regarded as positive impacts on urban life. Urban dwellers and infrastructure service providers (i.e., municipalities, province administrations, highway authorities) mentioned the positive effects of lower heating costs and reduced demand for municipal winter services.

As a result of the PVA, five particularly vulnerable areas have been identified: i) water resource management; ii) the agriculture sector and food security; iii) disaster risk management; iv) ecosystem services, biodiversity and forestry; and v) public health.

Coastal zones, settlements and tourism issues have also been covered in both the National Climate Change Adaptation Strategy and the National Climate Change Action Plan even though they were not addressed as individual issues here. In this context, vulnerability and adaptation for these seven headings have been discussed in detail in the following chapters of this National Communication.

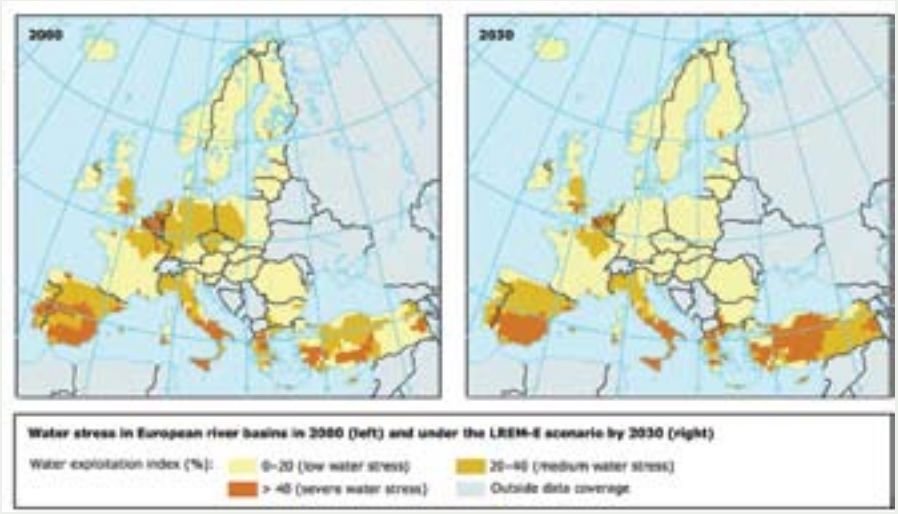
Studies on socio-economic impacts and cost of adaptation to climate change are limited for the time being. Therefore, socio-economic impact studies are going to be initated and the results are going to be submitted in following communications.

6.2.1. Water Resources

Expected Impact and Vulnerability

Based on historical water consumption patterns in Turkey, water use is expected to triple between 2004 and 2030[17]. Irrigation accounts for the highest share of national water consumption. As per the Turkish Statistical Institution's (TUIK) forecasts, Turkey's population is expected to reach 100 million by 2030, which will then bring consumable water volume per capita to 1,000 m3/year. Current growth rate and water consumption trends impose significant pressures on existing and future water resources[18]. The expected percentage variation in water stress across the basins in

Figure 6.9. Historical and Expected Water Stress Levels in Turkey and European Countries



Source: EEA, 2009.

17 Environmental Management Directorate, 2008.

18 Talu, 2010

Europe is presented in Figure 6.9. As shown in this figure, many river systems in the Mediterranean will be facing water stress in the near future. It is expected that the Central and Western regions of Turkey will face water stress, which will increase by 40% by 2030. This is likely to vary between 20-40% in the Southeastern and Eastern regions.[19]

Climate change signals also demonstrate significant differences among different climatic regions across Turkey. As shown in Section 6.1, temperature projections completed using the IPCC's A2 emission scenario indicate that average temperatures in the region by the end of the 21st century will tend to be 2-6oC higher than the average temperatures experienced in the 20th century. The precipitation patterns by the end of the 21st century, in comparison to current precipitation, also indicate seasonal and regional changes. During winter months, when the highest amount of precipitation takes place, significant decreases in precipitation along the Southern region and significant increases along the Northern region are expected. As per the IPCC's A2 scenario, temperatures are expected to increase significantly following the 2030's. In the case of precipitation, even though significant changes are not expected across all of Turkey, significant decreases are expected in the Mediterranean region. There are expected to be significant increases in precipitation in the Black Sea region in winter and spring seasons.

The expected changes in surface water resources will be crucial for groundwater resources as well, but at a different scale. As such the most important factor that will intensify impacts of climate change is the dependence on groundwater resources for agricultural applications in some regions. These applications will also increase saltwater intrusion in the coastal regions.

The projects implemented in Turkey in the context of impact and vulnerability in the water resources sector can be summarized in the following three main headings:

- Development and improvement of databases;
- Feasibility, planning and project development; and
- Modeling at the basin scale.

Development and Improvement of Databases

General Directorate of State Hydraulics Works (SHW) Water Database

The project was implemented by the SHW and completed in 2008. It was financed by TUBITAK. As part of the project outcomes: a database platform was developed that allows access to all types of water resources information generated by DSI through various measurement, evaluation and modeling studies. The platform allows storage, reporting and other applications as needed. Various types of data are collected, including hydrometric data (precipitation, temperature, level and discharge), groundwater data, and water data. The information is collected at specific gauge locations and stored at predetermined time intervals, queried and made available to users through various types of reports. The electronic data flowing from other institutions (EIE, DMI, etc.) can also be transferred to the system automatically.

Water Basin Management

Yeşilırmak Basin Development Project

The project is implemented by the Yeşilırmak Basin Union of Municipality Special Administrations and funded by the Ministry of Development. This is a regional development model developed by incorporating the cities of Amasya, Tokat, Samsun and Corum, which are representative of underdeveloped region of Turkey, and are targeting their work to advance development in these cities. "Yeşilırmak Basin Union of Municipality Special Administrations" were established by connecting 5 major cities (Amasya, Çorum, Samsun, Tokat and Yozgat) to accomplish various activities such as: preventive measures to avoid pollution along Yeşilırmak and its tributaries; initiatives to reduce erosion in the region; regulation of flow regime; activities to enhance social, cultural and economic development by increasing the level of integration between public and

19 EEA, 2009.

private entities and institutions. The project may increase the resilience of the basin by decreasing stresses caused by pollution within the basin.

Basin Scale Modelling

There is numerous completed and ongoing basin scale modeling studies that aim to investigate impact of climate change on water resources. Some of these studies were presented in the INC. There has been a significant increase in the amount of research in this area since the publication of the INC. Some of this research and relevant projects are described in the following paragraphs.

The Climate Change Vulnerability Assessment at a Regional and Sectoral Scale in Turkey project is going to start in 2013 coordinated by the MEU. The project will assess vulnerabilities in a pilot basin for the following sectors: natural disasters, water resources, agriculture, forestry, health and tourism.

The Climate Induced Changes on the Hydrology of the Mediterranean Basins (CLIMB) Project is funded by the EU FP7 programme and implemented by scientists from six countries including Turkey. The study area covers water basins in Italy, France, Turkey, Egypt, Tunisia and Palestine. The study aims to decrease uncertainty in climate change impact assessments through monitoring, remote sensing, and hydrological modeling techniques, and to develop a tool for quatitave risk assessment. The results of the hydrological modeling and socio-economic factor analysis studies are going to be used to develop a geographical information system based vulnerability and risk assessment tool. A water basin in the Kocaeli Province will be the pilot site in Turkey.[20]

The Water Scenarios for Europe and Neighboring Countries Project is funded by the EU FP6 and was completed in 2011. Middle East Technical University participated from Turkey and contributed to outcomes related to: improvement of methods to evaluate water resources; analysis of freshwater resources in Europe and development of detailed scenarios by 2025; analysis of water use, demand and quality and their relationships to socio-economic, environmental and ecologic scenarios; and establishment of a dynamic process to generate scenarios in Europe. The project will establish a database to assist in long-term strategic planning and to facilitate the development of water resources projects.

The Turkey's Future: Development of Climate Change Scenarios and Assessment of Impacts for Konya Closed Water Basin and East Anatolia Water Basin Project implemented by WWF-Turkey and funded by ETİ Burçak was completed in 2010. The aim of the basin scale modeling studies was to identify water and groundwater resources for Konya Closed and Göksu Water Basins under current climate conditions and then project impacts of climate change on the basins for 2015, 2030, 2050 and 2057. Crop and irrigation alternatives for the climate change scenarios were also investigated.

"Impact of Climate Change on Dam Reservoir Supply Reliability Project" was funded by TUBITAK and conducted by Dokuz Eylul University in 2011. It is expected that current dam reservoirs, that are designed by using past climate records, might be negatively affected from the changing climate in the future. Recently, large metropolitan areas in Turkey, such as Istanbul, Ankara and Izmir negatively affected by drought induced water supply problems, similarly Gediz and Great Menderes agricultural basins experienced drought induced irrigation problems. The Project aimed at investigating impacts of climate change on Tahtalı and Gördes Dam Reservoirs that supply water to Izmir. HadCM3 climate model was used under A1B, A2 and B1 scenarios, followed by statistical and neural network downscaling methods. Change in the water supply of dams was calculated. According to study; total drinking water supply from Tahtali and Gordes dams are expected to decrease by 21.6-28.8 million m3/year as a result of climate change.[21]

"Investigation of Lake- Groundwater- Climate Relation using Grounwater Modeling and Geographical Information System techniques, and establishing an optimum Dynamic Business Model for Beyşehir Lake" project is funded by TUBITAK and conducted by Süleyman Demirel University since 2010. Beyşehir Lake is the third largest lake in Turkey and the largest freshwater lake. The lake is also classified as wetland according to Ramsar Convention. The project aimed at establishing an optimum dynamic business model that is determination of minimum water

[20] Ludwig ve diğerleri, 2010.

[21] Fıstıkoğlu et. al., 2011. "Identification of Impact of Climate Change on Dam Reservoir Supply Reliability Project", TUBITAK Project No 108Y301

level of lake considering current precipitation, evaporation and groundwater levels, for Beyşehir Lake. Climate data produced in this study will be used to make time dependent drougth analysis. Existing vegetation and land use will also be identified by using satellite data. With these studies, interaction of the lake with ground water and neighboring basins will be investigated.

"Impact of Climate Change onto Euphrates River Basin" Project is funded by TUBITAK and conducted by ITU since 2010. This study investigates change in flow of middle and upper Euphrates River Basin in the 21th century by using regional climate change projections under different IPCC emission scenarios.

"Impact of Climate Change on Water Resources of Istanbul and Turkey" was conducted by Istanbul Water and Sewerage Directorate. Three outcomes of the project are: i) modeling of meteorological or hydrological parameters (flow, flood, drought, groundwater feed, etc.); ii) decision making on type of IPCC scenarious to be used; iii) decision making on GCM parameters to be used.

Adaptation Measures

Measures that are applicable to sound water management such as water basin management, protection of water resources, increase of water storage capacities also provide benefit in terms of climate change adaptation. Major objectives of such measures conducted in Turkey are as follows:

- Efforts continue to harmonize the EU Water Framework Directive.
- Creating Basin Management Plans considering an integrated water resources management approach.
- Promoting effective use of water resouces by enhancing irrigation, rehabilitation and modernization. Hence, minimization of risk of drop in ground water levels and resulting salinization that is as a result of improper irrigation methods.
- Promoting innovative solutions and techniques in order to minimize risk of irriversrible resource destruction by dimishing groundwater resources as a result of illegal and/ or excessive groundwater use; and to minimize water resource pollution at areas where industry and agriculture activities are dense..
- Increasing capacities of Hydro-Electric Power Plants and water storage facilities, so as to decrease vulnerability of changing water resources resulted by climate change and also to promote use of natural resources of Turkey.

Activities performed by the MFWW, SHW as the national focal point for Climate Change Adaptation are summarized as follows:

- In order to increase water holding capacity and allocate water for drinking, industry and irrigation, reservoirs and lakes have been constructed across Turkey. A total of 677 reservoirs and lakes have been constructed to date, and investments are ongoing.
- 1000 Lakes in 1000 Days (Lake-Water Project) promotes irrigated agriculture practices in rural areas.
- Irrigation facilities are being rehabilitated and/or converted into modern systems to reduce excessive water consumption and improve operation and maintenance. The SHW has increased pressurized irrigation systems from 6% in 2003 to 11% at present. Of the irrigation systems under construction, 57% are being constructed as pressure systems. Among the irrigation projects in the planning stage until 2014, approximately 88% will be developed as pressure systems.
- The Southeastern Anatolia Project (GAP) Action Plan was completed for 2008-2012 to accelerate economic development, social improvement and infrastructure works in the GAP region. As part of the GAP, 1,058,509 ha will be targeted for irrigation.
- In order to meet urgent drinking water needs of cities, the Action Plan for the Provision of Drinking, Use and Industry Water at 81 City Centers was prepared for 2008-2012 and then updated for 2010-2014. Additionally, Action Plan for the Provision of Drinking, Use and Industry

Water (2010-2014) was preapred for district center that has population over 50,000.

- In order to evaluate the impacts of climate change on water resources, a project is under preparation by SHW

With and aim to integrate these activities and to be enable implementation at regional and local level, SHW Strategic Plan (2010-2014) was prepared. Within this Strategic Plan, that is prepared in consultation with all relevant stakeholders, mid-term and long-term targets, basic principals and policies, priorities and objectives with their performance indicators and methods to achieve them are stated.

Some of the specific activities of SHW that support climate change adaptation are as follows:

Adaptation to Climate Change at Seyhan River Basin

Development of Water Resources Management Policies in Seyhan Basin in the Context of Climate Change Adaptation, that aims to identify surface water resources potential and to identify and manage flood risks, was conducted by Adana Provincial Directorate of SHW and financially supported by UNDP-MDGF 1680 UN Joint Programme. Seyhan River Basin is the second largest in the Eastern Mediterranean following the Nile Basin. Under this project, climate change (2011-2090) is projected, rainfall-runoff relations were determined, and a water resources budget were developed based on three scenarios by using an integrated basin management modelling tool in Seyhan basin. In this project, scenarios were generated to evaluate existing and planned irrigation projects related to: existing water resources; planned water resources under climate change; and integrated basin management plan for future/planned water resources under climate change. The project is completed in 2010.

Anatolia Water Basins Rehabilitation

The project is financed by World Bank, IBRD and the GEF and implemented by MFAL, MFWW and MEU. The main purpose of the project is to support sustainable natural resource management practices in 28 micro basins in the Anatolia and Black Sea regions and increase revenue streams of populations who are impacted adversely. In addition to this main objective, the project will evaluate impacts of cities discharging water into the Black Sea and will implement agricultural practices to minimize pollution of surface- and ground-water resources. The project is being implemented in the cities of Samsun, Tokat, Sivas, Kayseri, Çorum and Amasya. The project is related to the reduction of agricultural impacts on water resources in the cities of Samsun, Tokat, Çorum and Amasya.

Capacity Building in the Water Sector in Turkey

The Project is funded by the EU, implemented by former MEF and SHW and completed in 2010. A legal and institutional analysis of the Water Framework Directive, Municipal Wastewater Treatment Directive and Dangerous Substances Directive was performed within the scope of the project. This included a detailed legal gap analysis to evaluate the applicability of these directives for Turkey, an assessment of institutions and institutional capacities, and the identification of training needs for enhancement of existing institutions. Additionally, the project resulted in the establishment of a road map for implementation of these directives at the national level. Finally, the project implemented pilot activities in the Büyük Menderes Basin.

Application and Capacity Building for Sustainable Management of Groundwater Resources in Turkey

The Project is funded by the EU, implemented by former MEF and SHW and completed in 2008. The project focused on the protection of groundwater resources against pollution from dangerous substances to be compliant with existing legislation. It also included an evaluation of institutional structures for groundwater resource management.

Turkey-Bulgaria Cross-Border Cooperation Region Capacity Building and Flood Control for Flood Forecasting

The project is funded by the EU, implemented by former MEF and SHW and completed in 2010. As a result of five main objectives of the project following outcomes were achieved:

- Flood forecasting models developed
- Operationalization of a Flood Forecasting and Early Warning System (FFEWS), the development of flood extent maps, and technology transfer and training. In the operationalization of the FFEWS,
- Integration of FFEWS with real time data and generation of warning messages were provided and forecast results evaluated.
- Flood Distribution Maps generated.
- Technology transfer trainings held.

Enhancement of Turkey's Capacity in Flood Directive

The project is financed by the EU, implemented by MFWW and is planned to end on 2014. The objective of the project that is under preparation is to develop administrative and technical capacity to allow the SHW to implement Flood Risk Evaluation and Implementation in Turkey.

Capacity Building in Water Quality Monitoring

The project is under preparation. It is planned to be funded by the EU and implemented by MFWW by the end of 2013. The objective of the project is to evaluate the Ministry's existing monitoring network and develop a structured plan to establish a monitoring system that represents the basin's characteristics.

Table 6.4. Potential Impacts of Climate Change on Water Resources and Adaptation Measures

Vulnerability	Adaptation Measures
Water Resource Management, Flood and Drought Conditions	• Provision of sustainable use, protection and improvement of water resources within the basin. • Establishment of reservoir operation policies in-line with impacts of climate change. • Customization of Forecasting and Early Warning Systems, preparation of flood and drought management plans.
Irrigation	• Use of pressurized irrigation systems at places where it is technically and economically feasible to use this system. • Rehabilitation and/or modernization of irrigation systems that result in excessive water use. • Promoting suitable crop types that are compatible with climate and water resource characteristics of agricultural basins. • Implementation of capacity building activities to allow farmers to adapt new technologies and develop awareness of soil-plant-water relationships.
Urban Water Distribution Systems	• Protection of drinking water basins • Promoting measures to reduce water loss and leakages at urban areas and dissemination of SCADA system at national level. • Raising public awareness on water conservation.
Groundwater	• Prevention of groundwater pollution and degradation, protection of current status of groundwater which is in good condition, and improvement of groundwater with poor conditions. • Provide sustainable groundwater management by using modeling of groundwater reservoir and uptake relations and controlling the system by supporting with modern irrigation systems and by measuring groundwater drawn from wells in the system. • Prevention of excessive and illegal use of groundwater and providing public awareness on this issue.

6.2.2. Agriculture and Food Security

Expected Impacts and Vulnerability

Agriculture is heavily dependent on weather and natural systems. Therefore, the impact of climate change on agriculture is more pronounced than on other sectors. Turkey is one of the most vulnerable countries to impacts of climate change on agriculture and food production due to its location in the Mediterranean basin, which is highly vulnerable to climate change.[22] This is further reflected in the importance of the agriculture sector in economic and social welfare of the country.

About 24% of Turkey's population lives in rural areas. The agriculture sector contributes to 9% of GDP, 24% of employment and 9% of exports nationally.[23] Any changes in agricultural production patterns or total productivity will have an impact on farmer welfare and the national economy. The total amount of cultivated agricultural land is 24.4 million hectares, but only 5 million hectares of this is irrigated. Average precipitation in Turkey is 653 mm, and is as low as 200 mm at some regions. The non-irrigated regions that receive less rainfall are most vulnerable to climate change.

According to the IPCC 4th Assessment Report, over the next century there will be an increase in temperature and number of heat waves, a decrease in precipitation of up to 20%, a decrease in soil moisture, as well as a sea level rise in the Mediterranean Basin. Semi-arid and subtropical regions of Mediterranean region are expected to receive the most significant changes in temperature,

22 IPCC, 2007.
23 TÜİK, 2011.

rain, and frequency and density of extreme weather phenomena, like floods and drought. It is estimated that these changes will cause loss and destruction of agricultural areas and also reduce yield productivity. A 2°C temperature increase is estimated to cause a 5% reduction in grain yield throughout world. While estimates for a 4°C temperature increase are estimated to result in a 10% reduction in grain yield throughout world, such an impact would cause a reduction of 25-35% for the Mediterranean region.[24]

Regional studies for Turkey are in the process of verifying these data (Chapter 6.1.1). It is estimated that there will be an increase of average temperatures in Turkey of 1.3 - 7.3°C in 21st century. Major increases are expected in the Central and East regions of Turkey. It is estimated that there will be an increase in the Mediterranean region and a decrease in the Black Sea Region in terms of winter precipitation. Also an increase in spring stream flow and decrease of winter stream flow are expected in the East Anatolia region.[25]

Although there are few studies on the impacts of climate change on agriculture in Turkey, there have been an increasing number since the Initial National Communications in 2007. The results of these studies indicate that Turkey is expected to experience a decrease in the yield of agricultural products due to decreases in precipitation in semi-arid regions, increases in temperature, and decreases of water for irrigated activities (IPCC 2007).

One of these studies on climate impacts on agriculture was conducted by Dellal et al.[26] in seven geographic regions of Turkey and at a national scale. Five fundamental products (wheat, barley, corn, sunflower and cotton) comprising 85% of Turkey's cultivated areas were assessed. Precipitation and temperature changes were generated based on HADCM projections for the year 2050. Effects of climate change were estimated on Turkey's agricultural production, inter-regional product pattern, prices of agricultural products, the amount of import and export, as well as consumer, manufacturer and social welfare. is the study results estimate a decrease in the yield in all regions of Turkey (Table 6.5). Decrease of production is estimated to be 8.18%, 2.24%, 9.11%, 4.53%, 12.89% on wheat, barley, corn, sunflower and sunflower, respectively. The study also estimated changes in production patterns, with decreases expected in export of wheat and sunflower, increases of export of corn and cotton, and increases in the prices of products by 6.3%, 7.1%, 12.6% and 0.1% respectively for wheat, barley, corn and sunflower. Manufacturer welfare is expected to increase by 8.3%, while consumer welfare and total welfare are expected to decrease by 1.7% and 0.7%, respectively. [27]

Table 6.5. Effects of Climate Change on Productivity (%)

	Wheat	Barley	Corn	Cotton	Sunflower
Black Sea	-6.0	-7.0	-7.4		-5.0
Marmara	-10.3	-8.5	-7.9	-5.0	-5.9
Aegean	-7.2	-7.2	-11.0	-3.6	-6.6
Mediterranean	-6.5	-6.0	-10.9	-2.8	-6.8
Central Anatolia	-7.4	-8.2	-12.5		-7.3
East Anatolia	-8.3	-8.5	-12.1		-7.9
Southeast Anatolia	-7.2	-7.5	-9.2	-4.0	-6.3
Turkey	-7.6	-7.6	-10.1	-3.8	-6.5

Empty cells were not estimated.
(Ref/Source: Dellal et. al. 2011)

24 IPCC, 2007.
25 age.
26 Dellal et al. 2011.
27 Dellal et al. 2011.

The Impact of Climatic Change on Agricultural System in Arid Areas project was conducted by TUBITAK and the Research Institute for Humanity and Nature-RIHN between 2002 and 2007 with the goal of determining the effects of climate change on agricultural production systems in arid areas. The project estimates that by 2070, average temperatures will increase 3°C, annual precipitation will decrease 25%, water surface sources, snow storage and underground water potential will decrease by up to 30% in the Seyhan Basin. It is also found that the need for irrigation for wheat will increase in the summer, plant growth time will be shortened based on an increase in the temperature, and wheat cultivation will be more difficult due to a decrease in precipitation during winter. These impacts are expected to result in a shift in the area of cultivation to the central and north regions of the basin (Impact of Climate Change on Agricultural Production Systems in the Arid Areas (ICCAP).[28]

According to the results, natural and agricultural water needs of plants may increase, and irrigation management are going to be important responses to the decrease in water availability. Issues like inter-sectoral water distribution, water saving, water demand management, control of water usage, expansion of observation networks, and the increase of large volume storage buildings are also priority activities.[29]

Scenarios have been developed for adaptation to climate change within the Seyhan Basin as a result of the ICCAP project. These are named as 'Valid/Existing Conditions', 'Adaptation-1 (low investment situation)', 'Adaptation-2 (high investment situation)' and 'Adaptation-3 (combination of the last two scenarios)' According to the Adaptation-1 (adaptation) scenario, upstream locations are expected to experience a decrease in wheat production areas, an increase at the yield of barley and grassland areas, and a slight increase in irrigated agricultural areas. On the other hand, a decrease in wheat yields, an increase at the need for irrigation, change in traditional plant composition and 4th level irrigation investments of lower-Seyhan are expected to downstream.

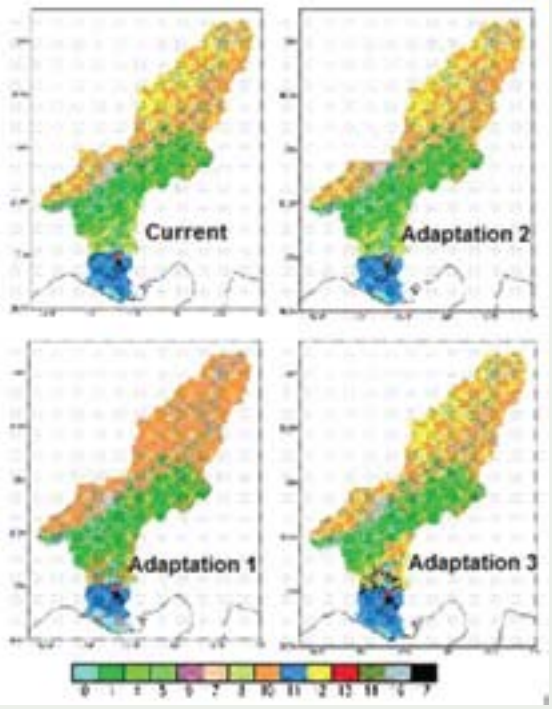
According to the Adaptation-2 scenario, upstream areas should expect a decrease in the areas where wheat grows under natural precipitation, and an increase of production areas of lucrative plants (walnut, pistachio, olive, fruits). On the other hand, a decrease in yield and production areas of wheat, increase of irrigated areas of some plants (melon-watermelon, fruits), an increase in groundwater use and completion of 4th level irrigation investments of lower-Seyhan are predicted in downstream areas.

When all these assumptions/scenarios are considered, the report finds important changes in land use across the basin. Figure 6.10 shows that especially at the Adaptation-2 (adaptation) scenario, which requires high investment, a large number of plants from downstream in the basin will shift upstream, fruit and vegetable cultivation will be widely implemented at central and high altitudes of the basin, and especially hard core fruits will be grown over wider areas. However, all of the plants mentioned will be produced under irrigated conditions. Therefore, investments in irrigation and the establishment of water reservoirs are recommended across these areas. In particular, a focus should be placed on storage water from early surface streams by taking into account changes of snow melting times.

28 IPCC, 2007.

29 ICCAP, 2007b; Kanber, 2008.

Figure 6.10 Changes in the Status of Land Use in Seyhan Basin between 2070 and 2100 with Respect to Different Scenarios



LEGEND

0: Water surface
1: Permanent evergreen forest
4: Deciduous forest
5: Mixed forest
6: Bushes
7: Bushes/Pastures
8: Savanna
10: Meadow vegetation
11: Corn
12: Dry agriculture areas
13: Urban areas
14: Plant/Natural cover
16: Arid areas
17: Citrus

Source: ICCAP, 2007

ADAPTATION MEASURES

Information about legal regulations and applications for climate change adaptation in the agriculture sector is provided in Chapter 4. Many agricultural projects struggle with aridity issues, and efforts to implement good agriculture practices, and organic agriculture in addition to adaptation to climate change are presented below.

MDG-F 1680 Enhancing the Capacity of Turkey to Adapt to Climate Change UN Joint Programme

The UN Joint Programme was conducted between 2008 and 2011 to enhance adaptation capacity to climate change in Turkey through the collaboration of UNDP, FAO, UNIDO, United Nations Environment Program (UNEP), former MEF, former MARA and relevant public institutions. The aims of the project were to integrate climate change adaptation into Turkey's national plan, develop institutional capacity for climate change risk management, develop community based adaptation capacity in the Seyhan River Basin, integrate climate change adaptation into the UN programming framework. Within the scope of the Programme, important workshops with national and international attendance were organized to increase the institutional capacity of Ministries' with the collaboration of FAO and MFAL. Workshops were held related to: Carbon Management in Agriculture; Climate Data Analysis; Measurement of Soil Moisture; Drought Monitoring Tools and Applications; and Crop Insurance in relation to Floods and Drought. The Joint Programme, and especially its grant projects that were implemented in the Seyhan Basin, aimed to develop institutional capacity for climate change adaptation, create awareness, develop correct agriculture techniques, and enhance food security.

Research, Meetings and Activities on Climate Change

Research and development studies on climate change and agriculture are conducted by MFAL and other relevant public institutions, international organizations, universities, municipalities and NGOs.

The General Directorate of Agricultural Research and Policy of MFAL is developing resistant seed varieties appropriate to dry farming conditions. In addition, methods for soil moisture conservation in arid regions to reduce the risk of agricultural production are being developed. Various research projects are underway, including on: economic and sustainable use of soil and water sources; the establishment of appropriate technology and irrigation programmes for irrigation water under drought; planning of irrigation and drainage systems; reclamation of saline soils; assessment of soil quality, soil pollution and waste water; measurement and monitoring of soil moisture; soil carbon measurement; soil reduced cultivation and soil quality management. Efficient use of agricultural research is addressed through public-private sector cooperation and through the expansion of relationships between the private sector and universities.

Closed Drainage and Land Reclamation

There are drainage problems across nearly 3 million hectares of field in Turkey. This occurs mostly because of poor irrigation and natural causes. Drainage problems lead to environmental problems like high ground water and salinization of land. There are salinization problems across approximately 1.5 million hectares of Turkey corresponding with 31% of irrigated lands. Factors like irrigation, drainage, soil properties, physiography and climate are mostly responsible for salinization of soils. This is often experienced in plains and the areas of Harran, Amik, Konya and Down Seyhan Plains have serious salinity problems. High ground water causes the production of methane gas by breaking down organic substances in an anaerobic environment. As a result, dealing with high ground water is important. Closed drainage studies are being conducted by General Directorate of Agricultural Reform (GDAR) and the Secretariat General of the Special Provincial Administration. The project is implemented across 60,000 hectares area in the Harran Plain by the GDAR. In addition to this, preliminary studies are underway across Turkey including Konya and Aksaray Plains.[30]

Modernization of Irrigation Systems

Grant support has been provided for irrigation cooperatives and village service to transform on-farm irrigation systems to closed and pressurized systems through the Supporting Rural Development Investments Programme implementing by MFAL. The grants support 75% of costs for collective pressurized irrigation applications and 50% of within-parcel modern pressurized irrigation investments. The rest of the investment is provided as low-rate long-term loans.

Agriculture with Minimum Cultivation

Agricultural producers who use minimum tillage are supported by the Land Protection for Environmental Purposes (LPEP) Programme. Support payments are made to producers who undertake minimum tillage. In addition, grant support for machine transformation based on Support of Rural Development Investments is provided. Soil is left intact from planting to harvest and from harvest to planting under a minimum soil tillage system. This also relies on direct planting of seeds to previously intact soil. Soil is cultivated in the form of a narrow strip only by waste shredders and direct sowing machines. As a result, direct sowing machines provide minimal soil disruption.

Agricultural Insurance Law

The Agricultural Insurance Law entered into force with its publication in the Official Gazette.[31] The law defines principles and procedures for agricultural insurance to compensate potential losses of producers for the risks which are determined by the law. The law establishes the Agriculture Insurance Pool Company, which supports 50% of insurance premium of farmers.

Agricultural insurance is supported by Government and managed by Agriculture Insurance Pool Company and risk scope of the insurance is growing faster than other countries according to results of the five year implementation. As a result, the domestic branch of premiums in 2010 increased by 12%.

30 Küsek, 2010.

31 No. 25852 on 21 June 2005.

Activities on Erosion

The Water Resources Research Institute of General Directorate of Agricultural Research and Policies, which operates under MFAL, undertakes research on regional erosion estimates, measurements and mapping. This research also addresses erosion prevention and control. The institute collaborates with former the General Directorate of Forestation and Erosion Control of MFWW.

Box 6.1. Training and Awareness Activities for Farmers

One of the studies that MFAL is undertaking related to adaptation to climate change is awareness-raising activities for farmers. MFAL supported a television programme that has provided information on climate change to farmers periodically since 2007.

MFAL also continues training on climate change within cities with the help of city organizations. Information about the short courses that have been held since 2007 is provided below.

Farmer Trainings on Climate Change and Aridity

Years	Number of Training	Number of Attended Farmers
2007	334	7227
2008	332	9477
2009	199	2785
2010	169	2807
2011*	36	470

* Numbers for the first six months.
Source: MFAL, APDGD 2011

Table 6.6. Potential Impacts of Climate Change on Agriculture and Food Security and Adaptation Measures

Vulnerability	Adaptation Measures
Yields of agricultural products, possible changes in soil and water sources	• Updating the databases; • Updating the inventory and maps of soil; • Determining the effects of climate change on soil, water, yields of crops and animal products at basin, regional and national levels; • Predicting production patterns and planning according to this information; • Determining possible effects on production quality of crops and animal production, undertaking studies on protection and improvement of quality; • Predicting possible plant and animal diseases; • Determining possible effects on plant and animal health; • Predicting possible effects on agriculture based industry; • Establishing research centers on climate change and agriculture interactions; • Developing crop varieties that are well-adapted to changing climate; • Disseminating activities to farmers; • Completing consolidation of land; • Expanding irrigated areas; • Disseminating water-saving irrigation systems; • Raising awareness on erosion and desertification; • Developing public-private sector cooperation on R&D; • Increasing pasture and meadow improvement studies; and • Carrying out capacity development and awareness-raising studies at all levels.
Economic, social and environmental effects within the agriculture sector	• Conducting economic, social and environmental impact analyses at national, regional and basin levels; • Determining regions and groups that are at high risk and making actions plans for/with them; • Promoting production varieties that are appropriate for climate and water conditions within agricultural basins; • Extending non-farm employment opportunities and increasing training activities; • Facilitating the use of agricultural loans, conducting studies to increase the use of loans especially by small-scale farmers; • Increasing the support that is given to environmentally sensitive agriculture techniques; • Carrying out studies on increasing environmental awareness of farmers; and • Carrying out capacity development and awareness-raising studies at all levels.

CONCLUSION

Agriculture will be one of the sectors most affected by climate change. The agriculture sector in Turkey is important for food supply, raw materials, national income, export and employment. Nine percent of national income and export and 25% of employment is from agriculture. Therefore, a potential change in agricultural production due to climate change will have important impacts on the country's economy.

Studies on the effects of climate change on agriculture in Turkey are limited. There are two studies on the subject. One of them is an economic impact assessment on the effects of climate change on agriculture in Turkey which was conducted by Dellal et al.[32] According to this research, it is estimated that yield of products at seven locations and across the country will decrease. It is also estimated that production patterns across the country will change, exports of wheat and sunflower will decrease, imports of corn and cotton will increase, product prices will increase, welfare of producers with respect to product prices will increase by 8.3%, welfare of consumers will decrease by 1.7%, and total welfare will decrease by 0.7%. The second study is based on regional research conducted within the ICCAP project framework. According to ICCAP project's results, it is estimated there will be shorter periods for plant growth, shifts of planting areas and decreases in yields due to climate change.

Additional studies indicate decreased yield and product losses due to an increase in extreme events such as drought and floods. Acceleration of the adaptation research is necessary to reduce and prevent the negative effects of climate change on agriculture. It is important to run awareness-raising and capacity development efforts, increase the number of studies on effects of climate changes on agriculture in local, regional and national levels, and to disseminate agricultural adaptation activities for farmers.

6.2.3. Natural Disasters

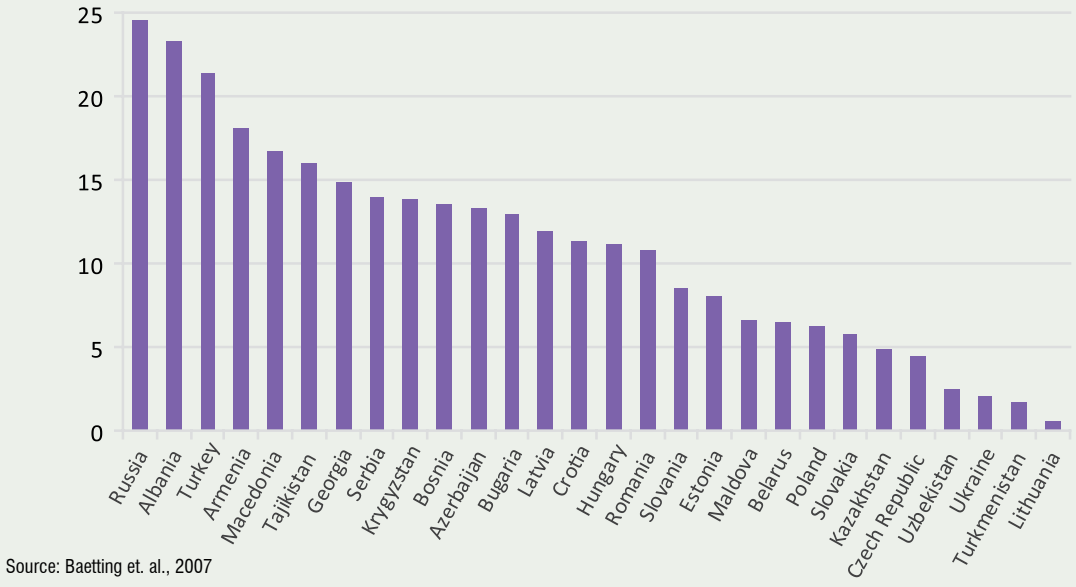
EXPECTED IMPACTS AND VULNERABILITY

There have been consistent and significant increases in the number of large scale "catastrophic" hydro-meteorological natural disasters resulting from climate change since 1980.[33] It is estimated that 91% of natural disasters observed worldwide over recent years have been caused by atmospheric events. Hydro-meteorological disasters has been estimated to cause more than 300,000 deaths, 325 million people to get seriously injured and 125 billion dollars economic loss globally.[34] According to EEA[35] extreme weather and climate conditions have been directly responsible for 64% of disasters that have occurred since 1980 in Europe. These are floods, storms, droughts and heat waves. The average annual number of events that result from weather and climate conditions and have caused disasters doubled in Europe since 1990's in comparison to the previous decade, while the number of disasters that are not related to weather and climate change such as earthquake remained unchanged.

Turkey will be the country with the third highest exposure to extreme events from climate change among European and Central Asian countries by the end of 21st century (Figure 6.11).[36]

32 Dellal et al. 2011.
33 MunichRe, 2011.
34 GHF, 2009.
35 EEA 2004.
36 Dünya Bankası, 2009.

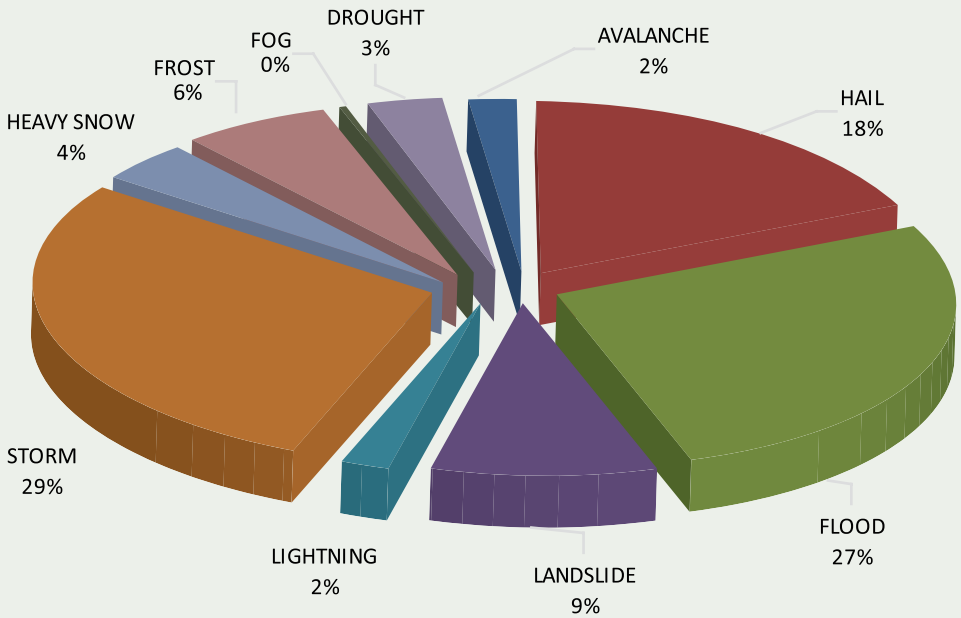
Figure 6.11. Risk of Exposure of Countries in Europe and Central Asia to the Expected Extreme Climate Events by the End of the 21st Century



Source: Baetting et. al., 2007

Most of the thirty-one types of natural disasters have been experienced (except for tropical storms and active volcanoes) in Turkey. Excluding earthquakes occurred in 1999 having a magnitude of 7.4 and 7.2 (respectively for occurrence dates of 17th August and 12th November), storms (strong wind), flood, hail and frost are the most common natural disasters (Figure 6.12). Heat waves, landslides, rock falls and avalanches have led to notable loss of life and property. Increasing temperature and decreasing rainfall has triggered long-distance migration of populations due to serious drought and water shortages. Forests have become susceptible to insects and diseases and there has been an increase in the number of dried trees and forest fires though not in great numbers. Recently, the main reason for damage to Turkey's forests has been acid rain and ozone depletion complemented by climate change impacts.[37]

Figure 6.12. Percent of Meteorological Events that Resulted in Disasters in Turkey (1940- 2010).

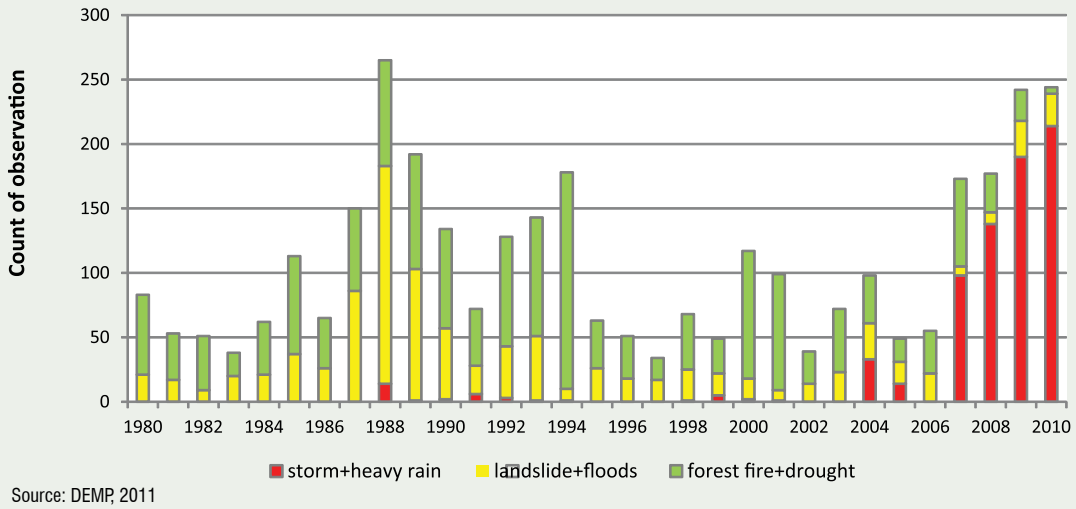


Source: EEA, 2009.

37 GDF, 2011.

The number of meteorological disasters like storms and floods has been increasing in Turkey since 1995 (Figure 6.13). Nevertheless, increased capacity of early warning and disaster management capacities in Turkey resulted in decrease in the number of casualty per flood events.

Figure 6.13 Types and Numbers of Disasters in Turkey between 1980 and 2010

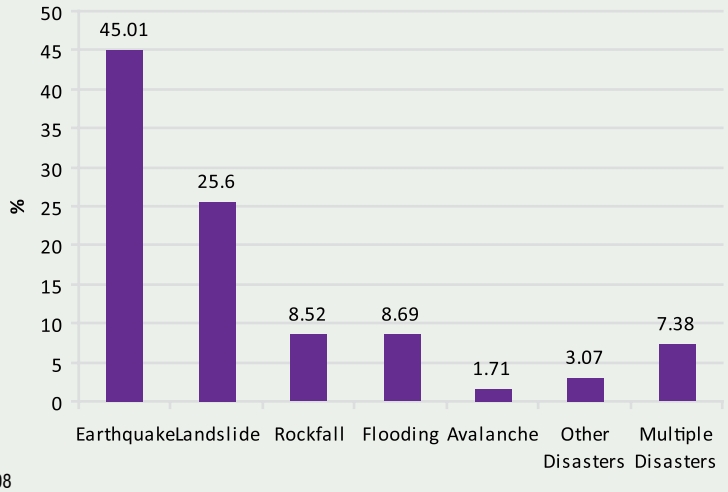


Source: DEMP, 2011

Between 1940 and 2000, the Black Sea, Mediterranean and West Anatolia have been the most impacted parts of the country due to natural disasters especially in March-July.[39] Similarly, it is expected that in recent years hydro-meteorological landslides and rock falls will increasingly threaten East Anatolia and inner parts of the Southeast and Black Sea regions. Central Anatolian and Eastern Anatolian along with Kayseri, Niğde and Tunceli are likely to experience more rock falls.

Former General Direcorate of Disaster Works (GDDW) has prepared "Disaster Data Inventory" that includes disaster data that occurred between 1950 and 2007 and prepared an assessment regarding the economic losses of disasters (events were addressed as disasters in this inventory when event resulted in relocation). According to this assessment, share of disasters that resulted in relocation are 45.01% earthquakes, 25.60% landslides, 8.52% rock falls, 8.69% floods and 1.71% avalanches (Figure 6.14).[38] Share of total hydrometeorological disasters including avalanches, floods and landslides account for more than 50%.

Figure 6.14 The Percentage of Disasters Causing Relocation of Houses



Source: Özden et al, 2008

38 Özden et al. 2008.
39 Özden et al. 2008.

Impacts of some of the hydro-meteorological disasters in Turkey are summarized in the following paragraphs.

Environment and Climate Migrants

According to UNHCR, up to the present, 26 million of people in the world have been made "climate migrants" due to the direct impacts of climate change. The number of these migrants is expected to reach 150 million by 2050. People might have forced to leave their homes and lands when they lose their livelihoods as a result of increasing deforestation, drought and floods (Box 6.2).

Box 6.2: Climate Induced Migration in Turkey: Suruç Case

Suruç is a town located in the south west of Şanlıurfa. According to the census in 2008, the population as a whole is 102,109. A continental climate is dominant in this region and the common vegetation of the land is steppe.

Ariculture used to be the main livelihood, and cotton, barley and lentil were formerly grown as basic crops in this region. Underground water from a depth of one meter had been intensely used for agricultural irrigation due to the limited and open water sources on the surface. In the 1970s in spite of the warnings from related public institutions, the underground water level started to decrease sharply. In the 25-30 years since, the depth that wells and artesian pipes reached had fallen to 200 meters which is the lowest level experienced historically. Reaching this water at this level has become uneconomical. The decrease in water levels on which farming relies in the winter decreased by 60% as a result of changing climate, not only stopped the feeding of underground water reserves used in farming but also resulted in a shortage of drinking water. The town has been supplied with daily drinking water through tankers.

Some of wealthy inhabitants have moved to city centres like Şanlıurfa, Ankara or İstanbul as a result of increased drought and water shortage in the area. Some of the less wealthy inhabitants have started working in Adana, Aydın and Harran as seasonal farm labourers in the summer time. Consequently, increasing drought and water shortage as a result of changing climate destroyed the whole economic based of the community and has forced the farmers, merchants, truck drivers, shop keepers and restaurateurs to migrate involuntarily.

Source: Kadirbeyoğlu, 2010

Forest Fires

In Turkey the frequency, influenced area and the duration of forest fires have been rising due to the increase in the length and the severity of hot and dry period. According to GDF data, in recent years there has been an 85% increase in forest fires (both in number and area burned) resulting from the increasing heat waves and thunderstorms that occur in June-October in Turkey.[40] According data from the past ten years, 54% of fires were caused by negligence, carelessness and accident, 11% of them were intentional, 12% resulted from lightning, and 23% of these fires occurred due to unknown reasons. From 1937 to 2010 the average number of fires per annum was 1,198, but during the past ten years the number of forest fires has doubled and reached an average number of 2,042 per year. On the other hand, the size of the lost land per fire between 2001 and 2010 was reduced to 5.27 hectare as a result of improved early warning and response activities by GDF in recent years, that was 18.29 hectare on the average for many years.[41] Revisions in some laws according to Basic Criminal Law numbered 5728, and revision of article 104 of Forest Law numbered 6831 resulted in extension of forest fire season to sevem months covering 1 May and 30 November that was previously lasting for five months covering 1 June to 31 October.[42]

40 GDF, 2011.
41 GDF, 2011.
42 8/02/2008 tarih ve 26781 sayılı Resmi Gazete.

Storms

According to SMS extreme event observations data, percent of occurrence of hydro-meteorological disasters between 1940 and 2000 are as follows: 30% flood, 27% storm and 23% hail.[43] In the period between 1940 and 2010, occurance of storms increased by 6% and reached to a total share within hydro-meteorological events to 33%.

Hail

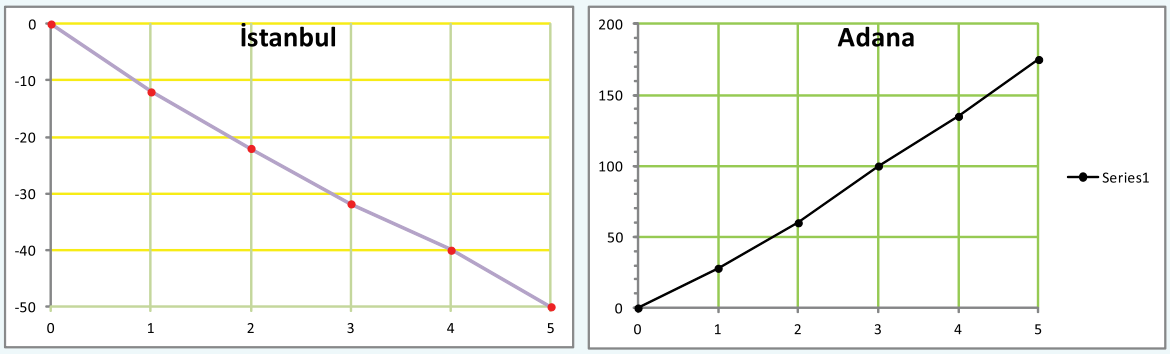
Hail fall is generally experienced in the Lakes Region, Erzurum, Kars, Eastern Anatolian and Thrace regions. Since hail generally occurs when agricultural activities are at their busiest and when trees blossom and bear fruit (March – July), they increase negative impacts on farming and cause great economic loss. According to DEMP data there has been a marked increase in the number of days with hail in Turkey since 2004.

Heat Waves and Electricity Consumption

Increase in temperature in hot days in a year results in increased electricity consumption for cooling especially in large cities (Box 6.3).

Box 6.3. Heat Waves and Electricity Consumption in the Building Sector

The amount of energy and fuel required to heat houses and industrial facilities in cold weather and cooling them in hot weather is directly related to weather conditions. Therefore, by taking into account temperature as degree-day figures, the yearly heating energy requirement of cities and how they are likely to vary with climate change may be estimated. It has been observed that electricity consumption increases and fluctuates in Turkey during hot seasons; this resulted in difficuly in meeting demand.



For instance, it has been estimated that in Istanbul, every 1°C temperature rise resulting from global climate change may cause a 10% decline in heating energy requirements in buildings in winter season. Furthermore, as a result of global climate change, cooling energy requirements during hot months is more susceptible to climate change than heating requirement. For example, it has been estimated that every 1°C temperature rise due to the global climate change will increase the cooling requirement of buildings in Adana by 32%. Hence, it has been estimated that electricity consumption for cooling in buildings in summer will be higher than that of heating in winter.

Source: Durmayaz ve Kadıoğlu, 2001.

43 Ceylan, 200.

Landslides and Avalanches

According to former GDDW's Disaster Data Inventory the rate of landslides as a result of hydro-meteorological disasters increased between 1988 and 2008. While 64% of hydro-meteorological disasters resulted in landslides between 1967 and 1987, this reached 78% between 1988 and 2008. In a similar respect, the number of avalanches within all hydro-meteorological disasters grew from 3% between 1967 and 1987 to 8% between 1988 and 2008.[44]

Floods

According to SHW data, 820 floods occurred from 1975 to 2011 with impacts that included 660 deaths, 799,758 ha of impacted farmlands and national economic losses of 150 million TL.

The share of river floods (flush floods) within hydro meteorological disasters observed between 1967 and 1987 is 33% while this share decreased to 14% between 1998 and 2008. This decrease in flush flood events is due to an increase in the number of dams, stream improvement and rural to urban migration. Nevertheless, increase in the number of urban floods has been observed in recent years. This is mainly driven by destruction of natural vegetation, unplanned urbanization, settlements in river and flood beds. Economic loss and casualties resulted from urban floods are also increasing significantly (Box 6.4).

Box 6.4. Threat of Increased Urban Floods

Recent floods in large cities in Turkey demonstrated a growing frequency, severity and impact and ranked in number two among natural disasters in the country. Some of news on the newspaper are as follows:

Flood disaster in Istanbul: 31 dead. "The disaster that occured in Trakya and caused 7 deaths, hit Istanbul today. This is the first time Marmara region has experienced such a large disaster since the 17 August earthquake. Thirty-one people died in two days and it stopped access to airport." (Hurriyet newspaper news dated 9 September 2009)

The damage of the last flood will cost more than 150 Billion dollars: A flood disaster on 9 September 2009 had a marked influenced on the insurance sector which has experienced a rough time because of the economic crisis. The insurance sector paid nearly 140 billion dollars for floods over last two decades. The estimated cost of recent flood disaster is supposed to be more than 150 billion for the insurance sector. Therefore, insurance agents are claiming that they are facing a flood disaster which has the highest cost. Insurance agents have been raising alarm on the damage of loss of life and property that is being increasingly caused by floods. (Hurriyet newspaper news dated 14 September 2009)

ADAPTATION MEASURES

Regarding flood management, within the scope of the "The Year 2010 Flood Safety Campaign" of former MFE several studies have been conducted by SHW, SMS, GDF and General Directorate of Afforestation (GDA) to enhance the institutional capacity of Turkey and the region regarding disaster management. Some of these activities include:

- The 2012-2014 European Commission Project on 2007/60/EC Directive on Assessment and Management of Flood Risks;
- Improving 473 flood protection facilities, built since 2007, to service and protecting nearly 41,000 hectares from flood damage.

Some of the activities regarding meteorological observations include:

- EUMETNET METEOALARM Early Warning System Integration Study of ITU Meteorological engineering and SMS, January 2011;
- The standardization of Meteorological Observation Systems and Early Warning Systems 2006-2013;

44 GDDW, 2008.

- The establishment of Meteorological Radar Net (purchasing of 6+1 radar), 2006-2013;
- The establishment of Marine Meteorology Systems, 2006-2013;
- Purchasing of AWOS for airports, 2007-2015;
- Enhancement of meteorological and hydrological disaster warning systems, 2010-2015;
- Selection of SMS as Regional Center for Black Sea and Middle East Flush Flood Early Warning System by World Meteorological Organization (WMO) in 2010.

Some of the activities regarding forest protection include:

- The establishment of the forest fire management system[45];
- The restoration of burned areas and fire-resilient forest project[46];
- The adaptation of forestry policies to climate change in Middle East and North Africa (MENA) region project (2010-2014)[47]; and
- The forestation and reclamation of damaged areas in 2.3 million hectares by 2012 as a part of forestation campaign started for flood management in 2008.

Box 6.5 GAPSEL: Both a Technical and Community Based Project on Flood Risk Mitigation.

In the GAP region, on hot days with heavy rain, flash floods causing loss of life and property occur. Therefore social and economic values such as developing settlements, infrastructure and industrial plants, agriculture and tourism etc., are under the risk of increasing floods. Heavy rain and floods that occurred in the past have had a negative effect on the region in terms of social, environmental and economic impacts. For instance, as a result of the flood that occurred in 2006, 42 people died and hundreds of people were socially and economically affected by the damaged infrastructure and farm lands. Therefore, a program was prioritized to enhance the flood risk mitigation capacity of local public intuitions and NGOs to eliminate the negative impacts of floods and to provide long term solutions. Various studies have been conducted in these two components as "Social Support and Physical Planning/investment Grant Programme" and capacity enhancement to accomplish these objectives within the scope of GAPSEL project which was conducted from December 2008 to April 2010 . The grant projects included municipalities, local public institutions and NGOs as well.

The GAPSEL project covers six cities, which were most affected by the flood, like Batman, Diyarbakır, Mardin, Siirt, Şanlıurfa and Şırnak. Technical support was provided for Adıyaman, Gaziantep and Kilis. As a part of this study 21 projects, valued at Euro 2.2 billion, were conducted for building a disaster resilient community, enhancing the institutional disaster management capacity, basic first aid, basic healthcare, safe maternity, psycho-social post-flood trauma support and vocational training and skills development directed to flood victims. Furthermore, 16 physical projects, valued at Euro 12 million, were carried out to provide stream improvement, infrastructure strengthening (canalization and rainwater drainage) and to establish disaster coordination centres.

With this project, studies were carried out in line with the European Commission Directive on Floods (2007/60/EC) for the first time and a guidebook for Flood Risk Management Planning has been prepared as a requirement of the directive. Both the social and physical infrastructure precautions to eliminate risks were examined together, the first and overall step was taken to enhance the coordination in and between institutions, to expand the institutional capacity and to establish a community based structure by providing awareness raising activities for the public.

Source: /www.gapsel.org/index.php, July, 2011.

Regarding agricultural drought, Agricultural Drought Management Strategy and Action Plan of Turkey (2008-2012) was implemented by MFAL. Drought Test Centre was put into operation by TAGEM of MFAL on December 4, 2010.

45 http://yanginyonetimi.ogm.gov.tr/
46 www.yardop.ogm.gov.tr
47 http://web.ogm.gov.tr/diger/mena/Sayfalar/default.aspx

As a part of the MDG-F 1680 Joint Programme on Enhancing the Capacity of Turkey to Adapt to Climate Change, the FAO cooperated with other UN teams and state institutions to strengthen staff capacity to deal with climate change problems in the agriculture, forest, livestock and fishing sectors. In this regard, climate change studies that examined responses to disasters were conducted at relevant departments, NGOs and universities to reinforce and enhance national and regional institutions in their efforts to systematically collect climate data and transmit them to end users via early warning systems.

Regional Cooperation Project on Disaster Risk Reduction in South East Europe is a project developed by the WMO Development and Regional Activities Department and supported by WMO-UNDP to mitigate hydro-meteorological disaster damages and to improve regional cooperation. In this project, in addition to SMS, SHW and DEMP, Balkan states have been "beneficiary institutions." The second phase of the project is planned to be conducted between 2011 and 2013.

As part of the Preparation of Turkey's Second National Communication Project that is funded by GEF, a preliminary assessment for Climate Risk Management in Turkey was conducted in 2012. Climate risk management is a holistic approach that integrates climate change adaptation and disaster risk reduction. In this study, assessment of current situation regarding the climate risk management in Turkey was performed.[48]

Table 6.7 Potential Impact of Climate Change on Natural Disasters and Adaptation Measures

Vulnerability	Adaptation Measures
Increase in the frequency, severity and impact duration of hydro-meteorological disasters	Measures applicable to drought and flood fighting, forest protection, climate resilience agriculture and water management,
Livelihoods, social and economic values are more exposed to disasters in unplanned and risky settlements.	
Increase in city floods due to heavy rainfall	
Increase in environmental and climate migration and immigration	
Increase in dried trees, forest pests and fires	
Due to the increasing thunderstorms, plant production is being exposed to hail damage.	Activities on disaster risk reduction and disaster management
Negative influence on agriculture, forestry, insurance, energy and water sectors	
Local and national socio-economic development	

6.2.4. Ecosystem Services

6.2.4.1. Inland Aquatic Ecosystem

There are 25 river basins in Turkey spanning geographic and climatic regions. This results in a wide variety of different aquatic ecosystems with rich biodiversity. Within these rivers basins there are around 200 natural lakes, 75 lagoons and 700 ponds[49] covering an overall surface areas of 10,000 km^2. Future precipitation and temperature are anticipated to affect the hydrology of these inland waters.[50]

Inland aquatic ecosystems located in the Mediterranean basin are among the most severely impacted ecosystems by human use and climate change. Several model scenarios anticipate a more than 30% drop in precipitation in summer in the Mediterranean basins.[51] This is expected to have a strong impact on the flow of rivers and water level fluctuations of lakes especially in the Eastern Mediterranean.[52] A resulting drop in water flow rate of rivers is anticipated by several models especially at a 3°C increase in temperature.[53] Furthermore, water temperature rise in inland

48 http://www.undp.org.tr/Gozlem2.aspx?WebSayfaNo=2708
49 Kazancı et al., 2007
50 IPPC, 2007
51 EU-FP7, Scene Project
52 Solomon et al., 2007
53 Scholze et al., 2006

aquatic ecosystems is also anticipated. Such changes in inland aquatic ecosystems are expected to lead to cyanobacteria blooms associated with a drop in dissolved oxygen concentrations in water, and may trigger fish kills.[54]

With more than 41% of terrestrial ecosystems in Turkey having been converted to agricultural land, natural ecosystem are heavily threatened and climate change effects must be considered alongside existing land use impacts.[55] Land use, especially agriculture with irrigated crop farming, is the main factor affecting water quality and quantity.[56] Indeed, waste water discharge and drainage water from agriculture and introduction of exotic species are the main sources of eutrophication (nutrient enrichment) and degradation of food web.[57] Turkey experienced a 50% lost in biodiversity during the period of 1970-2000 due in large part to these threats.[58] Most of this loss of species diversity took placed in the semi-dry Mediterranean climatic regions.

Precipitation decreased by 20% in the last 25 year within whole Mediterranean region. In the Mediterranean Basin, global climate change is anticipated to lead to enhanced drought that may result in water shortage and consequently a major reduction in agricultural crop yield, loss in tourism profits, major forest fires, and loss of biodiversity.[59] In addition to water quantity loss due to irrigated crop farming, there is also a great threat of quality loss mainly due to poor sewage treatment systems in big cities and town and to intensive fertilizer use from farming. [60] Such nutrient enrichment has already led to eutrophication of lakes resulting in large algal blooms and fish kills.[60]

CHANGES IN LAKE ECOSYSTEMS

Lake ecosystem dynamics and the response to impacts from outside are complex and do not occur in linear fashion.[62] Inland freshwater ecosystems are under the threat particularly due to land use practices, making it difficult to isolate the effect of climate change. Thus several different approaches needed to be employed to enhance spatial and temporal resolution for pinning down the individual effects of different threats mentioned above (such as, space for time substitute, long term monitoring, in situ experiments, modelling, paleoecology etc.).

About %95 of the world lakes by number are small and shallow[63] same is the case for Turkey as well though Turkish shallow lakes have large surface area (Lakes Beysehir, Marmara, Işıklı, Uluabat vb.). For shallow lakes located in the semi dry Mediterranean climatic region, hydrological changes have critical effects that have been depended on climate. Thus hydrology is critical for effecting shallow lakes ecosystem structure, function and biodiversity.[64]

Although hydrological changes are considered to be local events, they are affected by regional and global scale climate patterns such as the North Atlantic Oscillation (NAO), which affects precipitation and temperature in America, Europe, Middle East and North Africa.[65]

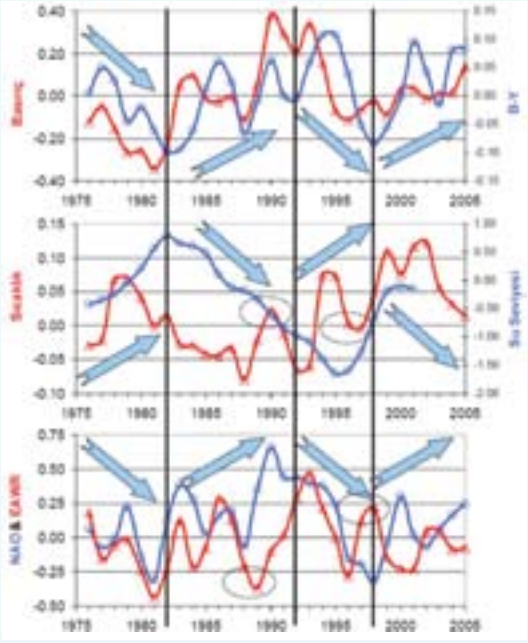
There are two basic studies that have focused on determining the effect of the NAO on Turkish lakes water levels (one of which has been given in detail in Box 6.6). Kücük et al.[66] found significant effect of the NAO on the three of out of seven the lakes (Lakes Tuz, İznik and Uluabat). They attributed the lack of correlation in the other lakes to overriding effect of anthropogenic effects such irrigation (Kücük et al., 2009).

It has been anticipated that there will be salinity rise in the southern Europe through drought and enhanced evaporations (IPCC, 2007). In freshwaters dissociated ions concentrations are less (1 mg L^{-1}) compared to the sea (36 mg L^{-1}).[67] Drought that has been experienced consecuaateve years in the Central Anatolia has triggered rise salinity or conductivity. Such as two of lakes which are part of the same catchment, which have been monitored for over a decade showed the drought induced rise in salinity (Box 6.7).[68] Another lake from Aegean region of Turkey, in Lake Bafa salinity increased from %o 6 to %o 12 as a response to less freshwater input in the lake and increased evaporation (Kazancı & Dügel, 2009).

54 Hammond & Pryce, 2007.
55 age.
56 Doll et al. 2009.
57 Dudgeon et al., 2006.
58 Dudgeon et al., 2006; Doll et al. 2009).
59 WWF, 2010.
60 Beklioğlu et al. 2007; Beklioğlu & Tan, 2008; Hadjikakou & et al. 2011.
61 Sensu Millennium Assessment, 2005.
62 Moss, 2010.
63 Williamson et al. 2009.
64 Beklioğlu & Özen, 2007; Beklioğlu & Özen, 2009.
65 Wanner ve diğerleri, 2001.
66 Kücük ve diğerleri, 2009.
68 Beklioglu & Tan 2008; Beklioglu & Özen, 2008, Beklioğlu et al. unpublished data.
67 Moss, 2010.

Box 6.6. NAO Impact on Lake Hydrology

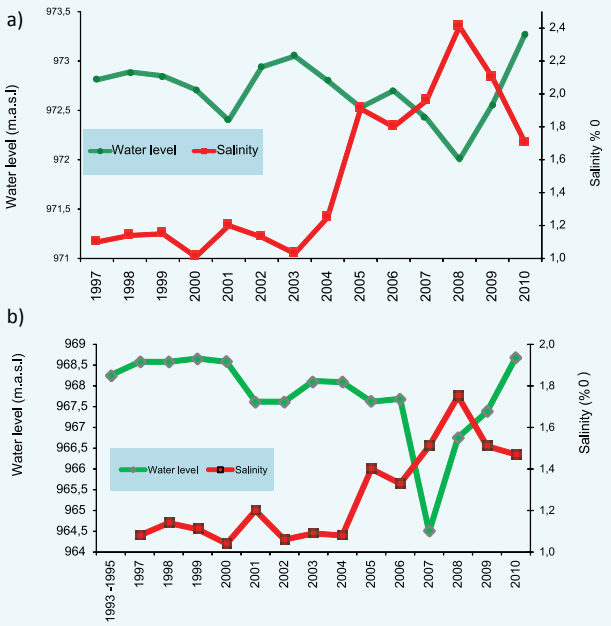
Long term hydrological and meterological data for eleven lakes spanning over 4 degrees of latitude and 15 degrees of longitudes (İznik, Uluabat, Manyas, Eymir, Mogan, Beyşehir, Eğirdir, Burdur, Işıklı, Marmara ve Tuz Göllerine) were analyzed in-depth through research project. For each lake, changes in air temperature, lake level, and evaporation minus precipitation patterns with NAO and East Atlantic West Russia (EAWR) were explored. When NAO is experienced in negative phases, lakes water level and air temperature increased and evaporation-precipitaion became small.



P_P: Pressure, Evaporation, Precipitation
Source: Kerimoğlu et al. 2006)

Box 6.7. In Lakes Mogan (a) and Eymir (b), drought induced salinization

Long term monitoring of Lakes Eymir and Mogan has shown a regular drop in water level and consequent increase in hydraulic residence time since 2002. Such changes have triggered about a 2-2.5 fold increase in water salinity. Even a short period of drought triggers a several fold increase in salinity. Through global climate change, more intensive drought conditions will lead to salinization and a large problem for inland freshwater lakes.



Lakes Mogan (a) and Eymir (b), drought induced salinization.

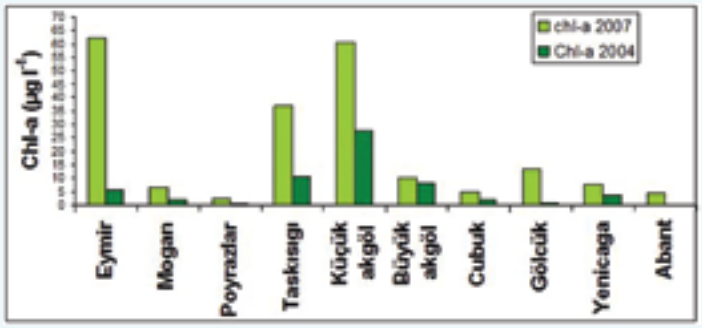
In southern Europe and the Eastern Mediterranean increased temperature and decreased precipitation are expected to result in lower nutrients inputs to lakes due to climate change. However, the opposite of this, increase in in-lake nutrient concentrations, has been experienced. Water and nutrients (Dissolved Inorganic Nitrogen-DIN and Total Phosphorous-TP) budgets constructed for over a decade periods for two of Anatolian Lakes Mogan and Eymir revealed that long hydraulic residence time initiated through drought periods led to a large increase in in-lake TP and DIN concentrations despite the fact there was little to no nutrient input into the lakes during the drought period.[69] Thus the in-lake nutrients concentrations increased through in-lake mechanisms such as sediment loading and a more concentrated presence of nutrients due to low volume.

69 Özen et al. 2010, Jeppesen et al. 2009; 2011; Beklioğlu & Özen, 2009.

Drought induced increase in in-lake nutrient concentrations triggered fast eutrophication with heavy cyanobacteria blooms (Box 6.8). Turkish lakes suffer from salinization and eutrophication with heavy toxic cyanobacteri blooms during the drought periods. Such changes are anticipated to be even more severe through the impacts of global climate change.[70]

Box 6.8 Drought and Toxic Cyanobacteria Blooms

2007 was the driest year since metorological records have been taken. Lakes that were sampled during 2007 had a several fold increase in primary production especially in terms of cyanobacteria bloom compared to a hydrological regular year, such as 2004, when the same lakes had much lower production. Thus drought can enhance eutrophication with a several fold increase in algal production.



Chlorphyll-a concentration of some the lakes sampled in 2004 and t 2007 at Sakarya, Bolu and Ankara provinces. 2004 data from Balık et al. 2004, 2007 data from Beklioğlu et al. unpublished data.
Photo: M. Beklioğlu Küçük Akgöl, 2007

While long-term studies provide high temporal resolution, spatial resolution has been weak. Such weakness is a critical gap in our understanding of impacts of lakes. Features, such as lake morphology and geology can have critical impacts on the ecology. Spatial resolution can be achieved through snap-shot sampling along a latitudinal gradient through a "space for time substitute." As the temperature increases from the equator northward, several lakes can be sampled using the same methodology. The differences among lakes is then presumed to be due to climate differences. This approach can enhance spatial resolution and can allow us to understand the possible effects of climate change.

Such an approach has been used in two nationally funded projects that included 32 shallow lakes and an additional 25 lakes, spanning over 5 degrees of latitude. These projects were funded by TUBITAK and Middle East Technical University Research Funds. The results show that the lakes located in the southern latitudes are 2-3°C warmer than that of the northern ones. In addition, southern lakes had more nutrients (TP, TN), phytoplankton and chlorophyll-a concentrations. Large contribution of toxic cyanobacteria in the southern lakes led to low water clarity and loss of aquatic plants.[71] Additionally, in southern lakes, there are more cyprinid fish, especially in small lakes. Thus, southern lakes are more eutrophic and saline. Consequently the southern shallow lakes provide a model for northern lakes under a future experiencing similar degree of warming through global climate change (Beklioğlu et al., nd). See Figure 6.15 for summary of these changes.

Aquatic plants in shallow lakes provide critical services and goods such as fish nurseries, filtering of water, storing of carbon, denitrification, etc. A recenty study based on an in-situ mesocosms experiment provided evidence that the negative impacts of increase nutrient loading on aquatic plant growth was overridden by a major water level drop in the summer in Turkish lakes (Özkan et al. 2010).

70 IPCC, 2007.
71 Beklioğlu et al., under publication.

Climate change triggered salinization and eutrophication is expected to lead to loss of biodiversity. Twelve lakes located in the north[72] demonstrated higher plankton and invertebrate fauna compared with the another set of lakes[73] located in the southern part of Turkey.[74] Invasive fish species are being found in coastal lagoons and from here they are expected to move inwards (Beklioğlu et al., 2010). Thus global climate change is expected to result in a drop in native biodiversity and an increase in invasive species.

An EU-FP-7 funded consortium project called REFRESH (2010-14) will produce more comprehensive and reliable data on how climate change will affect shallow lakes in Turkey through connecting land use and dynamic ecosystem modelling in Lake Beyşehir. This in situ mesocosms experiment on a latitudinal gradient from Sweden to Turkey and further detailed paleolimnological research will provide useful insights.

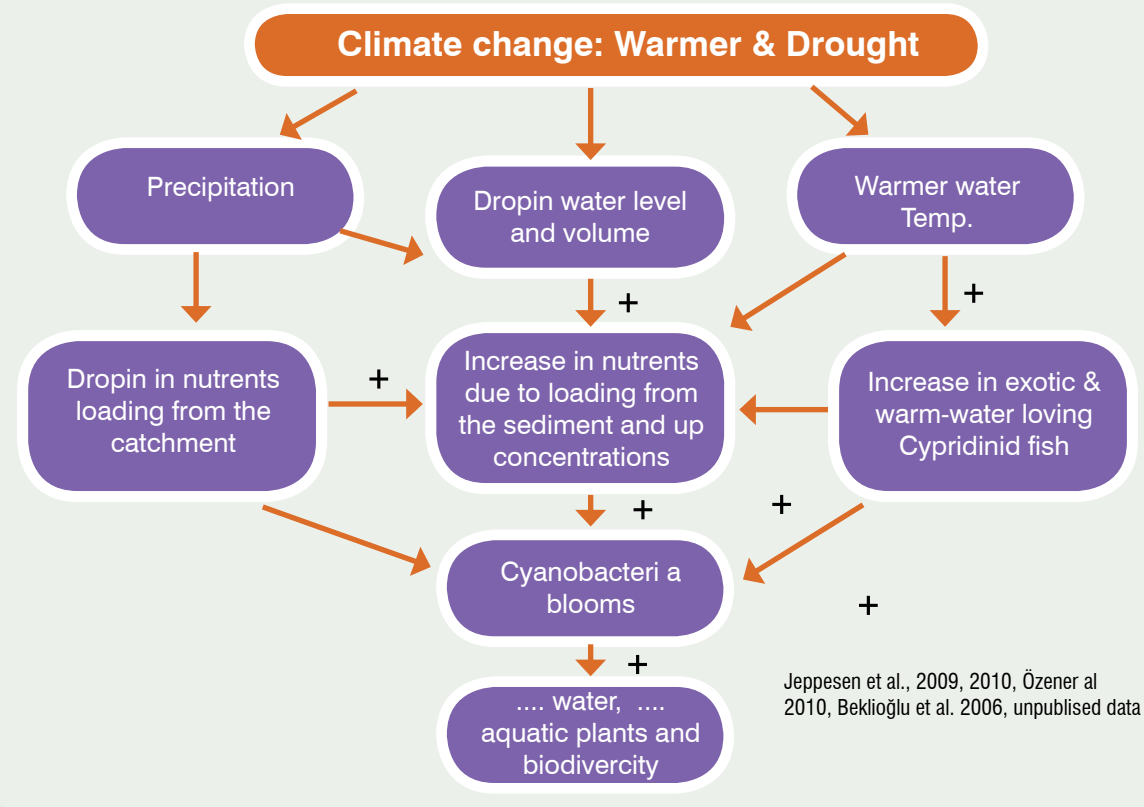
CHANGES IN RIVERS

Rivers will be directly affected by elevated temperature and changes in precipitation regimes induced through the global climate change. Increase in air temperature directly increases water temperature. In European rivers over last 100 years, a 1–3°C increase in water temperature has been observed.[75]

Observational Changes

In Turkey, a study by Berkant & Evrendilek[76] examined the physical and hydrological properties of 38 rivers and tributaries spanning 25 river basins for the period 1995-2000. They found that there was about a 4m3s^{-1} decrease in discharge rate and water temperature increased by about 0.2°C. In another study covering the Tigris and Euphrates Rivers, it was found that the NAO directly affects the flow rate of the rivers.[77] Odemiş & Evrendilek[78] also found a major drop in water discharge rate and a rise in water temperature (0.05°C yr^{-1}) and pH in a study spanning 25 river basins with 96 sites during the period of 1970-2002. Such results from Turkish rivers are in accordance with expectations based on the climate change scenarios for the region.

Figure 6.15. A Scheme for Summarising the Impact of Climate Change in Lake Ecosystems



72 Balık et al., 2004.
73 Kazancı et al., 2001.
74 Kerimoğlu et al., 2007.
75 EEA, 2007.
76 Berkant & Evrendilek, 2007.
77 Cullen ve deMenocal, 2000.
78 Ödemiş ve Evrendilek, 2008.

Anticipated Changes

A modeling study on Yeşilırmak River investigated the effects of land use and global warming on changes in nitrogen concentration.[79] They found that the highest N concentrations will be 7.5 mg N/l for the period of 2069-2098. They concluded that such increase in nitrate will originate from land use and will be related to global climate change.

For river ecosystems, water discharge rate is critical and will affect the concentrations of dissolved nutrients, habitat structure, primary productivity and the food web structure. Such a deterioration of physical and chemical conditions may lead to major drop in invertebrate fauna. The major impact would be on the fish fauna, and these conditions would lead to disappearance of salmonoid and cold water fish. The niche opened up from such a disappearance of fish would quickly be filled by exotic fish species.

ADAPTATION MEASURES

Inland freshwater ecosystems have already been facing water quality and quantity problems resulting from lands use, especially agriculture. Reduction of such problems will increase adaptive capacity to climate change.

Cyprinid fish (e.g. carp, bream etc.) stir up bottom sediment, and increase internal phosphorus loading and water turbidity. As a result, these fish trigger eutrophication. Adjustment of the fish community to enhance top-down control on primary production and destruction of eutrophic conditions has been referred as biomanipulation. In one example 50% of cyprinids were removed from Lake Eymir, Ankara, which triggered a great increase in water clarity and major reduction of in-lake nutrient concentrations especially during dry periods.[80] Biomanipulation can be a reliable mitigation measure for adapting to the impacts of climate change.

Table 6.8. Impact of Climate Change on Inland Freshwater Ecosystems and Adaptation Measures

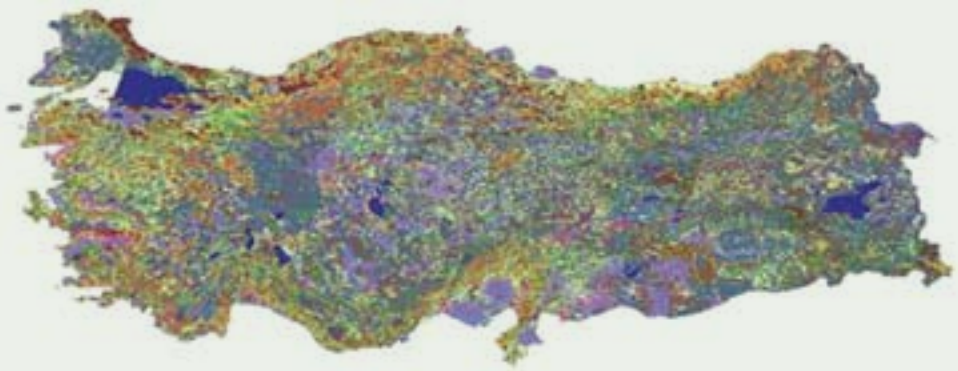
Vulnerability	Adaptation Measures to Reduce Vulnerability
Salinization	• Major reduction in irrigation water use through implementing efficient systems; • Abandon irrigated crop farming especially in catchments where evaporation exceeds precipitation; • In water engineering projects, the ecosystem needs for maintaining ecosystem services and goods should be taken into account
Eutrophication (nutrient enrichment with cyanocabteria blooms)	• Stringent waste water treatment in water catchments; • Maintaining or restoring riparian wetlands especially around crop and animal farming to act as buffer for draining nutrients; • Follow the requirements of the EU WFD (2000), Nitrate Directive etc; and • Prevent the introduction of cyprinids to inland water bodies e.g. lakes and biomanipulation of fish from the water bodies.
Biodiversity Loss	• Prevent salinization and eutrophication; • Prevent exotic and invasive species movement.

6.2.4.2. Terrestrial Ecosystems

According to studies conducted by APDGD under the scope of Coordination of Information on Environment (CORINE) EU Project and based on images from 2000, natural meadows and pastures cover 28% of Turkey, while cultivated lands constitutes 36% the country's landmass. Forests, heathers and thickets cover 30.2%, and wetlands composed of peats and marshes cover 0.3% (Figure 6.16).

[79] Hadjikakou ve diğerleri, 2011.
[80] Beklioglu et al., 2003; Beklioğlu & Tan, 2008.

Figure 6.16 Distribution of Land Uses across the Country



Source: TÜGEM 2008

Turkey's Terrestrial Ecosystems

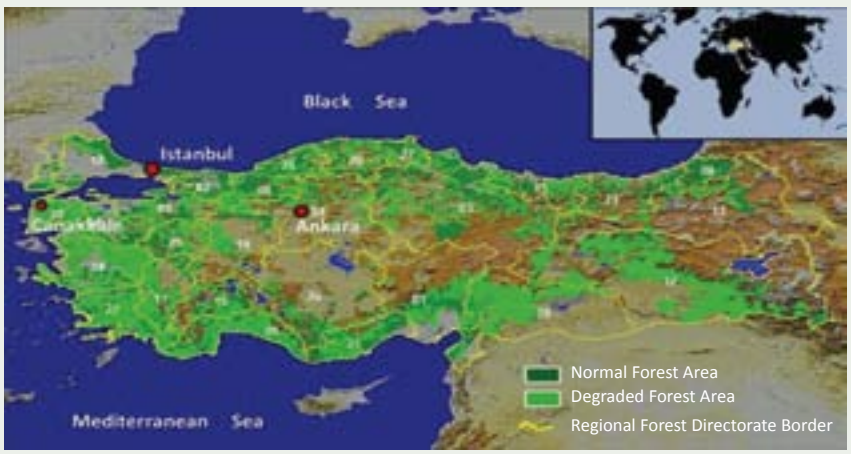
Natural Meadow and Pasture Ecosystems

In terms of sensitivity to climate change, there are two different categories of terrestrial ecosystem in Turkey namely, natural pasture and grasslands and natural steppe and alpine zone pastures. All meadow areas located above 2,200m altitude and at higher altitudes than the natural forest border are called alpine zone pastures. Although the rain amount in the Alpine zone is sufficient for forest growth, the temperature is to lower (less than 10^{o}C) that that is required for forest ecosystems. This suggests that a large part of these high altitude pastures located in Central and Eastern Anatolia and included in cold-dry and cold-moisturized areas in the climatic map may become forest ecosystems if average temperature increases. Transformation of natural steppes, which locates mainly in hot-dry climate regions and lower altitudes, to forest is only possible with increase in precipitation. However, other factors that effect these transformations are suitable soil dept that supports tall bush and tree roots.

Forest Ecosystems

Different combinations of rain and moisture factors lead to the emergence of forest ecosystems with different structures and formation. There are eight forest ecosystems types in Turkey regarding the climate, topography, forest types and forest distributions. The distribution of forests in Turkey across the entire country is shown in Figure 6.17.

Figure 6.17. Distribution of Forests Types in Turkey



Source: GDF, 2006

Turkey's Forests and Their Change through Time

According to 2009 forest inventory data, forest cover 21.39 million ha in Turkey. The wealth of planted trees on those areas is 1.37 billion m^3 with annual increment of 38 m^3 million.[81] In the first national forest inventory in Turkey in 1972 those values were respectively 20.2 million ha; 976 million m^3 and 30 million m^3.[82] The growth of Turkey's forest estate over this time period of 37 years is provided in Table 6.9

Table 6.9 Change of Turkey's Forest Estate between 1972 and 2009

Forest Estate	1972	2009	Difference of 37 Years	
			Numerical	Percent Change (%)
Area (million ha)	20.2	21.39	1.190	5.89
Tree Wealth (billion m^3)	0.976	1.374	0.398	40.78
Volume Increase (million m^3)	30.04	38.45	8.415	28.01

This increase in the forest estate has been reflected in the carbon stocks that have accumulated in Turkey forests, which was 12.02 Mton in 1990 and increased to 15.64 Mton in 2009. Respective CO_2 sinks increased from 44.08 Mton to 57.36 Mton.[83]

Wetland (Marshland and Peatland) Ecosystems

Wetlands make up the richest and the most productive ecosystems of the world. These areas are quite complex natural systems that provide a wide range of services for people of the country. They have functions and values that are not comparable with any other ecosystems. Turkey has among the richest diversity of watery areas of Europe and the Middle East. Turkey's different topographic structures and the fact that two of the four significant bird migration routes in the West Palearctic region pass over Turkey make the wetlands of Turkey particularly significant.

This section focuses on peatland ecosystems. In a research, peatlands were classified into five groups on the basis of their dominant plant cover types namely: Sphagnum peats (in shallow holes in high mountainous lands); broad leaved moss peats (in Antalya, Beydağları and Bolu Aladağ); reedy lands (in İğneada Kocagöl, Yeniçağa and Abant Lakes, Muğla Gökova); scrubby peatlands (Kırklareli Limanköy); and forest peatlands (Tarsus Karabucak marsh, İgneada Erikligöl swamp).[84]

Çolak and Günay (2011) state that peatland and peatland like formations in Turkey covered approximately 22,000 ha up to recent times but these areas are gradually decreasing in many places due to increased agricultural fields, the use of peat as fuel and as a result of peat production activities. It is reported that the amount of real "living peat" in Turkey decreased by approximately 2,000-3,000 ha.[85]

EXPECTED IMPACTS AND VULNERABILITY

If species are not well-suited to particular ecosystems or if there is any change in the existing circumstances, the species migrate, disappear or adapt to the environment (mutation). Phenological observations from around the world suggest that plant compositions are changing and some species are becoming locally extinct. For example, in Europe it has been observed that numerous plant species have moved northward during the last 30 years and this movement is closely related to temperature increases.[86] Similarly, the frequency of plant species that require

81 GDF, 2011.
82 ASAN, 2011.
83 GDF, 2011.
84 Kantarcı, 2005.
85 Çolak ve Günay, 2011.
86 Parmesan ve Yohe, 2003.

high temperatures in inner regions of countries including Netherlands, England and Norway have increased dramatically over the past 30 years, and trees and scrubs in tundra have increased.

Research suggests that there will be a change in composition of 1/3 of global forests by 2050 due to climate change. Climate change is expected to affect ideal conditions for tree species and their growth season. The reactions of plants to climate changes will vary. Certain tree species tend to grow better depending on rain and relative moisture, while the reaction of other species may be negative.

Temperature, rain and surface flow projections for Turkey is discussed in Chapter 6.1. Considering the changes in the climatic parameters, one may expect the following impacts to emerge:

- Depending on the increase in temperature and rain in the sections of North Anatolia overlooking the Black Sea, the proportion of species as beech, hornbeam, chestnut, elm, alder demanding high temperature and moisture in the forest zone with leaved trees under 1000m may change and the upper limit of this zone may increase to 1300m. Coniferous and leaved mixed zone that appear between 1000-1300m may increase to 1600m, and the mixed forests composed of coniferous trees may increase by 300m and the upper forest zone may reach 2700m. In the sections of mountain chains extending in parallel to Black Sea overlooking the south, the upper forest limit may increase to 2800m, while both and coniferous and leaved mixed forest zones may expand.
- The coniferous forest zone in Eastern Anatolia may enter the upper alpine pasture. The forest zone where oaks are located may climb higher. The moisture to be brought by the increasing rains may allow beech to enter in the mixture. And in the lower altitude steppe (approximately 1500m), hard leaved forest zones may be seen.
- While the hard leaved forest zone composed of maquis elements in the West and South Anatolia under sea influence will likely continue to exist, in the inner sections of Aegean Region, savanna and desert ecosystems may emerge depending on rain and moisture. Today the oak and chestnut forests of the Aegean Region may enter in the coniferous forests in the high regions in the inner sections, black pines and junipers may be over 2,000m.
- Pinus buritia starting from the maquis zone in the coasts of Mediterranean Region and low altitude steppe may expand in the region up to 1,300-1,500m, cedar and black pine forests may reach an altitude of 2,500m. Taurus fir (Abies cilicica) the current spread of which starts from 1,500m may begin to appear from 1,800m. As a matter of fact, as a result of a study performed in Seyhan Basin, it has been suggested that climate change will affect the steppes in the basin, deciduous and coniferous trees in middle mountainous area.[87] However, since temperatures may increase by 4.0°C with no change in rain, the lower forest limit in the zone of transition to the steppe in north hillsides of Taurus Mountains may go expand higher than its current altitude.
- While the steppe ecosystem of the Central Anatolia remains in the form of a narrow strip in places close to the forest limits in the north and in the south, the steppe areas covering broad areas today shall transform into desert ecosystems particularly in the broad area surrounding the Salk Lake. As noted in the INC, since regions of Central and Southeast Anatolia are arid lands, they will tend to become desert with loose and sensitive plant cover,[87] the phenomenon of desertification may be realized in those regions easily. However since an improvement shall be seen in the northern parts of Central Anatolia in the direction of semi-moisturized climatic conditions, one may expect that the existing forest limit may decline to the south, though minimally.
- A reduction may be observed in a great proportion of the watery areas in Central Aegean and Central Anatolia; and in relatively small proportion of the watery areas in Marmara and East Anatolia in the lake surface areas. Although this reduction is expected in surface areas due to evaporation from temperature increase, due to sea level rise, there may not be much change in the situations of deltas and lagoons in the coastal regions. However due to increased salinities and changing flora (plant cover), an absolute change in fauna and bird species may be observed.

87 MEF 2007.
88 MEF 2007.

- The intensity of nitrogen and phosphorous mixed in lakes from rivers feeding inner lakes may increase due to increasing aridity. The algae eruptions arising may disrupt the ecological balance in the inner lakes and may lead to a decrease of water plants, hunting fish and birds.[89]
- There may be increases in the number of forest fires in the Aegean, Mediterranean and Marmara Regions, and in the amount and severity of insects and fungus disasters. The area of the regions with sensitivity to forest fires may increase.

At present, there are 737 species of amphibians, birds, mammalians and reptiles in Turkey's terrestrial ecosystems. Three to five percent of these are endemic species to Turkey and six percent are under threat. Turkey has 8,650 plant species, of which 30.9% are endemic, but 0.7% are under protection based on the Red List categories of International Union for the Conservation of Nature (IUCN).[89] Undoubtedly, climate change will directly or indirectly affect fauna and flora and may cause some of them to disappear completely, particularly those that are currently threatened.

The Effects of Structural Changes in the Terrestrial Ecosystems on the Ecosystem Services

Structural changes in the terrestrial ecosystems from climate change may have "positive" or "negative" impacts, as follows. Some of the potential positive impacts are:

- The growth season is prolonged due to temperature increases, which will increase annual firewood production in the forest ecosystems.
- Both firewood and non-firewood products shall be diversified in the Black Sea coastal forest strip where rain and temperature increase together and biomass production per unit area may also increase. Biological diversity in Mounts Kaçkar and Küre on this strip shall be further enriched, particularly in terms of species and genetic diversity.
- Since the snow accumulation in those regions may become routine and if upper forest limits in upper basins of large rivers is likely to increase by 300-400m, the number of avalanches is likely to decrease. On the other hand, since melting of the snow under forests shall slow down, water circulation may become more regular, and the number and severity of flood and torrents may decrease. This situation may affect the natural balance in the riparian zones and the wildlife in coastal areas be affected .

And the potential negative effects are as follows:

1. Increasing forest fires and insect infestation may result in increased greenhouse gas emissions from forest ecosystems.
2. Since shrinkage or full drying in the watery areas may eliminate certain links in the food chain that shapes these ecosystems, migratory water birds may be negatively affected and perhaps change their migration patterns.
3. Wind erosion may appear in forested areas that transformed into steppe in the Central Anatolia. This situation may accelerate desertification particularly in regions where soil depth is insufficient for trees to take root and shall expose agricultural fields to freezing winds in the winter and drying winds in the summer. In addition, dust storms resulting from the steppes and lands becoming desert may make living conditions in the settlements more difficult.

ADAPTATION MEASURES

NCCAP and NCSD have taken actions related to forestry and these are presented in the Policies section of the Report. Some other adaptation measures are given in the following sections.

Turkish National Forestry Program (2004-2023)

The Turkish National Forestry Program started in 2004 and focused on contemporary understanding of protecting/using forest sources in a sustainable manner and developing international contracts to develop the forestry sector towards a vision for 2020. The document does not contain a policy or strategy in the context of climatic change and forestry. However, it is understood that the actions

89 MEF, 2007.
90 MEF, 2007.

and strategies in this report for expanding the forest areas, protecting biological diversity and contributing to the development of forest dependent villages should complement policies and actions for climate change as well.

Combating Desertification Turkish National Forestry Program

Combating Desertification Turkish National Forestry Program is related to basic issues, sectors interacting with desertification and aridity directly or indirectly and basic policies and strategies about their operation. This program addresses the natural resources affected by desertification and aridity (soil, water, plant cover, etc.), the existing situation of positive and negative developments arising from their management, and the measures to be taken in order to eliminate the negative impacts.[91] In the program document, there are: policies against desertification and aridity; provisions for protection and sustainability of forest areas and water resources; support for the forest dependent community development; increased awareness of climate change; use of renewable energy instead of fossil fuel; and encouragement of reforestation.

National Biological Diversity Strategy and Action Plan

This document prepared by the General Directorate of Nature Protection and National Park describes the policies and actions necessary to: fulfill responsibilities related to the UN Convention on Biological Diversity; realize conformity with the EU nature protection actions; and achieve protection and sustainable use targets. Climate change is provided in the Action Plan, as a single article and climate change is exclusively considered based on its effects on biological diversity.[92]

Forestation and Erosion Control Mobilization Action Plan 2008-2012

The Forestation and Erosion Control Mobilization Action Plan (2008-2012) was put into force with the Forestation Mobilization Communiqué of Prime Minister issued on 1 November 2007. Within the scope of the Plan, reforestation, erosion control and forest improvement works were undertaken in the period of 2008–2012 on 2.3 million hectares to provide employment for 150 thousand people annually for 6 months and to spend 540 million YTL/year.[93] This is a significant tool for decreasing greenhouse gases emission.

Institutional Structuring

According to the information provided in NNCAP, the institutions operating directly or indirectly in climate change, include MEU which functions as both national focal point of UNFCCC in Turkey and as the secretary of CBCC. The focal point for adaptation with climate change is the MFWW, SHW. The SHW has responsibilities focused mainly on soil and water resources and undertakes collaboration with the MFAL in coordination with MFWW on the issues of: a) water resources management; b) food and agriculture security; c) natural disaster risk management; d) basin management; and e) natural resources management.

When the issue is dealt in terms of ecosystem services, it is understood that all works performed by units associated to GDF for the purpose of increasing the resilience of forest ecosystems to climatic change should be assessed within the scope of adaptation. With a similar approach, the works of SMS seek to eliminate the ambiguities in climate change efforts, and the activities under the DEMP within the context of disaster risk and insurance are widely accepted to be related to adaptation. Similarly, soil and water research, work to increase the diversity and efficiency of vegetable, animal and water products and the activities to combat plant and animal diseases performed by institutions associated to MFAL are also related to climate change adaptation.[94]

91 MEF, 2005.
92 GDNCNP, 2007.
93 MEF, 2009.
94 MEF, 2011.

CONCLUSION

To summarize, one may broadly describe natural terrestrial ecosystems in Turkey as natural pasture and grassland, forests, and wetlands. Climate change affects these ecosystems differently according to their geographic locations. Some of these impacts are as follows: the upper limits of natural forests may increase up to 200-300m in altitude; desertification might impact flora and fauna in wetlands in Central Anatolia and Salt Lake. Sea level rise in coastal regions may change the fauna and flora in coastal areas. Climate change shall have both positive and negative impacts on the products and services of forests. While a prolonged growth period increases the amount of firewood; forest fires and drought shall increase the harms of insects and fungi. The policies stipulated and followed in the forestry sector in terms of adaptation to climate change may decrease greenhouse gas emissions, as well.

6.2.4.3. Marine Ecosystems

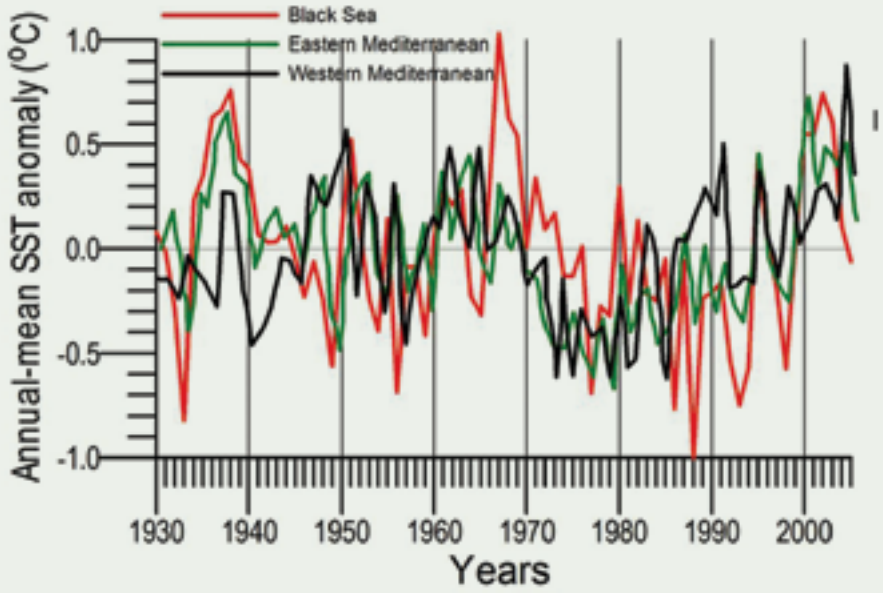
The seas surrounding Turkey, has diverse ecosystems including non-productive Eastern Mediterranean, productive Aegean Sea, productive but over polluted Marmara Sea and Black Sea ecosystems. To distinguish impact of climate change on these seas from impacts of environmental pollution, over-fishing and invasive species is difficult. On th other hand, factors such as influence of these external parameters, differences in bottom topography and shore geography, current and hydrographic changes in time make it more difficult to estimate impact of climate change quantitatively. Besides all these challenges, assessment of climate change impacts requires data from long term and systematic observations are costly and require strategic planning. Despite the lack of accurate information regarding the impact of climate change on sea ecosystem, it is anticipated that change in species diversity, ecosystem dynamics, production and physiology; increase in alien invasive species and taking control of systems; increase in vulnerabilities of systems might occur in seas surrounding Turkey in sea ecosystem.

EXPECTED IMPACTS AND VULNERABILITY

Observed Physical Changes

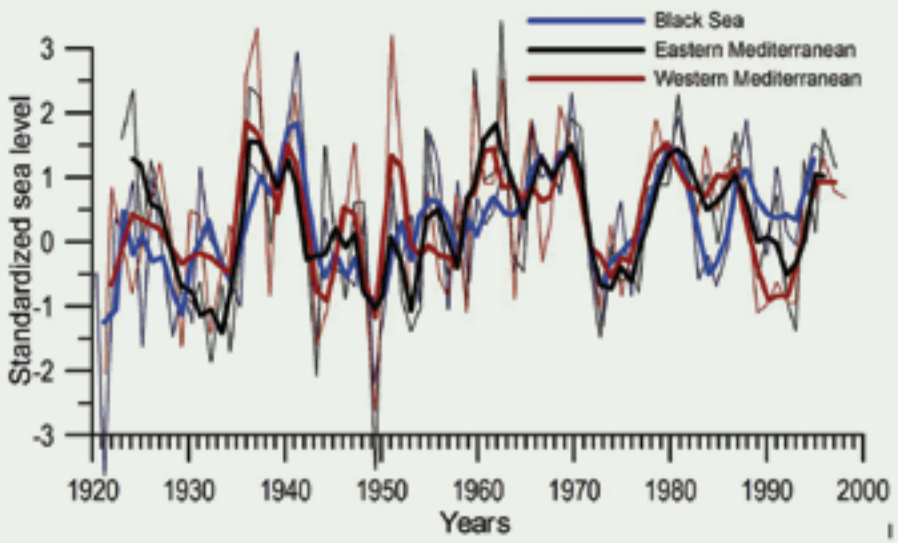
Temperature: Annual mean sea surface temperature (SST) anomalies of Black Sea and Eastern and Western Mediterranean follow a complex pattern of similarity and dissimilarities (Figure 6.18). They undergo a rapid cooling from the mid-1960s to the begining of 1980s, after which the Western Mediterranean SST switches to a warming mode whereas the Black Sea continues to cool until 1993 and then switches to the warming mode. The Eastern Mediterranean SST changes lie in between and represent a weak warming in the 1980s followed by stronger warming in the 1990s. A common characteristic of all three time series is the reduction of temperature during 1992-1993 that is also observed in the global SST time series. This reduction is evidently related to the global cooling induced by the eruption of Mount Pinotubo in the Philippines during June 1991 (Soden et al., 2002). As documented by satellite measurements, peak global cooling of approximately 0.5°C in the lower troposphere was attained nearly 18 months after the eruption that then gradually approached to pre-Pinatubo levels in 1995.

Figure 6.18. Time Series of Annual Mean SST Anomaly for the Eastern and Western Mediterranean and Black Seas



Sea Level: Based on an examination of 12 tide gauge records around the Black Sea for 1923–1999, sea level rise varies between a minimum of 2.0 mm yr^{-1} and a maximum of about 4.0 mm yr^{-1} over the time period (Mikhailov and Mikhailova, 2008) (Figure 6.19). Satellite-based altimeter data reveals a higher rate of about 7.5 mm yr^{-1} during 1993-2007. This is slightly higher than the global average rise of 1.8 mm yr^{-1}, 1.7 mm yr^{-1} in the Atlantic Ocean and 1.1-1.3 mm yr^{-1} in the Mediterranean from 1961 to 2003. Furthermore, subdecadal-to-decadal fluctuations of the detrended and standardized annual-mean sea level time series for the Black Sea agree fairly well with those of the Eastern and Western Mediterranean Seas although the Black Sea and the Mediterranean Sea have opposite hydrological balances.

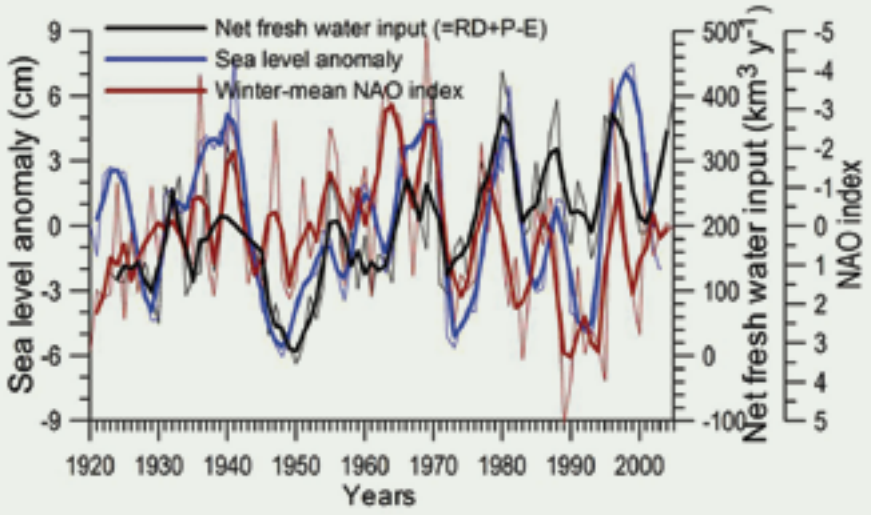
Figure 6.19. Detrended and Standardized Annual-Mean Sea Level Time Series for the Black Sea, Eastern and Western Mediterranean Seas



Source: Tsimplis and Josey, 2001

Net Freshwater Input: Temporal changes of net freshwater input into the Black Sea (river inflow plus precipitation minus evaporation) indicate a net long-term positive trend consistent with the sea level changes (Figure 6.20). The positive trend is based on increasing river discharge as well as increasing precipitation and decreasing evaporation rates. Periods with low freshwater input generally correspond to those of relatively low sea level, which also coincide with relatively low sea surface temperature.

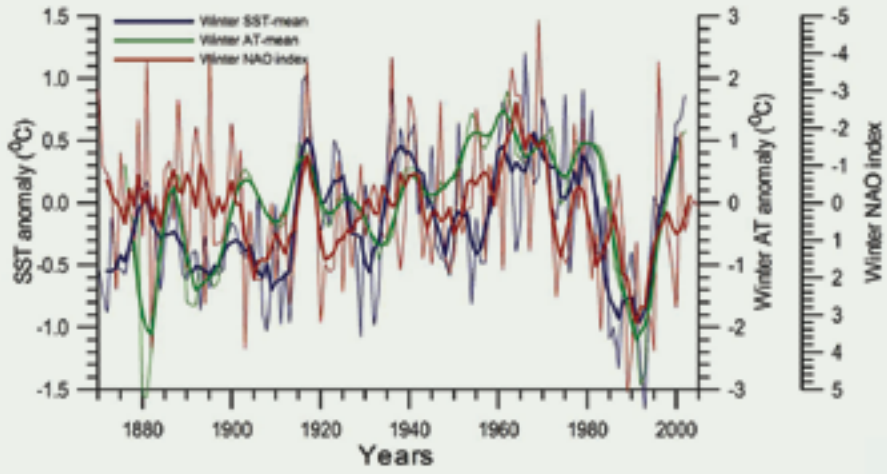
Figure 6.20. Time Series of the Detrended Annual-Mean Sea Level Anomaly, Net Freshwater Input into the Black Sea, and the Winter Mean North Atlantic Oscillation Index



Link between observed changes and climate

High and significant correlation between the basin-averaged winter-mean SST and the winter-mean air temperature anomaly and the NAO index provides compelling evidence for regulation of the regional hydro-meteorological conditions by large scale climatic teleconnection patterns (Figure 6.21). For example, long-term (1910-1970) warming trend coincides with declining NAO index values toward more negative values whereas the subsequent cooling up to the mid-1990s is related to strengthening of the NAO toward its more positive phase. Therefore, more positive NAO values imply colder, drier and more severe winters in the Black Sea.[95]

Figure 6.21. Time series of the basin-averaged winter mean sea surface and air temperatures in Black Sea, and the winter mean North Atlantic Oscillation index



[95] Oğuz et al., 2006

Biogeochemical impacts and effects on biodiversity

Turning Mediterranean toward a tropical system is the major sign of impact of climate change on Eastern Mediterranean and Black Sea. Warming in Mediterranean especially since the late 1990s, result in spread of fauna coming from tropical regions towards the Mediterranean Sea through the Strait of Gibraltar, the Suez Canal and led to important differences in species diversity.[96] Similarly, species intrusion to Black Sea from Mediterranean result in change in Black Sea ecosystem. [97] In addition to change in biodiversity as a result of climate change, climate change also result in change in the biogeochemical parameters.[98]

For example, Bacilariophycae abundance (i.e. mostly diatoms) in the western coastal waters of Black Sea closely follows temperature variations (Figure 6.22). It persists with a much higher abundance in relatively cold years, as clearly displayed by a linear rising trend from 1970 to 1993. On the other hand, the abundance tends to decrease during the intense warming period after 1993, and before 1970. Similarly, Mesozooplankton biomass fluctuations of the central-eastern Black Sea are also in phase with temperature (Figure 6.23). Biomass tends to increase in warm years and decrease in cold years.

Figure 6.22 Time Series of Standardized Bacilariophyceae Abundance along the Eastern Black Sea Coats

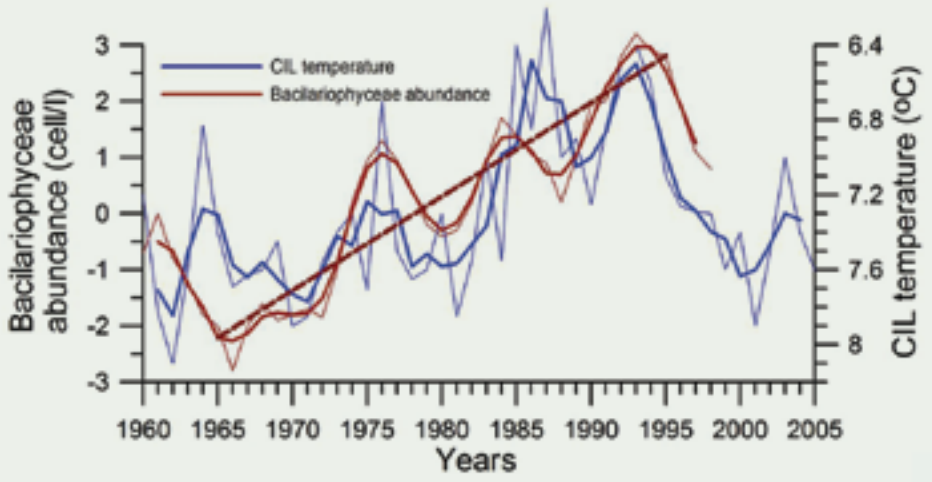
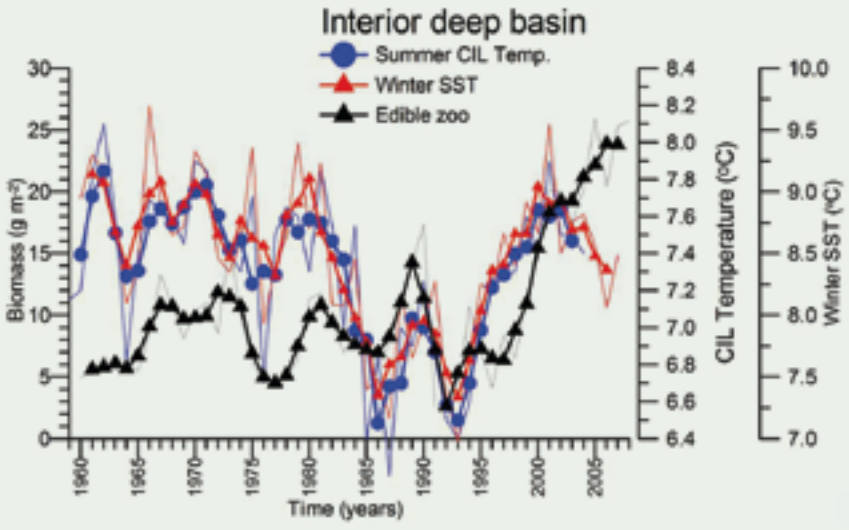


Figure 6.23. Time Series of the Annual-Mean Mesozooplankton Biomass in central Black Sea and winter temperatures.



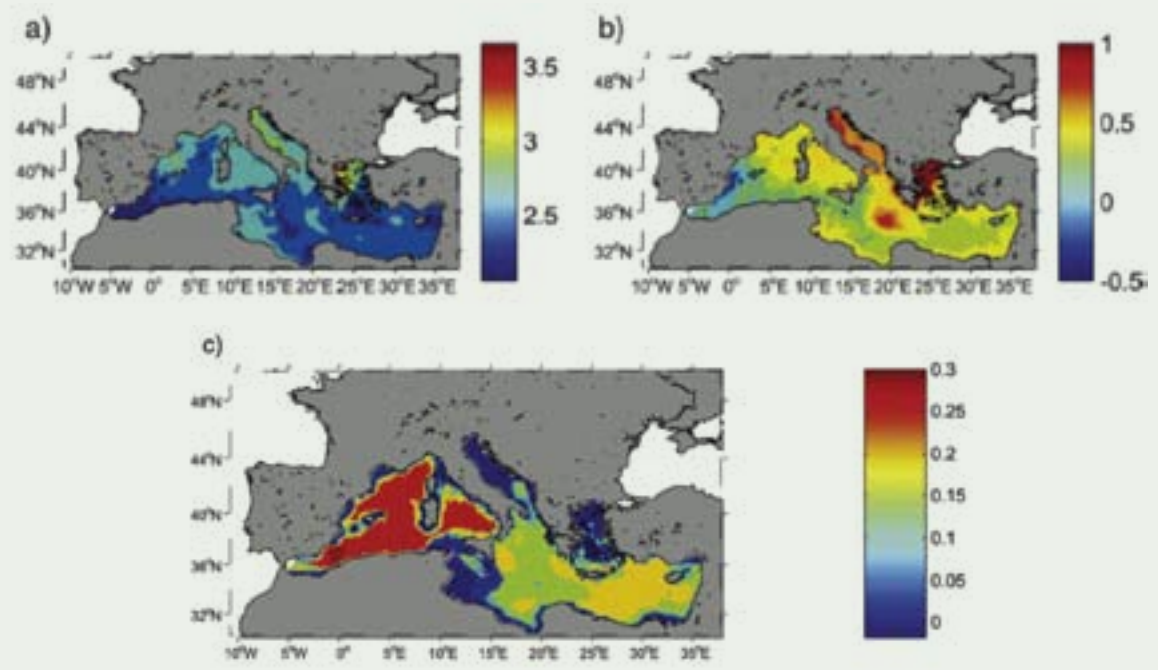
96 Oğuz et al., 2006
97 Shiganova & Özturk, 2010.
98 BSC, 2008.

Climate Change Projections

Results of the climate projection modeling conducted according to IPCC-A2 scenario indicates that an increase of 2.5 ^{0}C in sea surface temperature of Mediterranean is anticipated in the 21th century (Figure 2.24a). Simulations indicate that an increase in sea surface salinity of around 0.4 is expected mainly at Adriatic and Aegean Seas (Figure 2.24b). There will be no change in vertical water mix at Adriatic and Aegean Seas, but will be weaken at Levant Sea. Consequently current circulation system in Mediterranean is expected to be weakened. Average sea level rise of 0.18m in Western Mediterranean and 0.11 m in Eastern Mediterranean is expected within 110 year time period (1990-2100).[99]

No specific future climate change scenarios have been undertaken for the Black Sea yet. This is because, Black Sea lies in the transitional zone between these two regimes and thus it is challenging to identify its future climate regime with confidence. In the case of precipitation increase, a simultaneous increase in air temperature (and thus sea temperature) is projected over the Black Sea. Thus, the overall picture of future climate scenarios is an increasingly wetter and warmer conditions over the Black Sea. Alternatively, colder and drier climatic conditions may prevail in agreement with projections due to likely changes in the NAO pattern in response to the global warming described in the previous section.

Figure 6.24 2070–2099 Period (a) Sea Surface Temperature, (b) Sea Surface Salinity, (c) Deviation of Mean Sea Level from 1961-1990 Average



Source: Tsimplis vd., 2008

Some of the international studies that Turkish Researchers are also involved are as follows:

- Mediterranean CLImate VARiability and Predictability (Med – CLIVAR): Funded by European Scien Foundation. The project aims at guiding and supporting researchs on climate change in Mediterranen.
- Southern European Seas: Assessing and Modelling Ecosystem changes (SESAME): Funded under EU sixth framework programme. The project aims to identify impact of climate change on Mediterranean and Black Sea ecosystems and consequent impacts on tourism, fisheries, biological diversity and production.

[99] Tsimplis et al., 2008.

- Marine Ecosystem Evolution in a Changing Environment (MEECE): Funded under EU sixth framework programme. The project aims at holistic approach to assess impact of climate change and other antropogenic impact.
- Climate Change Impacts on the Marine Environment: Research Results And Public Perception (CLAMER): Funded under EU sixth framework programme. It aims to gather and assess studies done on climate change within the EU and Europen Seas.
- Response of Black and Aegean Seas to climatic variations: Funded by Turkish TUBITAK. The project aims at gathering an assessing studies done on climate change in Eueropean Seas, Black Sea and Aegean Seas.

In addition, GEF funded Project on "Strengthening Protected Area Network of Turkey: Catalyzing Sustainability of Marine and Coastal Protected Areas (MCPA)" that is executed by the General Directorate for Protection of Natural Assets of the MEU in partnership with the GDNCNP of the MFWW, together with the General Directorate of Fisheries and Aquaculture of the MFAL is being implemented by UNDP since 2009. The project aims to facilitate expansion of the national system of marine and coastal protected areas and improve its management effectiveness. Responsible institutions will have the capacities and internal structure needed for prioritizing the establishment of new MCPAs and for more effectively managing existing MCPAs. MCPA financial planning and management systems developed and implemented will be facilitating effective business planning, adequate levels of revenue generation and cost-effective management. Inter-agency coordination mechanisms will be in place to regulate and manage economic activities within multiple use areas of the MCPAs. Under this, inter-agency co-ordination will be encouraged at national and site levels.[100]

Table 6.10. Potential Impacts of Climate Change on Sea Ecosystem and Adaptation Measures

Vulnerability	**Adaptation Measures**
Structural damage of coastal and sea ecosystems, loss in productivity	■ Legislations and implementations on protection of marine ecosystem and coastal zones ■ Legislations and implementations on biodiversity conservation ■ Researches to investigate potential impact of climate change

100 http://www.undp.org.tr/Gozlem3.aspx?WebSayfaNo=2194

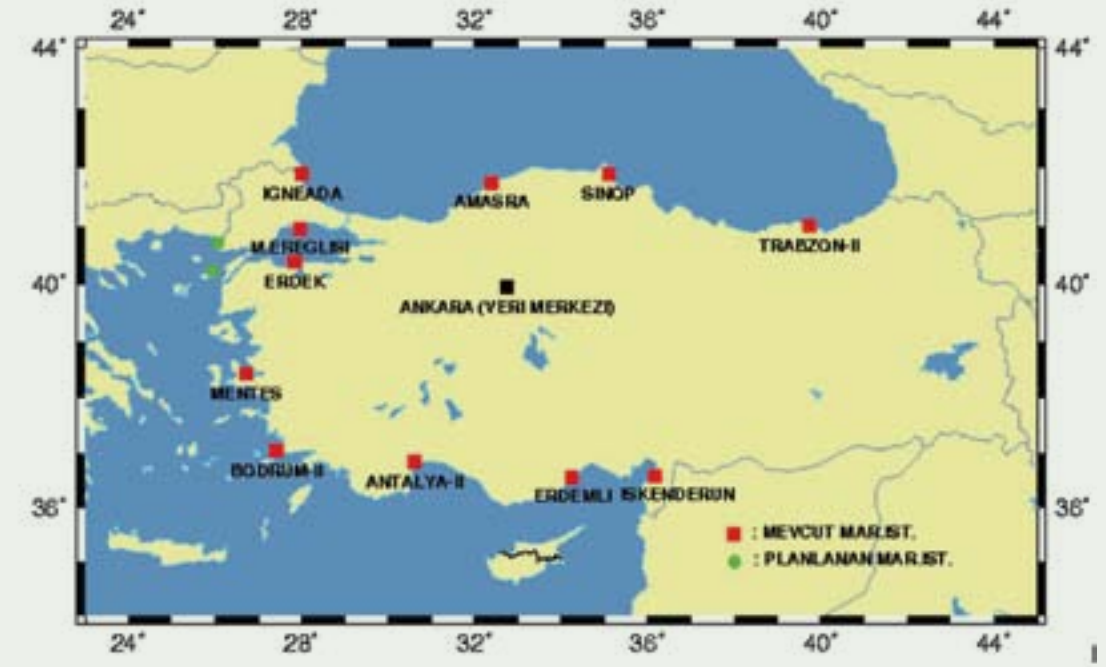
6.3.2. Coastal Zones

With 8333 km of coastline, Turkey is surrounded by the Black, Aegean and Mediterranean Seas. The Marmara Sea is an enclosed sea connecting the Black Sea to the Mediterranean through the Bosporus and Dardanelles. Coastal areas in the Black Sea and Western Mediterranean regions are a couple of hundreds of meters wide, while wide deltas and indented coasts are characteristic of the Aegean shorelines. The population density of coastal areas is twice as high as the inland and these coastal locations are important economic zones for settlements, industry, tourism, agriculture and transportation. Many ecologically important protected areas such as wetlands (e.g., Gediz, Göksu, Akyatan) and dunes (845 km of total length) are also located within the coastal zone. Continuing immigration, urbanization, degradation of ecosystems, erosion and flooding are the main pressures impacting these important resources.

Recently, additional pressures from climate change are being placed on coastal areas. Increases in sea surface temperature and sea level are two climate change driven parameters that have impacts on coastal areas. The impacts of sea level rise on coastal areas can be grouped into four categories: coastal erosion, flooding due to increased levels of storm surges, land loss due to inundation and saltwater intrusion to aquifers and rivers. While saltwater intrusion exerts more pressure on freshwater resources, flooding and inundation will exacerbate the already present pressure on agriculture, tourism, ecosystems and most notably infrastructure and settlements.

The sea level along the Turkish coastline was monitored several times between 1922 and 1985. Since 1985, it has been measured constantly and the Turkish National Sea Level Monitoring System (TUDES) was initiated in 1998. The number of observation stations has increased, and the data is now shared with the Globla Sea Level Observation System (GLOSS) network. Locations of active mareograph stations are presented in Figure 6.25.

Figure 6.25 TUDES Mareograph Stations



Source: GCM, 2011

As stated in the 4th Assessment Report of the IPCC[101], impact, vulnerability and adaptation studies on coastal areas require local (site specific) trends of sea level rather than global values. With data from TUDES network, an in-depth analysis of long term changes in sea level along Turkish coasts will be available in the future. The impact of local characteristics does not only influence local observations of sea level but also affects the level of intensity of sea level rise on the region.

[101] IPCC, 2007.

[102] Talu et al., 2010.

Expected Impacts and Vulnerability Assessment

In comparison with other countries that have low sea level corridors, Turkey has a relatively low vulnerability to the impacts of sea level rise. When compared to other climate change driven parameters such as temperature and precipitation, change in sea level is observed slowly and it is assumed that there is time for adaptation. This line of thought is believed to be one of the main reasons why impacts of sea level rise in Turkey are not expected to be particularly threatening. However, local tectonic movements as well as the socio-economic significance of coastal areas increases the vulnerability of Turkish coastlines despite the limited extent of expected physical impacts. The diversity of characteristics of Turkish coastlines also highlights the necessity of both regional and national assessments of coastal areas in relation to sea level rise.

Local observations and results of several projects (Boxes 6.9-6.13) have shown that several problems driven by climate change are affecting the coastal areas in Turkey. Participatory Vulnerability Analysis workshops held at six coastal cities as part of the UN Joint Programme on Enhancing the Capacity of Turkey to Adapt to Climate Change (Tekirdağ, Trabzon, Kastamonu, Antalya, Samsun and İzmir). Participants highlighted the importance of river – sea interaction and flooding due to changes in precipitation patterns as the most important impacts of climate change in these cities. At some locations, increased coastal erosion in estuaries and deltas as well as saltwater intrusion to coastal aquifers were also highlighted.[102] The driving force for these threats cannot be only attributed to climate change or sea level rise. As also stated in 4th Assessment Report (IPCC, 2007), it is not possible to accurately differentiate the impact of sea level rise from anthropogenic impacts on coastal areas, which have increased significantly during the past fifty years. Nevertheless, the observations voiced by local stakeholders underline the fact that problems will be exacerbated by the extra pressures posed by sea level rise.

Although there has been an increase in the number of impact and vulnerability studies since the Initial National Communication, an integrated national assessment of coastal areas still does not exist. The main reason for not having a national assessment is the limited amount of data available on coastal areas. Due to this gap, many of the available impact and vulnerability methodologies suggested by the IPCC or UNDP cannot be applied to Turkish coastlines. Considering this fundamental problem, a TUBITAK funded vulnerability assessment model aiming to generate national results is being developed.

The project on Vulnerability Analysis of Coasts to Climate Change supported by Sediment Model – KIDEKA has been conducted by the Department of Civil Engineering Coastal Engineering Division of METU since 2010. The project, expected to be finalized in 2012, developed a national coastal vulnerability assessment model using fuzzy logic methodology and assessed the vulnerability of Turkish coastlines to impacts of sea level rise by:

- prioritizing different coastal areas according to their vulnerability to impacts of sea level rise;
- prioritizing the impacts of sea level rise according to the vulnerability of a region to particular impact;
- determining governing parameters influencing the vulnerability of a region to a particular impact; and
- producing a baseline map for socio-economic vulnerability studies by showing vulnerability degrees and significant impacts to the coastal region.

The sediment model was used to determine the extent of coastal erosion initiated by climate change driven sea level rise.

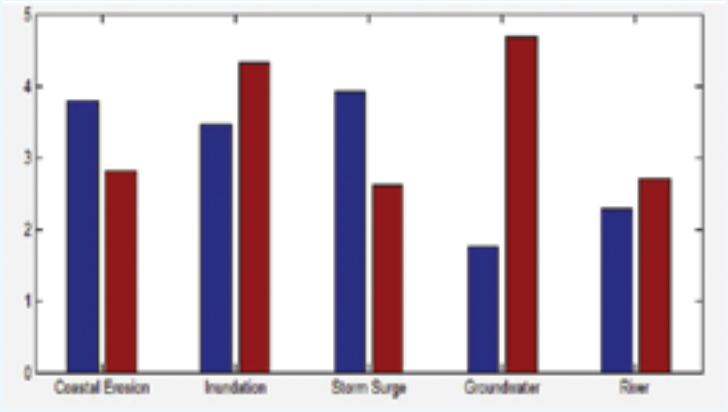
Vulnerability maps and information produced by the KIDEKA Project are expected to be efficient informative tools for decision makers. The developed model has been applied to three locations: Göksu Delta, Göcek and Amasra. A summary of the results produced by the application of the model to Göksu Delta is given in Box 1.

A limited number of studies covering all coastal areas of Turkey use synthetic scenarios of sea level rise. The study by Karaca and Nicholls[103] considers a rise of 1m over the next 100 years and groups the coastal areas into two according to elevation and distance to sea. The analysis considers population, capital value and protection/adaptation costs, and predicts that impacts of sea level rise will affect half million people directly and 2.4 million people indirectly.

[102] Talu et al., 2010.
[103] Karaca & Nicholls, 2008.

Box 6.9: Göksu Delta – Mediterranean Region

Conducted by METU in 2007-2008, Göksu Delta – a Pilot Project on Adaptation Strategies for Climate Change and Sea Level Rise was funded by Department for Environment, Food and Rural Affairs, United Kingdom (DEFRA). The Delta is declared as a Specially Protected Area and RAMSAR site and contributes significantly to national agricultural production. The project focused on assessing the vulnerability of the Göksu Delta to impacts of climate change. The results of the Fuzzy Coastal Vulnerability Assessment Model (FCVAM) list the impacts according to the vulnerability of the region in terms of coastal erosion, inundation, flooding due to storm surges, saltwater intrusion to aquifers and saltwater intrusion to Göksu River. Another output of the FCVAM model is the histogram of physical and human influence parameters with respect to vulnerability of the region to each impact. As presented in the figure below, the main reason for land loss is the physical properties of the region such as mild coastal slope, geomorphology and low elevation. Additionally, human activities put significant pressure on the region (degradation of dune habitat which acted as natural protection) before the declaration of protection status. Construction of a number of dams on Göksu River is another parameter that increases the vulnerability of the region in the long run. Analysis of freshwater parameters indicates that coastal aquifers at their natural state are resilient to impacts of sea level rise. However, high demand due to agriculture practice and lack of monitoring of the wells decreases the natural resilience of coastal aquifers and enables extensive intrusion of sea water in the future.

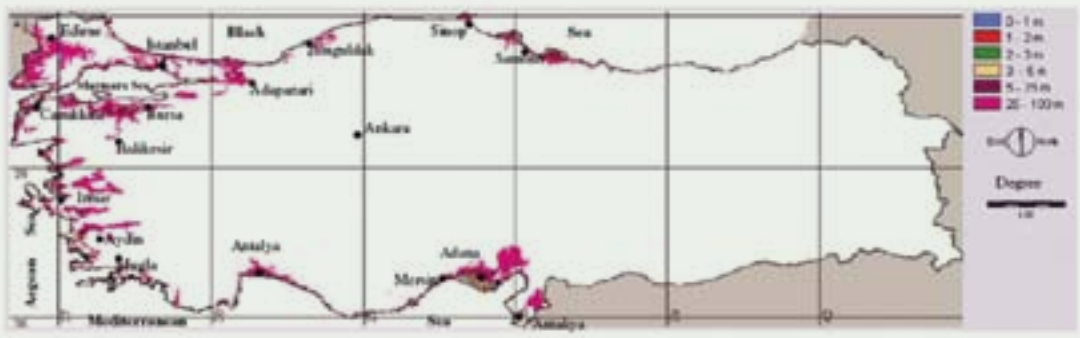


Source: Vulnerability scores for physical and human parameters [Özyurt, 2010] – Göksu Delta [Google Earth image]

Another study using synthetic sea level rise scenarios determines the land loss due to 1, 2, and 3m of sea level rise respectively.[104] Assessing the sea level rise for the next 100 years and 200 years (2205), the study states that 1.3% - 5.2% (545km2 - 2125km^2) of coastal areas of Turkey could be lost due to inundation. When compared to other countries, the amount of land lost is not significant. However, the locations of the expected land loss are very important due to the fact that these areas are important economic zones which significantly contribute to GNP (Figure 6.26).

[104] Demirkesen, 2008.

Figure 6.26 High Vulnerability Locations along the Turkish Coastlines by 2205



Source: Demirkesen, 2008

Independent of sea level rise projections, another stud[105] focused on vulnerability of locations below 10m in altitude. This study highlighted the vulnerable areas to sea level rise using parameters such as population, settlements, land use, wetlands, agricultural production rates and income tax rate. According to this assessment (Table 6.11), the Marmara region is the most vulnerable to sea level rise based on the extent of population to be affected. On the other hand, the Mediterranean region is the most vulnerable in terms of land loss due to sea level rise. Most of the land lost would be agricultural land, and this could cause significant reduction in agricultural production at a national level.

Table 6.11 Regional Vulnerability Assessment Results

Regional Vulnerability*									
Region	No of cities	No of districts	Total Population	No of settlements	Population within 0-10m	Areas within 0-10m (km2)	Income from national budget (TL)	Income tax rate (%)	Agricultural production rates (%)
Mediterranean	4	27	5,634,047	60	427,815	2,669.9	3,384,824	2.6	10.8
Aegean	3	31	3,634,161	38	208,226	1,833.3	4,588,819	1.5	3.9
Marmara	9	69	12,049,152	32	841,789	1,698.5	15,152,501	5.6	5.9
Black Sea	12	63	3,686,336	51	201,206	1,140.9	6,499,892	2.5	6.8

Data presented on the table correspond to characteristics at 0-10 m. .
Source: Kuleli, 2009.

According to the results of the limited available studies on vulnerability of Turkish coastlines to sea level rise, the most vulnerable locations are coastal deltas where most of the agricultural production takes place, wetlands, and low lying area with high tourism.

Areas between 1m and 3m of elevation and possessing high vulnerability in the long run are settlements where significant amount of population and economic activity would be affected in case of sea level rise.

[105] Kuleli, 2009.

Box 6.10: Kızılırmak Delta – Black Sea Region

According to assessment of impacts of sea level rise on the Kızılırmak Delta, the most vulnerable location to sea level rise along the coasts of the least vulnerable region of Turkey, the Black Sea Region. Coastal retreat of 2.5-5 m/year combined with sea level rise would significantly accelerate the loss of land along the coasts of the delta. Three lagoons and 15,000 ha of wetlands would be threatened by sea level rise. Although the dunes are located on northwestern coast of delta, which are 7-12 m high and 200-300m wide, act as natural protection, the dams constructed on Kızılırmak River during the past 50 years have decreased the amount of sediment transported by 97%. The coarse grained bottom sediment trapped by reservoirs is another parameter that increases the severity of coastal erosion. Intensive agriculture, reed burning to improve grazing conditions and illegal sand extractions are other threats. The results along the coast are likely to be gradual erosion of the lagoon barriers and total loss of wetlands.

Source: Alpar, 2009

Studies show that increased coastal erosion, land loss due to inundation and salt water intrusion to groundwater resources are the main impacts expected to be observed along Turkish coastlines. These studies point to certain limitations regarding vulnerability studies at a national level: lack of data (such as shoreline geomorphology, land use) at national level at the same level of detail, lack of long-term, continuous observations of sea level, lack of availability of high resolution digitized maps and high uncertainty associated with sea level rise projections. Continued monitoring of sea level at varying locations along coastal areas would enable reliable and detailed assessments of impact and vulnerability in the long term.

An example of studies using high resolution data is the Adaptation and Mitigation of the Effects of Sea-level Rise Related to Global Climate Change in Seyhan Delta Project conducted by the Adana Branch of the Bird Research Society. Funded by the MDG-F 1680: UN Joint Programme on Enhancing the Capacity of Turkey to Adapt to Climate Change, the project analyzed 3-D digitized topographical maps, elevation data, cadastral maps, habitat studies and economic assessments within the framework of IPCC SRES scenarios. Rises in the sea level by 1, 2, and 3m were modelled and the results highlighted that agricultural lands, dunes and wetlands are the primary areas under the risk of inundation (Figure 6.27). Endemic plants on the dunes, bird species using the wetlands are also under the threat in the case of inundation of these areas. Geographical Information System assessment of the possibly inundated areas determined that 2/3 of agricultural land would be lost in this region causing a loss of 30 million TL in the case of 1m rise. Adaptation strategies developed from these analyses are integrated into Management Plans, and the implementation phase has been initiated recently. Another important resource affected by sea level rise is aquifers of the region. A total of 35 observation wells have been registered for monitoring, and some of the locations have been identified as possible salt-water intrusion areas.[106]

[106] Erkol, 2011.

Figure 6.27 Vector Map Showing Risk of Sea Level Rise in Seyhan Delta

Source: Erkol, 2011

The capacity of aquifers is mostly defined by meteorological conditions, and these are expected to be adversely affected by climatic changes. Coastal aquifers are affected by meteorological conditions and high demand as well as sea level rise. This combination suggests that the aquifers with significant problems are likely to be in areas with high tourism potential, combined with summer temperatures and rise in sea level.

Box 6.11: Socio-Economic Impacts– Göksu Delta

Socio-economic impacts of climate change on local populations were analysed by conducting surveys as a part of the Goksu Delta – a Pilot Project on Adaptation Strategies for Climate Change and Sea Level Rise project. The surveys were performed as a joint partnership of the METU Department of Sociology and Department of Civil Engineering. The survey included questions probing the basic properties of households such as age, education, gender, marital status, education, characteristics of the residence, properties, work and labour, income, health, solidarity network, perceptions of local and national governments, natural disasters and management. A total of 111 households in five villages located on Goksu Delta were interviewed. The analysis of the survey results showed that protected status of the region negatively affects the development of infrastructure and settlements.

It was seen that the income of the local population is highly dependent on agriculture. Livestock breeding, which was the main source of income, lost its importance due to change in the land use of the region from meadows to agricultural land and settlements. Coastal and deep water fishing is an alternative source of income as well as lagoon fisheries (notably in Paradeniz lagoon). Although there are alternative sources of income, the main source of income is agriculture, which is highly dependent on climate, thus significantly increasing the socio-economic vulnerability of the region. The overall analysis of the results reveals that infrastructure-settlement-dependence on natural resources are the main reasons for high socio-economic vulnerability. Additionally, the social networks of local populations are weak. When a problem arises that alters the daily work flow, most families share the burden within their own families without depending on other sources of help. This type of action increases the social vulnerability of local population as it degrades trust of local government. The fatalistic approach of the local population in case of emergencies as well as lack of knowledge of causes and impacts of climate change also act as factors increasing the vulnerability of the region. The results of the survey show that encouraging implementation of different sources of income, strengthening the communication network between local government and residents especially on the subject of protected status and educating local populations on ways to mitigate and adapt to impacts of climate change would be the most effective actions to decrease the vulnerability of the region.

ADAPTATION MEASURES

It is a highly challenging process to develop and implement adaptation policies for coastal areas. The dynamic and complex physical characteristics of coastal areas, the crosscutting nature of many economic activities and the need to consider different spatial and time scales, require a holistic approach, which uses multi-criteria and interdisciplinary methodologies. Uncertainties in the body of knowledge of physical processes, gaps in data at national and regional levels, low efficiency of existing coastal protection projects as well as the complex institutional framework of coastal zone management are the major problems in any adaptation action in this area.

The 4th Assessment Report of the IPCC (IPCC, 2007) suggests three main courses of action with regard to adaptation of coastal areas to sea level rise: i) protect, ii) accommodate and iii) retreat. Table 6.12 shows possible adaptation options under these courses of action in Turkey. One difficulty, other than the planning of adaption measures, is the implementation of available options. Implementation is highly dependent on the acceptance of the plan financially, technologically and socially. Many adaptation plans failed to be implemented successfully due to lack of local support or total rejection of the plan by stakeholders. Thus, it is very important to involve local stakeholders in the development stage of adaptation plans before the final approval by the national institutions.

The Assessment Report on Turkey within the Scope of UNFCCC[107] states that "as a result of a theoretical work published by the former Ministry of Transportation, it is reported that the costs of improvement works, particularly in the coastal regions that may experience a rise in water level, are estimated at $50-65 million for coastal highways, while the costs for the preservation of railroads is estimated to be around $160 million." The same report also urges the preparation of a master plan, in terms of measurements for floods and wash outs in the basins assuming that there will be a rise in sea levels. In the study of Karaca and Nicholls[108], the cost of protection of coastal cities with populations higher than 50,000 is calculated as $20 billion, not including the cost of beach nourishment, cliff protection or adaptation of port structures to sea level rise. Both examples show that to develop adaptation plans, analyses of different sectors and disciplines should be performed, and the costs should be calculated considering the benefits as well.

Integrated Coastal Zone Management (ICZM) procedures allow for the development of adaptation plans with integrated frameworks. Notably, the IPCC and many other international institutions have proposed ICZM as a methodology to ensure sustainability of coastal areas. The aim of ICZM is to develop a management framework that enables exploitation of coastal resources for socio-economic benefits while ensuring physical and ecological sustainability of the region. While the development of ICZM plans requires a multidisciplinary approach and integration of many stakeholders, these plans should be monitored and reevaluated continuously making ICZM process an iterative management system. Site specific research and modelling is called for to successfully implement such a system.

Guidelines for ICZM practice have been proposed by different international institutions. Integrating reliable and efficient adaptation options for climate change into ICZM plans would require development of site specific models. The study on the Göksu Delta demonstrates the development of adaptation strategies within the ICZM framework by selecting and combining physical intervention and policy measures for each impact of sea level rise. An example of how the FCVAM model results evolved into adaptation options for Göksu Delta is presented in Box

[107] CBCC, 2009.
[108] Karaca & Nicholls, 2008..

Box 6.12: Local Adaptation Studies - Göksu Delta

Results of Fuzzy Coastal Vulnerability Assessment Model (FCVAM) on Göksu Delta demonstrate that the main reason for high vulnerability to coastal erosion, inundation and flooding is the physical characteristics of the region. Vulnerability is exacerbated by significant degradation of dune habitat as well. These results show that stabilization of present shoreline through physical intervention would be an effective adaptation option. Rehabilitation and restoration of dune systems is another adaptation option to be used for stabilization of shorelines. As a result of the FCVAM modelling of the region, in-depth analysis of impacts of dams on Goksu River is called for as well as integration of impacts on coastal areas to river basin management plans. Coastal aquifers are another resource that requires adaptation measures. Human influence parameters are the main reason for high vulnerability of groundwater resources in the region to the impact of sea level rise. Thus, the adaptation measures need to be more policy driven in the short term so that the wells and water infrastructure can be monitored and illegal wells can be registered and monitored. In the long term, altering the types of agriculture products and landscapes so that there is less demand on fresh water could be an effective adaptation measure. The use of the FVCAM model enables the comparison of different adaptation options to impacts of sea level rise, as well.

6.12. Important projects are being implemented to fill the gaps in data for vulnerability studies although most of them do not focus on coastal parameters. Environmental Information Systems, a National Biodiversity Database, a Turkish Environmental Information Exchange Network as well as the Turkey Flood and Early Warning Project, which focuses on real time river flooding risk, are some of the projects which will act as important data sources for coastal monitoring and data collection in the long term. However, rather than lack of data, the lack of a national coastal zone management plan is the main limitation to sustainability and adaptation of coastal areas for the future. The institutional system for coastal zone management practices consisting of many governmental agencies and local policy makers acts as another limitation. Led by the UN Joint Programme on Enhancing the Capacity of Turkey to Adapt to Climate Change project, many local pilot projects and multiple sector analysis were performed. These studies formed an important foundation for future studies on vulnerability and adaptation to climate change which are much needed at national, regional and local levels.

Box 6.13: Local Adaptation Examples – Seyhan

Funded by the UN Joint Programme on Enhancing the Capacity of Turkey to Adapt to Climate Change, the Adaptation and Mitigation of the Effects of Sea-level Rise related to Global Climate Change in Seyhan Delta Project conducted by Adana Branch of Bird Research Society determined site specific adaptation measures for impacts of climate change and took the necessary steps to implement these proposed measures. Two dune areas were selected to restore and rehabilitate. At first, a barrier of sand dune will be established with dense native vegetation on the western part of the area. Once the dune is restored, plants with economic value will be used to support the local economy. The rehabilitated area on the southern part of Tuzla Lagoon is planned to be protected as a Restricted Protection Zone according to Protection of Wetlands Act where native Red List species will be planted on the dunes. The cost of the implementation of this plan is estimated to be $85,000. The plan has been integrated into Management Plan of Tuzla-Akyatan Lagoons and sent to National Wetlands Committee to be approved. Additionally, 35 wells are monitored by State Hydraulics Works for possible salt water intrusion of coastal aquifers.

Another adaptation strategy proposed by the MDG-F 1680 funded project is the coordination of integration of coastal zone management plans to river basin management plans for the region. Active dams and future construction projects on the river basin accelerate coastal erosion in the region and act as one of the pressures on the wetlands and the delta. Ensuring sufficient water to be released for sustainability of coastal ecosystem especially wetlands as well as suggesting options to transport the trapped sediment in reservoirs to coastal areas are some of the measures proposed by the project.

Table 6.12. Potential Impacts of Climate Change on Coastal Areas and Adaptation Options

Vulnerability	Adaptation Measures
• Land loss and coastal erosion • Changes in frequency of storms • Salt water intrusion to rivers and increase in soil salinity near rivers • Inundation of coastal agricultural areas • Salt water intrusion to coastal aquifers • Adverse impacts on tourism • Exposure on coastal settlements to oceanographic impacts	• Strategies and actions stated in NCSD and NCCAP and their implementation. • Implementation projects and actions regarding impact assessment and adaptation to climate change • Studies on research and modeling • Legislations and their implementations

6.2.6. Public Health

EXPECTED IMPACTS AND VULNERABILITY

Impacts of climate change on health emerge either directly or indirectly. An increase of natural extreme events, such as heat waves, floods, droughts and fires, already affects health and these are expected to increase in frequency and intensity. The changing climate also negatively affects major health determinants, such as air quality, potable water, sufficient food and safe sheltering, as well as ecosystems and biodiversity. Thus climate change reinforces old challenges and contributes to new challenges. Turkey is a sensitive country to the health impacts of climate change, considering its geographical location, and socio-economic, health and demographic structure.

In recent years, efforts have gradually increased to better understand climate change and health impacts in Turkey. A report on impact of the climate change on respiratory (chronic) diseases was prepared in 2010 with the aim to raise awareness about air pollution and climate change and ensure mobilization of resources and develop programmes for solution.[109] The recent WHO project on assessing the health effects of climate change in Turkey created further evidence. The most likely effects of climate change on human health are:

- Death and disease from changes in extreme weather events;
- Cardio respiratory diseases (including allergies) emerging as a result of climate change and urban air pollution;
- Diseases originating from vectors and rodents (malaria, leishmania, dengue; and flee borne diseases);
- Water and food borne diseases; and
- Health problems like skin cancers and cataracts from the interaction between stratospheric ozone depletion and climate change.

Impacts will be felt through the: decrease in population who have access to healthy, clean and adequate potable and utility water; increase in prevalence of the diseases transmitted by climate-sensitive vectors; increase in floods; and increase in chronic respiratory tract diseases due to urban air pollution. But, since these health problems listed are affected by many factors like the quality of preventive and healing health care services, the socio-economic structure of the public and demographic changes it is rather difficult to attribute climate change directly to these impacts. There is a need for long term research at the national level to better understand if and how these impacts are related to climate changes, as well as undertake epidemiological quantification and scenario based assessments.

Health risks from climate change are high in the locations where there is poverty and a lack of health care services. Health investments should be determined according to where water hygiene, food safety, diseases, air quality and extreme climate incidents are felt and health care should be prioritized for needy women and children.

Within this scope, it is important to prioritize provision of clean potable and utility water both in urban and rural areas. It is also critical to develop preparation plans for extreme weather events that into account the pressure on the health care services.

Possible effects of climate change are not only in the field of interest of the Ministry of Health but also national institutions and organizations like the Turkish Grand National Assembly [110] and Turkish Academy of Sciences (TUBA). A report of the Parliamentary Research Commission established on impacts of Global Warming and Sustainable Management of Water Resources was accomplished in 2008 and drew attention to the influence of the climate change on health (Turkish Grand National Assembly, 2008). The report on Climate Change on the World from the Perspective of Turkey, which is a resource containing comprehensive information on climate change was published by TUBA in 2010.[111]

Extreme Weather Events in Turkey and their health implications

Heat waves have caused substantial mortality in many European countries. According to EM-DAT data, between 2000 and 2007 two heat waves resulted in health impacts on 300 people, including 14 deaths (EM-DAT). Very few studies have been carried out in Turkey on climate, health and extreme events. In a survey conducted in Antalya it was detected that patients who entered the hospital for respiratory diseases during hot weather were found to have more serious conditions.[112]

Floods can cause deaths, disruption of health services, as well as infectious diseases and mental stress disorders. Floods especially impact urban areas, and in cases where infrastructure is insufficient or there is unplanned urban growth, floods can present situations with serious health hazards. According to EM-DAT data, of the 10 largest disasters in the 20th century in Turkey, four were floods that occurred in the past two decades.

109 Ministry of Health, 2010.
110 TBMM, 2008
111 TUBA, 2010
112 Oktay et al., 2009

Diseases transmitted by vectors and rodents

The relationship between vector borne disease and climate conditions is generally related to how climate moderates the lifecycle of vectors. In cases where optimal climate conditions for vectors increase (especially related to humidity and temperature), the contagiousness of the disease may also increase. In other words climate conditions are one of the basic variables which affect spread of vector-borne diseases. Vectors are often also affected by land use.[113]

Malaria: Malaria is among the most sensitive vector-based diseases to long term climate change. Rising environmental average temperature will impact mosquito vector distribution. It is expected that malaria will become more prevalent and also increase in tropical and subtropical high regions where it is not yet existent over coming years.

Europe is an endemic region for some of vector-based diseases. Malaria is endemic in some Eastern European countries, including Turkey. The frequency of malaria cases in Turkey is related to precipitation and temperature. However, due to the malaria elimination programme, the frequency of malaria's prevalence has declined. Within the scope of this programme people with malaria are monitored on monthly basis.[114] In recent years the number of cases of malaria has gradually decreased and reached a level where no more new local cases have been detected.

Crimean-Congo Hemorrhagic Fever: Crimean-Congo Hemorrhagic Fever (CCHF) mostly occurs due to a virus transmitted by ticks. Ticks are sensitive to changes in climate and seasonal changes. Hence, monitoring the disease seasonally and taking preventative measures during the months when the disease is prevalent are important. Climate change is one of the factors that may lead to an increase in tick populations and accordingly increases the frequency of diseases transmitted by ticks.

Environmental factors like the clearing of agricultural fields, transformation of flood areas into agricultural lands, increases in population of rabbits and boars, and flood control activities are also important factors that influence CCHF prevalence.

The agent of the Crimean-Congo Hemorrhagic Fever is an RNA virus and the reported mortality rate varies between 3-30%.[115]

In Turkey, virus infected cases were reported for the first time in 2002. Between the years 2002-2009 4,453 cases were reported to the Ministry of Health and out of those 218 (5%) lost their lives

Table 6.13 Number of Crimean-Congo Hemorrhagic Fever Cases per Year in Turkey.

Year	Number of cases	Morbidity
2002-2003	150	6
2004	249	13
2005	266	13
2006	438	27
2007	717	33
2008	1315	63
2009	1318	63
Total	4453	218

(Table 6.13). Çorum, Kastamonu, Tokat, Yozgat, Karabük, Samsun and Sivas are the places where the disease prevalence is high and 90% of Turkish cases are in the Central and North Anatolia regions.[116] Crimean-Congo Hemorrhagic Fever (CCHF) Disease Assessment Workshops were organized by the Ministry of Health with participation from experts and authorities from provinces where CCHF is highly prevalent. At the workshops, experiences were exchanged and current situations and developments globally and in Turkey were discussed.

Tularemia: Tularemia is a disease caused by Francisella tularensis, which infects people by direct contact with infected animals, intake of contaminated water or food, biting by ticks, biting flies or mosquitoes, or inhalation of infected powders or aerosols. Transmission of the disease does

113 WHO Regional Office for Europe, 1999; Kovat and Haines, 1999
114 Ergönül, 2007; MEF, 2007
115 Watts, 1988; Ergönül, 2004
116 Ministry of Health, 2011

not occur from human to human. Cases are reported from all regions particularly from the Black Sea and Marmara regions. Before 1988 only a few cases were seen in Turkey, however several epidemics have been reported since 1988. All of these epidemics were caused by contaminated potable water. Population movements, various disasters, poverty, wars and immigrations have facilitated the spread of tularemia.[117] With the aim of controlling the disease, a Field Guide was published by the Ministry of Health for the control of Tularemia Disease.[118]

Phleboviruses: Sand fly fever is caused by a virus transmitted by simulium flies (Phlebotomus papatasi). Sand flies are sensitive to climate and seasonal changes. Hence, to monitor the disease seasonally and the measures to be taken during the months when the disease is seen is of central importance.

Table 6.14 Tularemia Epidemics in Turkey

Year	Place	Number of cases	Morbidity
1936	Lüleburgaz Kırklareli Tekirdağ	150	1
1938	Van	6	Ø
1945	Lüleburgaz	18	Ø
1953	Antalya	200	Ø
1988-2002	Bursa	205	Ø
2000	Ayaş-Ankara	16	Ø
2001	Gerede-Bolu	21	Ø
2004	Zonguldak Bartın Kastamonu	119	Ø
2004-2005	Kocaeli	188	Ø
2004	Samsun	75	Ø
2005	Edirne	10	Ø
2004-2005	Kars	56	Ø
2005	Gölcük-Kocaeli	145	Ø
	Yozgat Sorgun	237	

(Source: Akalın H. 2010)

Simulium malaria is seen in the endemic regions between 20-45 degrees of north latitude and in the countries where the vector flies exist. It is frequently observed in the Northern Republic of Cyprus, Balkans and southeast neighbors of Turkey (Iran, Iraq). In tropical regions these flies may transmit disease throughout the year, but in colder climates they are only active in warm months.

The disease is observed in the Middle East and Central Asia in warm and drought months (months of summer or autumn) and transmits to people through biting. Simulium is nourished at nights and found in dark places like wall cracks, caves, houses and tree hollows during the day.[119]

In the studies conducted in the Aegean and Çukurova regions, antibodies were detected related to this disease in Adana. Since the number of cases is not monitored, estimates can not be made of the disease incidences. In another study conducted over 106 patients in İzmir, Ankara and Adana antibody for SFSV and SFCV type was detected and in the same study a Turkish type of virus (sand-fly fever Turkey virus, SFTV) was isolated.[120]

Leishmaniasis: Leishmaniasis is a disease that infects by vectors that are influenced by climate conditions. Climate change may facilitate the spread of both the infecting vectors and cause of the disease. Increases in temperature and humidity may cause the disease to spread northward. Unplanned urbanism and poor infrastructure may influence the spread of the simuliums carrying this disease. Leishmaniasis has been reported in all the countries bordering the Mediterranean.

117 Uğur, 2011; Barut, 2009; Gurcan, 2006; Willke, 2009
118 MH, 2011
119 Midilli et al., 2009
120 Carhan et al., 2010

The cutaneous form of leshmaniasis (oriental sore) is endemic in the Southeast provinces of Turkey particularly in Şanlıurfa and in Çukurova region. For cutaneous leshmaniasis, immigration and urbanism are important risk factors.[121] It is also reported that with the increased agricultural irrigation due to the SEAP (Southeast Anatolian Project), the habitat of the flies transmitting disease will expand and cutaneous leshmaniasis may increase.[122]

Cutaneous leshmaniasis has been known in Turkey since 1833. In the 1950s it decreased as a result of the fight against malaria and pesticides affecting vector sandflies. However, its prevalence has started to increase due to irrigated farming, unplanned urbanism and immigration.[123]

As with all infection diseases, control measures have an important role to play in reducing impacts. In this regard, health care personnel must be informed and have an increasing awareness of how to diagnose and treat these diseases that will be impacted by climate change.

Water and Food Borne Diseases

Water borne infections may be transmitted through drinking contaminated water, eating food that was in contact with contaminated water, and using the contaminated water for recreation. Changes in temperature, extreme weather incidents, floods, and increases in precipitation, may each lead to an increase in water borne diseases.

Campylobacter, Salmonella and Shigella are the most common water and food borne diseases. While Salmonella and Shigella have decreased recently, there are surveys that shows there might be an increase in Campylobacter infections. Risk of Campylobacter infections displays a correlation with high average temperature.[124]

In order to protect populations from water and food borne diseases, several training materials, booklets, brochures and posters were published by the Ministry of Health for the public. For health service providers, in-service trainings have been held and training materials have been published.[125] Bacterial and viral infections borne by water and food are followed on monthly basis by the Ministry of Health. Surveillance has to be continued meticulously.

6.2.7. Settlements and Tourism

Obviously the impacts of urban functions and activities extend beyond the administrative boundaries of cities. Metropolitan cities attract migrants from other cities and rural areas thanks to the diversity and concentration of economic activities. Uncontrolled population growth leads to deficiencies in infrastructure; and subsequently to health and hygiene problems. The growth of cities, while putting pressure on natural areas, influences urban quality of life negatively, and particularly the quality of life of the urban poor. Constrained by low-incomes, these people mostly settle within water basins or on marginal areas that experience various risks away from the permitted housing areas. Any natural event (even it is not a disaster) could lead to collapses of buildings and infrastructure in such settlements. Likewise the intense and complex urban activities, large scale industrial facilities around cities and complicated highway infrastructure are also susceptible to climate change impacts.

With respect to urban development in Turkey in relation to climate change, there have both sustainable and unsustainable aspects. Uncontrolled population growth comes forefront at the top of the urban problems that will interact with climate change. Particularly due to rural-to-urban migration during the 1950s, urban populations have risen by up to 75.5% over the last 80 years. Another problem linked to the rapid population growth is the unbalanced distribution of this population among settlements.

[121] Ertem, 2004; WHO, 2002
[122] Aksoy vd., 1995
[123] Gruel et al., 2002; Ok ÜZ et al., 2002
[124] Semenza, 2009
[125] Irmak, 2008; Soylu, 2008; Ayaz, 2008

EXPECTED IMPACTS AND VULNERABILITY

Some of the potential impacts and vulnerabilities are presented in following paragraphs.

Building density

While the total number of buildings was 4.3 million in 1984, this number rose to 7.8 million in 2000; and the number of dwelling units climbed up to 16.2 million representing an increase of 129%. The area covered by residential, commercial and public buildings grew 56% between the years 2000 and 2008. Natural disasters such as flush flood that are triggered by climate change might affect people living in cities especially low income residents.

Lack of green areas

The presence of a green area network is a significant ingredient of an urban area as far as climate-sensitive urban development is concerned. According to a research undertaken in Freiburg, Germany (2003), the temperature difference between forested and vacant landl is approximately 1°C. Many medium and metropolitan scale cities in Turkey has insufficient green areas that decrease resilience if cities to climate change.

Tourism settlements

The most vulnerable settlements are in coastal areas, where economic life depends on sea-sun-sand tourism. Since the rise in temperature will cause water shortage and drought, the Mediterranean Region is under the risk of losing its attractiveness. Shift of comfortable temperature levels towards autumn and winter can also be seen as opportunities for new tourism seasons in coastal settlements. Meanwhile, winter tourism centers are under the risk of decreasing snowfall and increasing temperature.

ADAPTATION MEASURES

Sustainable cities approach provide a solution for both climate change adaptation and mitigation in cities. The approach of “resilience cities” has been considered in a recent project (TUBITAK URBAN-NET) that is jointly conducted by Swedish, Dutch and Turkish academicians. The project supports the integration of ecosystem services into urban planning.

Works Realized By Central Public Institutions

Former MEF, defines The 2010-2023 Integrated Urban Development Strategy and Action Plan (KENTGES) as a a road map that includes strategies and actions towards solving the problems of urbanization, settlements and planning. The process to prepare KENTGES was initiated in 2007, the document has been prepared in 2009 within the scope of Urbanization Council and accepted in 2010. One of the ten issues discussed during the Council was “Climate Change, Ecological Balance, Energy Efficiency and Urbanization.”

Works Realized by Local Governments

Local governments have activities on adaptation to climate change including sustainable urban planning, as well as mitigation efforts. NCCAP states responsibilities of local government both on in terms of adaptation and mitigation. On the other hand, Gaziantep and Çanakkale municipalities have already prepared their Local Climate Change Action Plans.

Table 6.15. Potential Impacts of Climate Change on Settlements and Tourism and Adaptation Measures

Vulnerability	Adaptation Measures
• Increase in disasters associated with extreme weather events • Water supply problem and related diseases in cities induced by increased temperatures and drought • Difficulty of living in cities because of excessive heat; • Vulnerability of the local economy in tourism settlements.	• Policies and actions defined within KENTGES; • Strategies and actions defined within NCSD and NCCAP • Academic research related to settlements and tourism.

6.3. Enhancing Adaptation Capacity

In order to establish the necessary strategies and enhance the institutional capacity for Turkey to combat and manage the effects of climate change, a United Nations Joint Programme titled "Enhancing the Capacity of Turkey to Adapt to Climate Change" was initiated in 2008. The Joint Programme aimed to integrate the climate change adaptation into national, regional and local policies within the framework of future development targets of Turkey in terms of sustainability. The goal of the Joint Programme was to enhance capacity in order to manage climate change risks that threaten Turkey's rural and coastal area development. The project aimed to achieve its goal through:

- Mainstreaming climate change adaptation in Turkey's national plans and developing a Climate Change Adaptation Strategy
- Developing national and regional institutional capacity in order to predict and manage risks induced by uncertainties caused by climate change and climatic conditions
- Implementing community-based pilot projects in the Seyhan River Basin
- Mainstreaming climate change adaptation into UN programming framework in Turkey

A three year programme was funded by the Millennium Development Goals Achievement Fund (MDG-F) entrusted to United Nations by Government of Spain. The beneficiary of the programme was the MEU and was implemented by UNDP, UNEP, FAO and UNIDO. Other relevant ministries such as the MFAL, MSIT, MFWW provided technical support for the implementation of the programme.

A National Climate Change Adaptation Strategy has been developed in the context of joint programme. In addition to that, the capacity of national and regional institutions has been improved to respond and manage the climate change induced risks.

Besides, in this process, a comprehensive "Knowledge Needs for Adaptation to Climate Change Survey" has been conducted in order to determine the needs related to awareness, education, participation and capacity development in the institutions across the country for adapting to climate change in Turkey. A series of training activities have been realized in line with the results of this survey in order to support capacity development for adaptation to climate change. Within this process, the adaptation to climate change has become the subject of a university certificate programme for the first time up to now. "Climate Change, Adaptation Policies and Turkey Certified Training Programme" was realized in cooperation with METU, UNDP, FAO and UNEP in the context of joint programme. The training programme aimed to provide training to employees of public and private sector institutions, universities, research institutions and NGOs on "climate change, the impacts of climate change and adaptation to these impacts, adaptation policies and planning, the understanding of the social, communal and economic dimensions of adaptation, Turkey's status and the interaction between climate change policies and economic development policies" as well as to build capacity in this field, ensure the implementation of scientific studies, project management and decision-making mechanisms and to establish human resources for implementing agencies.

One of the significant capacity development activities was the training programme that was developed to raise awareness among students on adaptation to climate change through implementation of the toolkit. The pilot Climate Classroom training programme was implemented in Seyhan River Basin and the training was arranged by UN Joint Programme on Enhancing the Capacity of Turkey to Adapt to Climate Change within the coordination of MEU to ensure training of the trainers.

Participatory Vulnerability Analysis (PVA) that has been carried out at local level was one of the main activities conducted to determine the impacts of the climate change and to put forward the vulnerable areas in Turkey. Vulnerabilities against the impacts of climate change were determined at local level in 11 provinces with a participatory approach and this process has guided the general principles, priorities and measures of the National Climate Change Adaptation Strategy.

Several activities have been conducted by FAO to identify the needs for institutional capacity to adapt to climate change particularly focusing on agriculture and forestry sector. FAO developed a thematic training programme with the support of UNEP and relevant governmental institutions to enhance the capacity of the technical staff of the MEU, MFWA and MFAL on climate change. Furthermore, FAO and MFAL started to work in cooperation to review the Turkey Agricultural Drought Strategy and Action Plan and to develop Agricultural Drought Action Plan for three years starting from 2012. FAO also carried out activities on development of Flood and Drought Information Portal to ensure sharing of information on institutional level, and access to data on flood and drought monitoring, thus enhancing the adaptation capacity of the institutions.

Within the framework of the joint programme, MFWW and MFAL coordinated efforts with METU on the development of an information management system on the impacts of drought and floods. The objective of these efforts was to have access to real-time meteorological data via an integrated system; to collect such data; to develop related software tools to collect and analyze such data and to design software and methods for emergency warning system.[126]

Moreover, many climate simulations with different scenarios has been produced under the UN Joint Programme on Enhancing the Capacity of Turkey to Adapt to Climate Change to increase reliability of the climate simulation over Turkey. The results of some of the global climate models were studied and elaborated in more detail and in the end models with a scale of 150-200 km were downscaled to 27 km-scale. The results are available through a web interface (www.agora. itu. edu.tr).

In the context of joint programme, UNIDO and TTGV in collaboration with METU have identified priority industrial sectors in Seyhan River Basin as food and beverages, textile, chemical materials and products and metal plating and machinery part manufacture. Pilot demonstrations implemented on water saving and clean production in six firms operating in these sectors with low cost investments which has resulted with more than 720,000m^3 water saving annually. In addition to that, UNIDO and TTGV have developed a dynamic center model and business plan for National Eco-efficiency and Cleaner Production Center to be operated under the coordination of Ministry of Science, Industry and Technology.

One of the most important activities carried out during the preparation of National Climate Change Adaption Strategy is Community Based Adaption to Climate Change in the Seyhan River Basin Grants Programme. Seyhan River Basin is part of the Eastern Mediterranean Basin and it is identified by the UNFCCC as one of the extremely vulnerable regions that would be affected the most by climate change. In order to enhance and complete the works that have been done before, the initiatives such as Stakeholder Analysis, Livelihood Analysis, and Ecosystem Analysis were taken. The “Community-Based Adaptation to Climate Change in the Seyhan River Basin Grants Programme” which was realized between 2009 and 2010, and was designed and developed as a model programme in order to demonstrate the approaches on climate change and adaptation strategy development thanks to its model applications. The aim of this programme is to reduce the adverse effects of climate change, and increase the benefits of its’ positive impacts at maximum level and to secure the achievement of Millennium Development Goals. While adaptation capacity of communities and institutions in the Seyhan River Basin is being enhanced, innovative adaptation activities have also been supported by bringing new approaches to people who live in the region.

[126] www.agora.itu.edu.tr.

18 local pilot implementations have been realized on adaptation to climate change within the scope of the grant programme. Each of the aforesaid local implementations has aimed to develop the adaptation capacity and to make contributions to the achievement of Millennium Development Goals. These implementations have been handled under different titles such as agriculture (including irrigation applications, crop production, animal husbandry and fishery), management of water and national resources, sea level rise level, public health and awareness raising.

The experiences gained in the process of the grant programme has been a baseline and guideline for the development of potential regional/basin level strategies on adaptation to climate change in Turkey and also has supported the development of National Climate Change Adaptation Strategy and Action Plan.

6.4. National Adaptation Policy Framework

National Climate Change Adaptation Strategy and Action Plan were prepared under the coordination of former MEF with participation of all relevant institutes and stakeholders. Stocktaking analysis and assessments through a PVA process were used as the basis for developing the Strategy and the Plan. Moreover, the other activities summarized above, described the needs and priorities for preparing the National Climate Change Adaptation Strategy and its actions. This resulted in a focus on five vulnerability fields:

1. Water Resources Management[127]
2. Agricultural Sector and Food Security[128]
3. Ecosystem Services, Biodiversity and Forestry
4. Natural Disaster Risk Management
5. Public Health

The common/crossing points of these vulnerability themes are: Finance, Economic Tools, Research and Development, Data and Information Systems, Education, Raising Awareness and Capacity Building, Governance, Coordination, Monitoring and Evaluation, and Gender Mainstreaming.

The first step in developing a National Climate Change Adaptation Strategy and Action Plan was to draw a "framework" covering the main objectives and principles of the Strategy. This framework was developed in line with sustainable development policies by considering the combined relationships of the possible effects of climate change on sectors. This formed a basis for determining the structural needs at regional/local level and priorities (in different terms) for adaptation. Within the scope of the "Strategy Framework," existing political initiatives were emphasized and potential barriers concerning legal/institutional infrastructure, planning processes and participatory mechanism for adapting to the impacts of climate change were pointed out. Each of the cross-cutting common issues in the context of climate change adaptation and five thematic areas were addressed.[129]

Objective/objectives and actions under each strategic goal were determined by identifying timeframes, outputs and performance indicators, responsible/coordinating agency and relevant agencies. Strategy and action plan chapters were prepared for each thematic area and submitted for approval by relevant agencies. The next process aimed at gathering public opinion through broad participation via the internet. The National Climate Change Adaptation Strategy was offered for the consideration of all segments of the society for a one month comment period. The National Climate Change Adaptation Strategy and Action Plan took its final version with the contributions gathered through this process.

National Climate Change Adaptation Strategy and Action Plan have been prepared in line with NCSD and in coordination with the preparation process of NCCAP and and the National Communication. Turkey started to prepare its Second National Communication on Climate Change in November 2010; as a result of this process, vulnerability analyses were realized and adaptation measures were updated within the framework of climate change adaptation.

[127] Including marine and coastal areas.

[128] Includes crop production and livestock.

[129] Each theme has one or more strategic objectives and the goal.

7. FINANCE AND TECHNOLOGY

7. FINANCE AND TECHNOLOGY

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. Therefore, this section does not report information on "Financial Resources and Technology Transfer" as required by UNFCCC National Communications Reporting Guidelines[1] that states reporting of responsibilities of Annex II countries. Rather, this section provides information on the finance and technology needs of Turkey.

Turkey is considered as a developing country according to the World Bank and International Monetary Fund, irrespective of its status in Annex I of the UNFCCC. 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. Furthermore, as a country with a middle-high income level, Turkey is included to the same category with several other Annex I countries, and can access resources from bilateral and multilateral development banks and international funds for climate finance. Turkey has been the first country to benefit from the Climate Investment Funds managed by the World Bank, and has also received bilateral (e.g KfW, AFD) and multilateral (e.g WB, EBRD, EIB) financing for renewable energy and energy efficiency investments.

As a country that is eligible to obtain credit from the World Bank and receive technical support from UNDP, Turkey received grants worth $22 million from the GEF to support five climate change projects since 2007 with the total budget of approximately $68 million. During the same time period, the GEF provided Turkey with $11 million of support for four projects related to biodiversity and forestry with the total budget of $38 million.

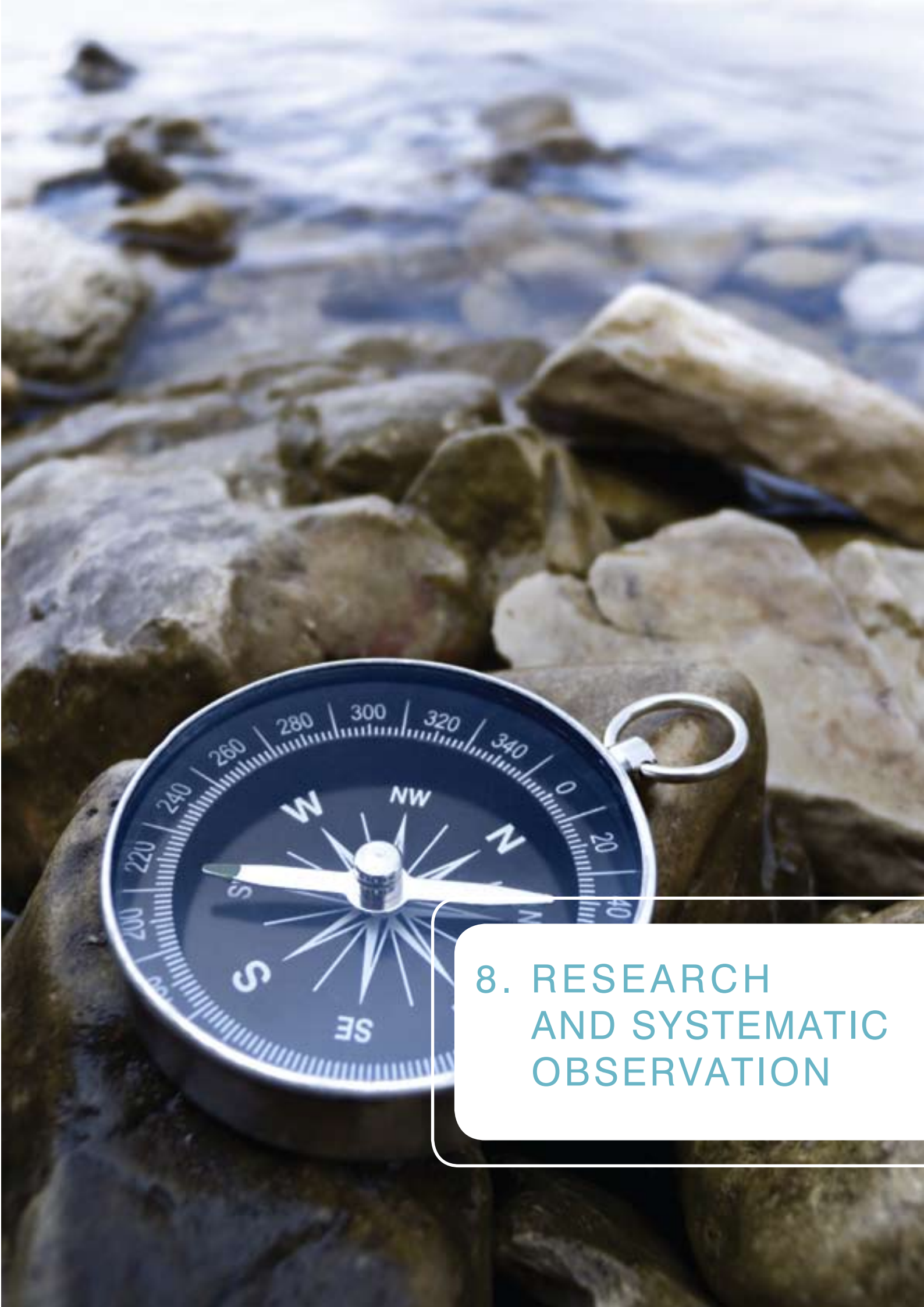
Turkey is also eligible to benefit from the short-term financing facility of $30 billion that is committed by developed countries under Copenhagen Accord" and officially recognized under Cancun Agreements, with an aim to provide support to developing countries in their investments to combat with climate change. This position, as agreed by Cancun Agreements (Resolution No.: 2/CP17), also emphasize the special position of Turkey among other Annex I countries of the UNFCCC,

Turkey is listed in the official list of countries eligible for development support that is declared by the OECD Development Assistance Committee, although Turkey is an OECD country. Accordingly, Turkey can benefit from official development assistances that are provided to help developing countries to combat climate change. This position also higlights the special circumstance of Turkey among other Annex I countries of the UNFCCC. As many of the non-Annex I countries are not listed in the OECD Development Assistance Committee list for receiving development assistance due to their high GDP per capita values. This situation also indicates unfair position of Turkey within the climate change regime in terms of economic indicators.

[1] Guidelines for the preparation of national communications by Parties included in Annex I to the UNFCCC, Part II: UNFCCC reporting guidelines on national communications, FCCC/CP/1999/7,16 February 2000..

On the other hand, in order to implement National Climate Change Strategy and Action Plan and to achieve ambitious national targets such as increasing share of renewable energy in national mix to 30% by 2023, Turkey needs to access additional 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 including Green Climate Fund that is agreed by Cancun Agreements.

Regarding the technology needs of the country, studies to better understand Turkey's technology needs to effectively adapt to climate change and reduce greenhouse gas emissions continue. In this context, Technology Need Assessment in the industrial sector is being conducted by Ministry of Science, Industry and Technology (MSIT). This Technology Need Assessment study is funded by national resources, focuses on energy intense industrial facilities and going to be initiated in the year 2012.



8. RESEARCH AND SYSTEMATIC OBSERVATION

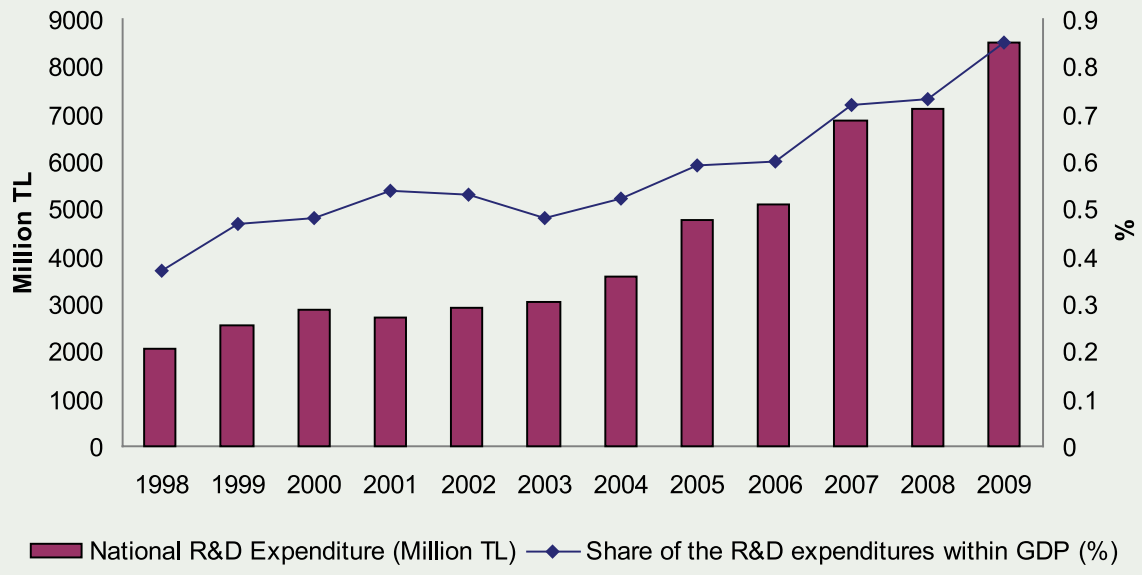
8. RESEARCH AND SYSTEMATIC OBSERVATION

8.1. General Policy and Finance

The Higher Board of Science and Technology (SCST) is the key organization that makes science and technology policies in Turkey. The SCST is chaired by the Prime Minister and consists of ministers and senior representatives of the relevant ministries and organizations. The National Science, Technology and Innovation System (NSTIS) (See Annex A), which operates under the HBST, provides a structure for participation of pertinent stakeholders including the private sector, civil society organizations (CSO), universities and the broader public. A system, "Turkish Research Area" (TARAL), has been established to enhance cooperation between NSTIS stakeholders, to ensure coherence with national objectives and to maintain a strategic focus in scientific and technological research efforts.

In recent years significant developments in Turkish scientific research have been achieved due to increased financial support to research. The national research and development (R&D) budget grew from 2 billion TL in 1988 to 8.5 billion TL in 2009. Similarly, the share of R&D expenses of Gross Domestic Product (GDP) grew from 0.5% in 2000 to 0.85% in 2009 (See Figure 8.1).

Figure 8.1. Change in National R&D Budget (1998-2009).



Source: TUBITAK, 2011

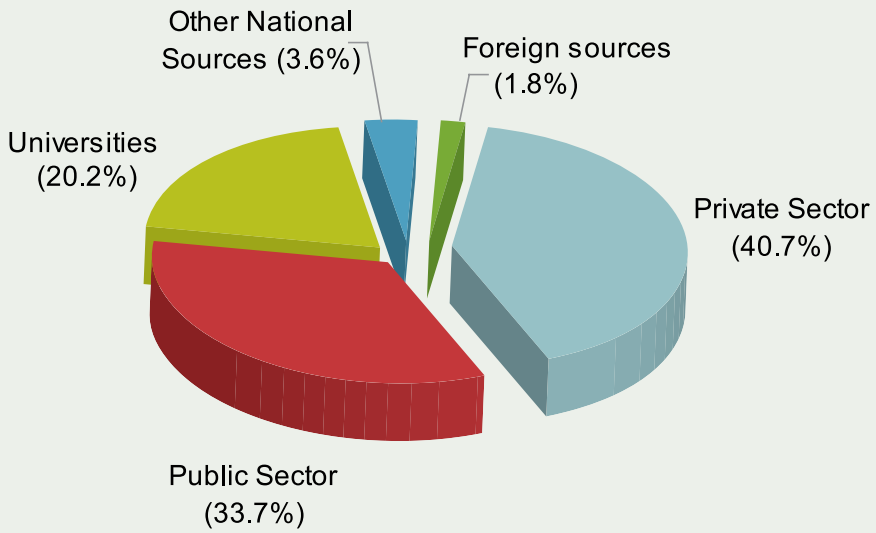
As of 2009 approximately 48% of national R&D was expended by universities, 40% by the private sector and 12% by the public sector. This represents a change from the period 1998-2004, when universities accounted for approximately 70% of R&D expenditures.

Various national organizations provide funding to promote R&D in private sector, including the TUBITAK, the Ministry of Science, Technology and Industry, the KOSGEB, and the TTGV. The most comprehensive of these subsidies is provided by the TechnoloTechnology and Innovation Funding Programs Directorate (TEYDEB) of TUBITAK. In addition to the support provided by TUBITAK, thirty-nine "Technology Development Regions" have been established by the Ministry of Science, Technology and Industry through the 2001 law #4691, which seeks to bring together the private sector and academics in research. An additional law #5746 on supporting research and development activities was passed in 2008 to create R&D tax incentives for the private sector, which has acted as another motivator of R&D.

The national R&D budget is depicted in Figure 8.2. The most significant contributor to the national R&D budget, with 40.7% of contribution, is the private sector, which is followed by the public sector (with 34%), universities (with 20%) and foreign resources (with 1.8%). While the contribution of the private sector and public sector to the national R&D budget was almost the same (about 30%) in the year 2000, the relative contribution of the public sector decreased and the contribution of the private sector has increased over the last ten years.

Despite these developments in the recent years, science, technology and innovation indicators of investment are currently below the EU27 and OECD averages (see Annex B).

Figure 8.2. Contributions of Different Resources to the National R&D Budget (2009)



Climate change does not occur as separate issue within the above discussions on research policy and finance mechanisms. However, increases observed in the research budgets, number of projects and publications also expected to indicate an increase in climate change research as well. Nevertheless, climate change-related research activities are still few in comparison with research in other scientific sectors.

8.2. Research

There are many ongoing international and national research activities in Turkey directly and indirectly related to climate change. Due to its geographical location with borders on both the Black Sea and Mediterranean, Turkey is a member of Black Sea Commission, which has been established to realize the Convention on the Protection of the Black Sea Against Pollution (Bucharest Convention). The Commission's Secretariat is based in Istanbul. Through the Commission, various activities on scientific research, observations and policy-development have been carried out through task groups consisting of researchers from member countries. The impact of climate change on the Black Sea has recently been included as one of the research issues being considered by the Commission, and Turkish researchers have contributed to a variety of studies performed on climate change in the task groups of the Commission. Detailed information report on related research topics can be found in the section on "Marine Ecosystems" (Section 6.2).

Twelve out of 40 projects funded by the European Union's 7th Framework Program are related to climate change and Turkish scientists are active participants in these activities. These projects are listed in Table 8.1.

The International Co-operative Program on Assessment and Monitoring of Air Pollution Effects on Forests (ICP-Forest) is a monitoring network that operates under UN Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution. The program includes most EU countries and has been operational over the last 30 years. Although the program initially aimed to understand the impact of acid rain on forest ecosystem, recently interest has shifted toward forests and climate change. Turkey joined the ICP-Forest program in 2009. The responsible authority in Turkey is the General Directorate of Forestry (GDF) within the Ministry of Forestry and Water Affairs, and Turkey is currently establishing Phase I and Phase II plots. Information on carbon stacks and sequestration will be produced once these test plots become operational.

Turkey is also participating in a project on adaptation of forestry policies to climate change in the Middle East and North Africa (MENA) region. The project, which began in 2010, is a large study with a budget of 4.5 million Euros. The focal point in the project is the GDF. The project is being carried out in close cooperation with the French Ministry of Food, Ministry of Agriculture and Fisheries, Plan Bleu and the other partners including Mediterranean Regional Office of the European Forest Institute (EFIMED), IUCN and WWF. Partners include Morocco, Algeria, Tunisia, Turkey and Lebanon.

Since 2009, the General Directorate of Meteorology (SMS) has been the coordinator of the "Eastern Mediterranean Climate Center (EMCC)," which is one of the Regional Climate Centers operated by the World Meteorological Organization (WMO) in "Region IV" (Europe). The Center provides data on monthly average temperature and rainfall, data on monthly and seasonal temperatures and rainfall forecasts and climate evaluation reports through 10 different websites updated monthly[1].

In recent years, there has been an increase in the number of scientific papers and reports published by Turkish researchers on climate change. As of 2010, the number of articles published in international refereed journals on climate change reached 353. Some of the studies on this issue are presented in Section 6 and some are discussed in the following sections.

1 http://emcc.dmi.gov.tr

Table 8.1. Projects under the EU 7th Framework Program

Name of the project	Abbreviation	Starting Date	Ending Date	Description
Analyzing the relationship among climate, social and economic changes and fires in the in Europe and Mediterranean regions	FUME	2010	2013	Climate, social structure and economic changes alter the land use and vegetation cover, which are directly related with fire incidence. This project uses historical data to understand how changes in climate, social structure and economy impact land use and vegetation cover.
Development of strategies that would be easily adapted in order to limit the impact of climate change in European freshwater ecosystem	REFRESH	2010	2014	This project aims to develop a system to enable decision makers to develop cost effective programs related to restoration of freshwater ecosystems.
Mega cities - Environmental indicator focus points	CITYZEN	2008	2011	By using satellite and surface data from the last 10 years the air quality from some mega cities was examined alongside evaluations for regional impacts of air pollution from cities.
Change of marine ecosystems based on climate	MEECE	2008	2012	This study has used modeling and experimental methods to analyze how marine ecosystems will respond to changing climate change.
Information transfer and research requirements in portfolios containing mitigation and adaptation policies	PROMITHEAS-4	2011	2013	This project targets the preparation of portfolios which include mitigation and adaptation policies in 12 countries (Albania, Azerbaijan, Bulgaria, Estonia, Kazakhstan, Moldova, Romania, Russian Federation, Serbia, Turkey and Ukraine).
Groundwater and dependent ecosystems: New scientific base to change the EU Groundwater Directive due to the effects of climate change and land use	GENESIS	2009	2014	Groundwater and dependent ecosystems are under stress due to overuse, changes in land use, climate change and pollution. This study targets the development of proposals to solve this important problem.
Preparedness for change	PREPARED	2010	2014	The “Prepared” project responds to the need for IPCC climate change scenarios to be downscaled to the local level. Outputs of the project will be activities related to infrastructure for wastewater, freshwater and floodwater in 12 cities.
For expanded European coordination of surveys for the impact on climate change second generation ERA-Net, integration of science with politics	CIRCLE-2	2010	2014	This project is targeted at forming a common research portfolio and supporting the studies to be conducted within the framework of this agenda.

Table 8.1. Projects under the EU 7th Framework Program

Name of the project	Abbreviation	Starting Date	Ending Date	Description
Analysis of oxygen decrease in inland waters with low oxygen, as well as coastal and open sea ecosystems	HYPOX	2009	2012	Ecosystems where there is insufficient oxygen level in waters are always under stress. Climate change causes the oxygen level to decrease more and thus increases the stress levels experienced in such ecosystems. This study is aimed at the development of a system that monitors oxygen in different waters.
Climate change in Mediterranean hydrology: Decreasing uncertainty by using an integrated monitoring and modeling system and determining risk quantitatively	CLIMB	2010	2013	This project targets decreasing existing certainties in climate change impact analyses by using techniques like monitoring, remote sensing and hydraulic modeling and development instruments for quantitative risk assessment.
Development of nano-materials that will ensure protection of cultural heritage sites under changing climate conditions	NANOMATCH	2011	2014	This project aims to develop nano-technology based materials to protect historical buildings from changing climate conditions.
Preparation study at European scale for geological storage of CO_2.	CGS EUROPE	2010	2013	In the EU there has been significant knowledge accumulation regarding CO_2 storage. The next stage will be to accelerate these efforts and expand them to include all EU member states. The target in the project carried out within this framework is to develop scientific consensus between the EU countries on storing of the CO_2 in geological structures.

8.2.1. Climate System Studies

In the last few years, there has been a significant increase in the number of studies on paleoclimatology, where data on past climate conditions in Turkey are generated through the analysis of substrates that are linked to the past climate parameters. The most common research in this area includes studies where sediments are investigated to obtain clues on past climate changes and sea-level variations (Darbaş and Nazik, 2010; Doğan, 2010; Ergin et al., 2007; Gürel and Kadir 2010; Jones et al., 2005 and 2006; Kuzucuoğlu et al., 1998; Meddy et al., 2008). In addition to sediments, pollen records (Popescu et al., 2010), growth-rings in trees (Usta, 2006) and different soil structures (Atalay, 1996) have been studied to generate information on past climates and sea level.

In another group of studies, past temperature data from archives of the SMS were used to generate information on past climate (Zhang et al., 2005; Albek and Albek, 2009; Kadıoğlu et al., 2001; Kadıoğlu and Saylan, 2004; Kurnaz, 2004; Orun and Koçak, 2009; Tatlı, 2007; Tayanç et al., 1997 and 1998; Tecer and Cerit, 2009; Turkeş et al., 1995; Türkeş and Sümer, 2004).

Similarly, in a different group of studies, long-term changes in precipitation in certain areas of Turkey were investigated by applying various statistical tools to data from the SMS archives (Akkemik and Aras, 2005; Partal and Kahya 2006; Çiçek and Türkoğlu, 2005; Karabulut M, 2009; Kömmücü, 2010; Tauchan et al., 2007; Türkeş and Erlat, 2003 and 2005; Türkeş et al., 2009). Factors affecting precipitation variation have also been investigated in some of these papers.

8.2.2. Studies on Modeling and Projections

Modeling studies forecasting future climate in the region have also increased in the last decade. ECHAM5, CCSM3 and HadCM3 have been the most widely used global circulation climate models in these studies.

One of the sites where such modeling studies are performed is the High Performance Computing Center in Istanbul Technical University (ITU). The center was established in ITU in 2006 with an initial cost of approximately 41 million TL. Currently there are 23 researchers employed in the center. The objective of the center is to provide high performance computing infrastructure to support scientific research and technological R&D activities. It will also be used to build capacity to use these technologies in Turkey. There are several studies in the center where global climate models have been used to generate climate projections specific to the country, by downscaling the models to Turkey. The SMS also has operated two regional climate models (namely RegCM3 and PRECIS) since 2005 to forecast future climate in Turkey.

The first study performed by the SMS using regional climate projections was to make future projections of temperature, precipitation, evaporation and surface flow with the RegCM3-4 regional climate model. This process used the outputs of the global climate model ECHAM5 as an input. Projections of temperature, precipitation, evaporation and surface flow using IPCC emission scenarios A2 and B1 have been completed. Currently, the regional model is being run with the ECHAM5 outputs using the IPCC scenario A1B.

In the second study performed by the SMS, projections of temperature, precipitation, evaporation and snow depth were undertaken using a regional climate model PRECIS, which was developed by the UK Meteorology Office Hadley Climate Research and Prediction Center. For this, a global climate model (HadAMP3) was run under different emission scenarios and outputs of this global model were used as input to the PRECIS model. Currently, temperature, precipitation, evaporation and snow depth projections with scenario A2 have been completed and model runs with scenario A1B are under way.

Detailed information on climate change research within the SMS and results of those studies are provided in Section 6.1.2. There have also been modeling studies conducted in other government organizations, universities and NGOs to investigate the impact of climate change on specific sectors

including water resources and agriculture. These studies are presented in detail in Section 6.

The dust transport modeling project, which is coordinated jointly among the Ministry of Forestry and Water Affairs and some of the Middle East countries, also has relevance to climate change impacts. In this project dust transport in the region is being forecasted using the DREAM8b model.

8.2.3. Research on Impacts of Climate Change

Scientific research on climate change has been conducted by universities, government organizations and NGOs. Some of these studies are discussed in this section. Additional studies on impacts of climate change are presented in detail in Section 6.

Various studies are being conducted by the Ministry of Food, Agriculture and Livestock on monitoring the impact of the climate change on agriculture. One of these studies includes the calculation of a "Water Sufficiency Index (WSI)." The WSI is calculated through the AgrometShell software developed by the FAO by taking into consideration: precipitation from planting to harvesting; temperature; evaporation due to insolation and wind; as well as plant water needs (FAO, 2004). The WSI is calculated separately for each Meteorology Station and take values between 0-100. Values close to 100 indicate that there is no problem in terms of the water requirement for the plant. Station based WSI values are interpolated using the IDW technique to generate WSI values between stations. Since results of the interpolation are gridded data organized in layers, WSI values are compared on an annual basis to monitor the temporal variation in the impact of climate change on agriculture.

In another project carried out by the Ministry of Food, Agriculture and Livestock, plant-yields are predicted using agro-meteorological techniques and yield statistics. In this project agro-meteorological data are generated by processing raw climatological data with AgrometShell software. Parameters related to the water needs of a plant (such as water demand, water excess, water deficiency, evaporation from plant) are generated for each meteorology station and these parameters are analyzed statistically together with the yield values for each province. Data generated are publicized on www.tagem.gov.tr/gis_web/bultenler.html website as a bulletin. Yield forecasts can also be made by adding climate scenarios to the new agro-meteorological simulation software.

Satellite images are also used for monitoring the impact of climate on agriculture. Vegetation index (Normalized Difference Vegetation Index - NDVI) distribution obtained from high resolution images from SPOT-Veg, and MODIS satellites. Chan due to changing climate is monitored by comparing these generated images over 10-15 day periods with corresponding images from previous years.

Additional projects are carried out with international cooperation by public institutions. For example, the "Establishment of Immediate Flood Warning Center for Black Sea and Middle East Region" is a project that has established a center to mitigate damages and increase the capacity to respond to sudden floods in the region. The project includes cooperation from the TSMS, WMO, US National Atmospheric and Oceanographic Administration (NOAA), HRC, as well as Azerbaijan, Bulgaria, Georgia and Armenia. The center became operational at 29 March 2010 and is currently functioning as planned.

The feasibility project for Flood Prediction and Early Warning System was launched in 2010 with support from USTDA (United States Trade and Development Agency). It was carried out by SHW, DEMP and American companies under the responsibility of the SMS through December 2011.

The Ministry of Health and the Ministry of Development are carrying out an evaluation study on global climate change and its impact on human health. The study, which is currently in progress, includes an assessment of the impact of climate change on public health in Turkey. In addition to projects carried out by government organizations, there are several research projects supported by TUBITAK and conducted by universities. These projects are described in Section 6.

8.2.4. Socio-economic Analysis Studies

The socio-economic dimension of climate change impacts is particularly important for Turkey. However, there are few national-level studies performed on the socio-economic impact of climate change. Some assessments on this issue are presented in Section 6.

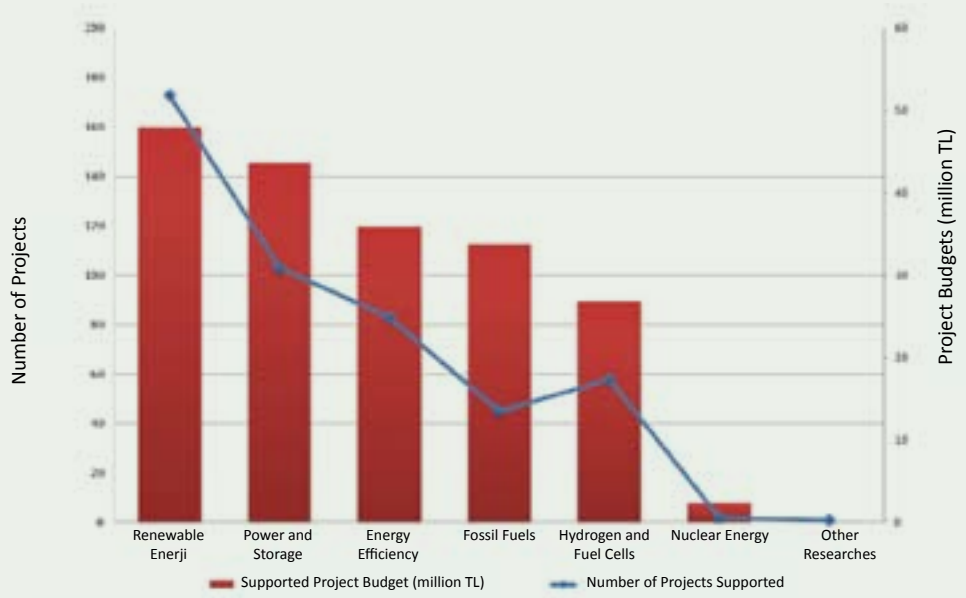
8.2.5. Research and Development on Mitigation and Adaptation Technologies

R&D studies for mitigation and adaptation technologies are conducted by the public sector, the private sector and universities. Research on mitigation focuses on energy efficiency, renewable and alternative energy sources and fuel cells. Most of the research projects supported by TUBITAK from 2003-2011 have been in the field of renewable energy (See Figure 8.3). Twenty-two of 45 research centers in the field of energy, where these projects have been carried out, specialize on renewable energy and four specialize in hydrogen energy, fuel cells and boron research (TUBITAK, 2010).

International Center for Hydrogen Energy Technologies (ICHET) is a project of the UNIDO was established in 2004 in Istanbul, with the support of the Ministry of Energy and Natural Resources. ICHET has hosted activities on the application of projects, research support and training. Some of the application projects of ICHET have included eco-lifts, ships operating with hydrogen energy, eco-carts, hybrid buses, and spare power units. Another project conducted by the center is "Hydrogen Island." In this project hydrogen energy is produced from renewable energy sources.

The National Boron Research Institute was established in 2003 operating under the Ministry of Energy and Natural Resources and is where most of Turkey's boron research is performed. The objective of the center is to provide the necessary scientific environment for research on the wide use of boron products and technologies in Turkey and the world. This includes the production and development of new boron products, and contribution and coordination of scientific research with a variety of public and private partners. These activities have resulted in 14 patent applications and nine patent certificates to date.

Figure 8.3. Energy Projects in the Programs Supported or Coordinated by TUBITAK (2003-2011) (TUBITAK, 2011)



Source: TUBITAK. 2011. National Energy R&D and Innovation Strategy. December 2011, p. 16.

In addition to the energy centers supported by TUBITAK, the list of research centers related to renewable energy and fuel cells technologies supported by the Ministry of Development is presented in Table 8.2.

Table 8.2. Thematic Advanced Research Centers (Ministry of Development) Supported within the Scope of Investment Programs, 2003-2011

Institution	Project Name	Survey Topics	Starting and Ending Year
TUBITAK	MAM Hybrid Vehicle Technologies Excellence Center	Storage	2007-2011
TUBITAK	MAM EE Instrument Laboratory	Storage	2008-2010
TUBITAK	MAM EE-Electric Energy Storing Technologies R&D Center	Storage	2010-2012
TUBITAK	MAM-EE Gas Technologies R&D Center	Fossil Fuels	2011-2012
Ege University	Solar Energy Institute	Renewable Energy	2011-2012
Harran University	GAP Renewable Energy and Energy Efficiency R&D Center	Renewable Energy	2011-2013
İzmir Higher Technology Institute	Geo-thermal Energy R&D and Test Training Center	Renewable Energy	2002-2005
METU	Solar Energy Research Center	Renewable Energy	2009-2011
METU	Wind Energy Technologies R&D Center	Renewable Energy	2011-2013

Source: TUBITAK, 2011. National Energy R&D and Innovation Strategy, December 2011, p. 19

In TUBITAK, the Marmara Research Center (MAM) Energy Institute studies fuel cell technologies, gas technologies, combustion and gasification technologies, biogas technologies, and fuel technologies. Some of the studies conducted in TUBITAK MAM are presented in Table 8.3

Table 8.3. Energy R&D Studies

Name of the Study	Type	Starting Date	Ending Date	Executing Institution/Organization	Partner Institutions/Organizations
Mitigation of Greenhouse Gases in the Transportation Sector	TUBITAK (TARAL 1007) Project (Client: Ministry of Transportation)	2006	2009	TUBITAK MAM Energy Institute	ITU, Kocaeli University
Establishment of Hybrid Vehicle Technologies Excellence Center	TUBITAK (TARAL 1007) Project	2007	2010	TUBITAK MAM Energy Institute	-
Micro-Cogeneration System with Fuel Cell	TUBITAK (TARAL 1007) Project (Client: EIE)	2006	2010	TUBITAK MAM Energy Institute	ITU, Kocaeli University Demirdöküm
E2PHEST2US- Solar Energy Thermionic-Thermo Electrical Combined System Based Heat and Electric Energy Production	EU FP7 Project	2010	2012	TUBITAK MAM Energy Institute	In partnership with 7 countries
Cost Effective Solar Collectors with Low Emission and Long Life Paint Use (TERMISOL)	EU FP6 Project	2006	2009		In partnership with 6 countries
Development of Technology for Burning the Biomass and Biomass/Coal Compounds in Circulating Fluidized Bed	TUBITAK (TARAL 1007) Project (Client: EIE, Directorate General for Forestry)	2007	2010	TUBITAK MAM Energy Institute	METU, GAMA
Production of Liquid Fuel from Biomass and Coal Compounds	TUBITAK (TARAL 1007) Project (Client: TKİ, EIEİ)	2009	2013	TUBITAK MAM Energy Institute	HABAŞ-UMDE ENGINEERING, Marmara University, ITU
Energy Generation Pilot Facility Based on Coal Gasification Technology	TUBITAK TEYDEP Project (Project Owner: Zorlu Energy)	2009	2012	TUBITAK MAM Energy Institute	-
Benefitting from Thermal Station Waste Heat (TSAD)	In TUBITAK 1007 Project	2006	2011	TUBITAK MAM and YTÜ	EÜAŞ, Ex EIE

In Turkey there are research activities to address agricultural drought that are closely related to climate change adaptation. A new center, "Drought Test Center," which is the first of its type in Turkey and the third in the world, was established under the Bahri Dağdaş International Research Institute at Konya. Research at this center will include increasing resilience to drought due to climate change, and developing crop varieties that are more resistant to climate change.

R&D studies within the private sector on mitigation of greenhouse gas emissions and adaptation to climate change are supported by various institutions and organizations including TUBITAK, the Ministry of Science, Industry and Technology and TTGV. The "TTGV Environmental Support Program" provides financial support for projects carried out by industrial enterprises in the fields of environmental technologies (clean production/sustainable production), energy efficiency and renewable energy. One of these projects, Environmental Technology Support promotes projects that: minimize consumption of energy, water and raw materials; produce innovative processes to minimize waste; and implement feasible and economical clean production technologies in industry.

The Energy Efficiency Support Program was established to protect Turkey's competitiveness in energy intense sectors; decrease its foreign dependency; contribute to the mitigation of greenhouse gas emissions; and promote related industrial activities in a way that limits the increase of energy prices. Objectives of the support include providing funding for projects in the field of energy efficiency. The Renewable Energy Support Program funds investment projects related to the generation of energy from renewable energy sources including wind, sun, biomass, biogas and geo-thermal.

8.3. Systematic Observation

The General Directorate of Meteorology (SMS) is the focal point for all kinds of atmospheric measurements and modeling. National monitoring and modeling activities and international cooperation of the SMS have undergone significant developments in recent years. Existing oceanographic monitoring and terrestrial monitoring programs of the State Hydraulic Works programs have continued. A new long-term program has begun in observation and monitoring of terrestrial ecosystems through the ICP-Forest Program launched by the General Directorate of Forestry. This section was prepared according to reporting principals indicated in decision of 11/CP.13 of the UNFCCC Conference of the Parties.

8.3.1. Atmospheric Climate Observation Systems

Different institutions in Turkey have participated in international monitoring studies as observers or as active participants providing data to the programs. In its role as a member of the World Meteorological Organization (WMO), the SMS participates in all relevant WMO programs, providing data to some of them. In particular, the SMS participates actively in the Global Observing System (GOS); the Global Climate Observing System (GCOS); the Surface Radiation Network (SRN); and the Global Atmospheric Watch (GAW).

Among these programs, the GOS is an umbrella program where meteorological data from every country around the world is compiled. The GOS includes land, atmosphere and space based observation platforms that are operated by the member countries. The GOS is composed of five sections, including surface measurements (11,000 stations), marine measurements (4,000 ships and 27,000 buoys), upper atmospheric measurements (1,300 upper atmosphere stations), and observation made from aircraft and satellites (nine meteorology satellites and 300,000 observations annually from planes). Turkey, through the SMS, provides data from 359 stations to the GOS program. Two hundred and twenty seven of these stations are climatological and 132 of them are synoptic stations.

GCOS consists of Global Surface Network (GSN) and Global Upper Air Network (GUAN). Stations located in these two networks are not different from the stations in the GOS program. A selection of the GOS stations with high quality data and extending back an adequate period of time also serve as a GCOS stations. There are approximately 950 stations in the GSN and 150 stations in GUAN networks and Turkey contributes to the GSN and GUAN programs with 7 and 1 stations, respectively. Upper atmospheric measurements are undertaken in 8 stations through the SMS. Although all data generated in these eight stations are transferred to the GOS program, data from one of the stations' (Ankara Meteorology Station) are also submitted to the GUAN network. Information related to the stations contributing to the global programs on atmosphere is provided in Table 8.4.

Table 8.4. Stations Contributing to the Atmospheric Global Program

Number of Indices	Name of the Station	Longitude	Latitude	Altitude (m)
GSN Stations				
17040	Rize	41 02N	40 31E	9
17062	İstanbul, Göztepe	40 54N	29 09E	18
17074	Kastamonu	41 22N	33 47E	800
17090	Sivas	39 45N	37 01E	1,285
17170	VAN	38 28N	43 21E	1,662
17240	Isparta	37 45N	30 33E	997
17375	Finike	36 18N	30 09E	2
GUAN Station				
17130	Ankara	39 57N	32 53E	891
Stations where upper atmosphere ozone measurements are made and data submitted to the World Ozone and Ultraviolet Radiation Data Center (WOUDC).				
STN 348	Ankara Brewer-total ozone, 9.11.06 – 28.02.09	39 57N	32 53E	891
STN 348	Ankara ozonesonde (ECC) 13.01.94 – 26.12.01	39 57N	32 53E	891
STN 348	Ankara ozonesonde (ECC) 15.01.03 – 26.05.10	39 57N	32 53E	891
GAW stations				
TRA	Ankara regional station	39 95N	32 88E	896
TRU	Çubuk regional station	40 50N	33 00E	1,196

The Surface Radiation Network (SRN) is another network operated by the WMO. The SRN was established to monitor changes in solar radiation reaching earth. There are 135 stations in the existing network with radiometric data longer 30 years. Results of radiometric measurements made all over the world are collected at the GAW data center in Leningrad, Russia. Long term changes in solar flux are assessed and Turkey sends data to SRN from 55 stations.

Turkey also contributes to the WMO's Global Atmospheric Watch Program (GAW). GAW is a network of stations from approximately 80 countries to monitor changes in the composition of the atmosphere throughout the globe. The GAW program is focused on six parameters, including ozone, UV radiation, greenhouse gases, aerosols, reactive gases and rain chemistry. Turkey participates, through the SMS, to ozonesonde and column ozone collections networks with one station each.

Turkey's contribution to global observation programs is provided in Table 8.5, Table 8.6 and Table 8.7.

Table 8.5. National Contribution to Basic Global Earth Climate Parameters*

Global measurement networks indicated in GCOS system	Parameters (ECV)	Number of operating stations currently	Stations required to be operating according to the GCMPS	Number of stations expected to be operating in 2010	Number of stations providing data to international data centers	Number of stations that have submitted retroactive long-term data to international centers
GCOS Surface	Air temperature	7	7		7	7
Network (GSN)	Precipitation	7	7		7	7
All World Weather Observation/Global Observing System (WWW/GOS) Surface Network	Air temperature, pressure, wind speed and direction, water vapor	227 (Climatological Stat.) 132 (Synoptic Stat.)	227 (Climatological Stat.) 132 (Synoptic Stat.)		58 (RBCN) 58 (RBSN)	
	Precipitation	227 132	227 132		58 58	
Current situation SRN	Surface radiation					
Solar radiation and radiation equilibrium data	Surface radiation	55	55		55	
Ocean drifting buoys	Air temperature and pressure					
Moored buoys	Air temperature and pressure					
Volunteer Ship Climate Observation Project (VOSClim)	Air temperature, pressure, wind speed and direction, water vapor					
Ocean Reference Mooring Network and Sites on Small Isolated Islands	Air temperature, pressure, wind speed and direction, Precipitation					

* UNFCCC, 2008 - Table 1a

Table 8.6. National Contribution to Global Upper Atmosphere Climate Data*

Global measurement networks indicated in GCOS system	Parameters (ECV)	Number of operating stations currently	Stations required to be operating according to the GCMPS	Number of stations expected to be operating in 2010	Number of stations providing data to international	Number of stations that have submitted retroactive long-term data to international centers
GCOS Upper Atmosphere Network (GUAN)	Upper atmosphere wind speed and direction, water vapor	8	8		1	1
All WWW/GOS Upper Atmosphere Network	Upper atmosphere air temperature, wind speed and direction, water vapor	8	8		8	

* UNFCCC, 2008 - Table 1b

Table 8.7. National Contribution to Global Atmosphere Composition Data*

Global measurement networks indicated in GCOS system	Parameters (ECV)	Number of operating stations currently	Stations required to be operating according to the GCMPS	Number of stations expected to be operating in 2010	Number of stations providing data to international	Number of stations that have submitted retroactive long-term data to international centers
WMO/GAW Global Atmosphere CO2 and CH4 Observation Network	CO_2, Methane, Other greenhouse gases					
WMO/GAW ozonesonde network (a)	Ozone	1			1	1
WMO/GAW column ozone network (b)	Ozone	1			1	1
WMO/GAW Aerosol network (c)	Aerosol optical depth, Other aerosol features					

* UNFCCC, 2008 - Table 1c

The Meteorological Instruments Calibration Center has been established in the SMS and has been adopted as the calibration center for 9 Economic Cooperation Organization (ECO) countries (Kazakhstan, Afghanistan, Azerbaijan, Iran, Kyrgyzstan, Pakistan, Uzbekistan, Tajikistan and Turkmenistan). The center will provide calibration services in the coming years.

In addition to the SMS, the MEU also provides atmospheric monitoring data to the European Monitoring and Evaluation Programme (EMEP). EMEP is the scientific leg of the UNECE Long Range Transnational Air Pollution Convention. The EMEP network consists of approximately 100 rural and suburban air pollution monitoring stations which are evenly distributed throughout the Europe. EMEP stations measure the chemical composition of atmospheric aerosols and rain water, as well as atmospheric concentrations of some gaseous pollutants, such as SO_2, NO_X and O_3. These measurements are conducted throughout Europe and play an important role in calibration of EMEP models. Turkey's only EMEP station is located in Çubuk (Ankara). Information on the station was provided in previous sections. The Ministry of Health submitted data generated at this station to EMEP secretariat in Norway from 1993-2010. Since 2010, management of the Çubuk Station has been transferred to the MEU (repealed MEF).

8.3.2. Oceanographic Climate Observation Systems

With respect to oceanographic observation programs, the General Command of Mapping (GCM) is a member of the European Sea Level Service (ESEAS). The GCM is also the member of the Permanent Service for Mean Sea Level (PSMSL), which is the center where data from oceanographic stations around the world are compiled and evaluated. The GCM had been a participant in the ESEAS infrastructure project (ESEAS-RI) from 2005-2008. Within the framework of this project it undertook the responsibility of analyzing the GPS data coming from GCM ESEAS oceanographic stations.

Turkey's Current Sea Level Measuring Network (TUDES) consists of 19 automatic oceanographic stations. Sea level data produced through the TUDES network are sent to PSMLS annually. Sea level data generated in the Antalya-I station from 1935-1997 were shared within the ESEAS and ESEAS-RI projects annually and at present, hourly sea level data received from station Antalya-II are still submitted to ESEAS.

As a part of the Global Ocean Observing System (GOOS), the METU Marine Sciences Institute is a member of EuroGOOS and MedGOOS and it is the founder of the Black Sea GOOS and Secretariat of the Executive Committee. The institute also participates in the International Geosphere-Biosphere Program.

8.3.3. Climate Observation Systems

Contributions to global terrestrial climate parameters are presented in Table 8.8. Important terrestrial observations are made at the national level. Systematic observations of forests, in relation to climate change are made by the Directorate General of Forestry within the framework of ICP-Forest. ICP-Forest was launched in 1985 to monitor the forest ecosystems of Europe. The ICP-Forests monitoring network consists of a 16 km x 16 km grid system and covers all of Europe was formed to assess to what extent European forests are impacted by air pollution.

ICP-Forest members states develop their own test plots and results derived from the measurements made in these plots are submitted to the ICP-Forest secretariat. ICP-Forest consists of two levels (Level 1 and Level 2) with different monitoring activities. As of 2010 there are about 6000 Level 1 plots and approximately 850 Level 2 plots in Europe. Although there are numerous Level 1 plots, relatively simple observations like assessment of the crown condition, needle/leaf loss rates, distribution of needle species are undertaken in these plots. However, much more sophisticated measurement programs are carried out in Level 2 plots, including crown condition, soil water content, needles and leaves, increment and yield, sedimentation, meteorology, vegetation, phonological observations, air quality, ozone damage, and dead-cover.

Turkey began participating in ICP-Forest in 2006 with 35 Level 1 plots. Preliminary investigations have promoted the development of approximately 700 Level 1 and 50 Level 2 plots in Turkey. As of 2010, 527 Level 1 and 15 Level 2 plots have been established. In order to carry out Level 2 measurements, a fully equipped laboratory was established in İzmir. Commissioning of this laboratory is currently in progress and the launching of approximately 200 Level 1 and 35 Level 2 plots is planned for the coming years.

Systematic observation studies in rivers and lakes are coordinated by the State Hydraulic Works (SHW), Head of the Department of Study and Planning, and Section Chief of Observations. In this observation program executed by the SHW, 1,149 flow observation, 135 lake level observation, 161 snow depth measurement, 357 meteorology and 1,038 water quality measurement stations have been launched. Moreover, water level measurements have been performed in 700 wells, to determine static water levels in the basins where underground water is processed. Another study which can be included in continental systematic observations is the monitoring of agricultural meteorology, which has been undertaken by establishing automatic meteorological stations within the regional directorates of the General Directorate of Agricultural Enterprises (TİGEM). This activity is jointly coordinated by TİGEM and SMS and began in 2011. The stations have been established and monitoring launched at the following regional Agricultural Directorates: Adana Ceyhan, Hatay, Polatlı, Antalya Boztepe (Aksu), Şanlıurfa Ceylanpınar, Malatya Sultan suyu, Eskişehir Mahmudiye, Lüleburgaz, Kırşehir Malya, Sivas Ulaş, Konya Altınova, Konya Gözlü, and Amasya Gökhöyük.

The objective of Agricultural Monitoring and Information System Project (TARBİL) is to investigate the relation between climate, soil topography and productivity. The project is coordinated by the Ministry of Food, Agriculture and Livestock (MFAL), the SMS and the TurkStat. It is currently at the initiation stage and studies for building necessary infrastructure to undertake the project continue.

Apart from the TARBİL project, there are other agreements between the MFAL and the GDM to conduct joint studies on the issues like calibration of humidity measurements in the soil, calibration of prediction and early warning systems, phenological observations, the establishment of agricultural observation network, as well as analysis of impacts of the climatologic changes on agricultural and meteorological drought. Some of these studies have already been started and others are under preparation.

Table 8.8. National Contribution to Global, Continental Climate Parameters*

Global measurement networks indicated in GCOS system	Parameters (ECV)	Number of operating stations currently	Stations required to be operating according to the GCMPS	Number of stations expected to be operating in 2010	Number of stations providing data to international	Number of stations that have submitted retroactive long-term measurements to international centers
GCOS current situation river flux network (GTN-R)	River discharge					
GCOS current situation Lake level/area/ temperature network (GTN-L)	Lake level/area/ temperature					
WWW/GOS synoptic network	Snowpack	132				

* UNFCCC, 2008 - Table 5

8.4. Assistance to the Developing Countries

Turkey also provides assistance in systematic observations to developing countries through bilateral and multilateral agreements. The "Meteorological Instruments Calibration Center" of the SMS as the calibration center of the Economic Cooperation Organization (ECO) is one example of this assistance. The Center will provide calibration service to Kazakhstan, Afghanistan, Azerbaijan, Iran, Kyrgyzstan, Pakistan, Uzbekistan, Tajikistan, and Turkmenistan.

In addition, through protocols signed with Azerbaijan and the Turkish Republic of Northern Cyprus (TRNC), 2 and 7 VSAT satellite communication systems were established in the Republic of Azerbaijan and in TRNC, respectively. These communication systems were operational by the end of 2004. As a result of change of the main system in 2010 VSAT Satellite Systems in these countries were also renewed and with the new system website of the SMS was started to be used more actively. Also, a software package for Meteorological Communication and Application Package (METCAP) developed by the software specialists in the SMS was updated. METCAP software is used by Azerbaijan, TRNC, Bosnia Herzegovina and DR Congo.

Within the scope of regional cooperation, Black Sea and Middle East Flood Early Warning Project is being executed in cooperation with the WMO and includes the participation of Bulgaria, Azerbaijan, Armenia, Georgia and Syria. The project will last for five years.

8.5. Additional Information

METEOROLOGICAL FORECASTS

Atmospheric and meteorological forecasts have been the responsibility of the SMS since the 1930s. Since 2003 the existing manual meteorological stations in the country have been replaced by fully automated meteorological observation stations (AMOS). There are 463 AMOS operating in different regions of Turkey. Their number is planned to increase to 709 by the end of 2012.

MEASUREMENTS OF OZONE AND ULTRAVIOLET RADIATION

Ozone measurements in Turkey began in 1994. In Ankara, meteorological station ozone sensors which can make measurements and transmit data to a surface station are used with a meteorological balloon. In this way vertical ozone profile in the atmosphere can be measured. Ozonesonde measurements are currently made once a month.

The SMS, in addition to ozone profile measurements, started to measure column ozone abundance and UV radiation from surface using a Brewer Spectrophotometer in 2006, and continues this use on a daily basis. Ozone data generated from both ozonesonde and Brewer spectrophotometer are submitted to the World Ozone and Ultraviolet Radiation Data Center (WOUDC) to which SMS is a member.

UV-B radiation measurements, using a UV-Biometer, have been carried out by the SMS since 1997 at the Ankara Keciören Meteorological station using a UV-Biometer device. Measurements of UV-B radiation using solar radiometers are carried out in 10 different cities, including Akçaabat, Aksaray, Elazığ, Göksun, Mardin, Oltu, Sivas, Tarsus, Tokat and Van.

SYSTEMATIC MODELING STUDIES

The SMS makes systematic calculations with a series of models and publishes the outputs via internet. Among the studies carried out by the SMS, numerical weather forecasts are the most important. The model ALADIN/ALORO has been the most significant model used in numerical

weather forecasts. The model is operated four times daily to produce hourly forecasts up to 72 hours ahead.

Another model used in numerical weather forecasts is the MM5 model developed by the US National Center for Atmospheric Research (NCAR). MM5 is a model that is frequently used by many meteorology organizations around the world and has been in use in the SMS since 2004.

The METU-3 Wave Model was developed by the METU, Department of Civil Engineering, Coastal and Ocean Engineering Laboratory with cooperation between the SMS, the Turkish Navy, the Office of Navigation, Hydrography and Oceanography, and the Directorate of Railways-Harbor-Airports Construction. This was undertaken in the framework of the NATO project "Determining the Wind Wave Climatology along Turkish Coasts." With the implementation of this new model, system performance has increased by approximately a factor of ten. The model is operated by the SMS systematically and the results are disseminated via internet.

The EURAD model, which is a regional scale transport model, is implemented in the SMS modeling system through a joint project between the SMS and Köln University (Germany). Turkey can now use this model to calculate ground level pollutant concentrations within the country.

AIR QUALITY MEASUREMENTS

Urban air quality measurements have been performed in Turkey since 1980. Until 2005, the measurements were made by the Ministry of Health using manual techniques. After 2005, the former MEF started replacing so-called "semi-automatic" stations with fully automated air quality monitoring stations. In 2005, 31 automatic stations were initiated beginning with cities with heavy air pollution. In 2007, the air quality network was expanded to 76 cities through the implementation of 45 new stations.

Along with these 76 stations installed by the former MEF, 10 stations in İstanbul and 6 stations in İzmir were initially established by the Metropolitan Municipalities of these cities and were subsequently transferred to former MEF. With the addition of these stations, the number of stations in national observation network increased to 92. In 2009, the number of cities in the national air pollution observation network reached 80 and the number of stations reached 100. In each of these stations, concentrations of SO_2 and PM10 are measured. In addition in some of the stations located in Ankara, İstanbul and İzmir concentrations of NO, NO_2, O_3 and CO are also measured.

9. EDUCATION, TRAINING AND PUBLIC AWARENESS

9. EDUCATION, TRAINING AND PUBLIC AWARENESS

9.1. General Policy

Legislation related to environmental protection and public awareness of environmental issues is defined in the Environment Law (No. 2872; Accepted: 9/8/1983; Revised: 26/4/2006). According to the law, environmental issues shall be present in the curriculum of formal education institutions of the MNE, beginning at the preschool level. The law also describes that environmental issues should be part of radio and television programs as an element of mass education.

To address the challenges of communicating, teaching, and learning about climate change, Parties to the UNFCCC adopted the New Delhi work programme on Article 6 of the UNFCCC (decision 11/CP.8) in 2002, a five-year country-driven work programme that engaged all stakeholders in the implementation of climate change commitments and recommended a list of activities that could be undertaken at the national level. The five-year mandate for the execution of the New Delhi work programme came to an end in 2007. However, in December 2007 Parties recognized that this work programme had proved to be a good framework for action (FCCC/SBI/2007/34) and decided to adopt the amended New Delhi work programme (ANDWP) for a further five years (decision 9/CP.13). The ANDWP called for a review of progress in the implementation of the work programme to be undertaken by 2012. There were several changes in the ANDWP in that public awareness, public participation and public access to information were given more importance, as was international cooperation.

After Turkey's ratification of the UNFCCC in 2004, Regional Environment Center (REC) Turkey was made the national focal point from 2005-2007. Several activities related to the first implementation period of the New Delhi Work Programm were reported in Turkey's Initial National Communication.

Since 2008, the General Directorate of Environmental Management of the Ministry of Environment and Urbanization has been the national focal point. Relevant activities have been continued by the Department of Climate Change and the Department of Education and Publication.

Turkey's medium and long term strategies for education, capacity development and establishing institutional capacity were described in the National Climate Change Strategy for the 2010-2020 period (May 2010). Accordingly, in the medium term, activites will include the following objectives:

- Public awareness and institutional capacity will be strengthened in order to reduce the impacts of climate change;
- Active participation will be ensured in the UNFCCC negotiations to contribute to the development of a comprehensive and functional international cooperation mechanism on mitigation and adaptation to climate change.
- Public awareness will be raised to promote climate friendly consumption patterns through joint efforts of all sectors of society, including the public and private sectors, universities and non-governmental organizations.

In the long term, national priorities are described as:

- Scientific studies on climate change shall be encouraged. A climate change research institute shall be established to conduct scientific research on climate change at national and regional levels.

Activities realized in the context of both the New Delhi Work Programme and the National Climate Change Strategy are presented in detail in the following sections.

9.2. Education

Education actitivities implemented at the primary school, high school and university levels are presented in this section.

The relationship between humans and the environment has been integrated into the Turkish primary school curricula since 2004. The revised programme, defined as Science-Technology-Public-Environment, addresses environmental problems with social and scientific dimensions. In addition to the programme revisions, the MNE has implemented several projects and campaigns on environmental education for teachers and students, sometimes in cooperation with NGOs and the private sector.

The Environment and Forestry Protocol, which contains climate change issues, was agreed on between the MEU and MNE in March 2010 and will circulate for five years. The most outstanding feature of the protocol is that, it envisages the preparation of printed material for teachers and primary school students to build environmental awareness.

Since 2007, there have been a large number of activities related to climate change education lead by the MNU and MNE and cooperations between NGOs, private sector and universities. Although elements of these projects are directly related to climate change, some are more closely related to forestry and energy efficiency. Several examples of projects related to education activities undertaken since 2007 are presented in Table 9.1.

Details about the projects mentioned in Table 9.1 are presented below.

Table 9.1. Science, Technology and Innovation Indicators

Project /Activity	Implementing Organization	Target Population	Project Output/ Population Reached
Environmental Education Campaign	MEU Publications and Public Relations Department	Primary school teachers	2,400 teachers (81 provinces x 300 teacher/province)
Mobile Vessels	MEU Publications and Public Relations Department	Teachers, students, local authority representatives, chambers of commerce and Trade, SMEs, housewives, university students	5,000,000 persons, 500,000 young trees, 15,000 shopping bags
Environmental News Bulletin	MEU Publications and Public Relations Department	Decision makers, academics, press, municipalities, chaplains	77,000 persons/week
Material Support for Applied Environmental and Forestry Education	MEU Education and Publications Department	Primary and high schools teachers, governmental authorities	2,400 primary school
Blue Sky, Green Leaf	MNE	Primary school students	1,500 students
Children's Fruit Gardens	MNE, Cappy	Primary school students and parents	Fruit garden plantation in 70 primary schools

Table 9.1. Science, Technology and Innovation Indicators

Project /Activity	Implementing Organization	Target Population	Project Output/ Population Reached
Recycle for the Future – Education of the Educators Program	MoNE, Environmental Protection and Packaging Waste Recovery and Recycling Trust (ÇEVKO)	Primary school students and teachers	318,287 students, 1,185 teachers (valid for the years 2009 – 2010)
MoNE – Turkish Foundation for Combating Soil Erosion, for Restoration and Protection of Natural Habitats (TEMA)	MoNE, TEMA	Primary school teachers	1,770 teachers
Green Pack	REC-Turkey, MNE, MEU, BOSCH	Primary school students and teachers	900,000 students, 9,000 teachers (valid for 2010)
Renewable Energy Sources Young TEMA University Seminars	TEMA	University students	300 students
Nature and Erosion Camp	TEMA	University students, teachers, chaplains	665 persons
Young TEMA High School Project	Young TEMA	High school students	100,000 students
State of the World – Climate Change Conferences	Young TEMA	University students	5,000 persons
Environmental Protection and Climate Change Conferences & Seminars	Young TEMA	Public	40,000 persons
Eco Schools	Turkish Environmental Education Foundation (TURCEV)	Primary schools students and teachers	246,711 students 17,901 teachers
Learning About Forests-LeAF	TURCEV	Primary schools students and teachers	33,690 students 1,849 teachers
Young Voices for the Environment	TURCEV	Primary schools students and teachers	1,200 students 120 teachers
Traces of the Future	MNE, Tuana Foundation of Education for Children Willing to Study (TOÇEV), TescoKipa, Unilever	Primary schools students	23,683 students
Climate Meeting in High Schools	British Council	High school students, teachers	1,385 students, 30 teachers
Before it Disappears	REC Turkey, AKBANK	Primary school students, AKBANK personnel	60 personnel 10,000 students
Climate Class	MEU, UNEP, UNDP	Primary school students, teachers	150 teachers 2,000 students

- Applied Environmental and Forestry Education Project

The Applied Environmental and Forestry Education Project has been implemented in 81 provinces and coordinated by the MEU Education and Publications Department. Environmental school competitions, World Environment Day activities, World Forestry Day activities, planting, theatre fests, and field trips are some of the activities undertaken through this project.

• Blue Sky, Green Leaf

The MNE started the Blue Sky, Green Leaf Project in November 2009. The target of the project was to develop the awareness of the Turkish primary schools students to the effects of climate change on individuals and protecting the natural environment. Primary schools have been evaluated based on a set of criteria and rewarded for their efforts. The criteria include waste management, recycling, physical conditions, and environmental protection measures. The project is implemented in 81 cities across Turkey and has received support from the public, as well as parents.

• Children's Fruit Gardens

The Children's Fruit Gardes Project represents a strong collaboration between the private sector (Cappy), public sector (MNE) and university (Ankara University Development Studies Research Center – AKÇAM). The project aims to establish 70 fruit gardens in 70 primary schools in 7 cities (Ankara, Istanbul, Izmir, Bursa, Adana, Antalya and Gaziantep). The Fruit Garden Clubs established at each project school promote sustainability (http://www.cocuklarinmeyvebahceleri.com).

• Recycling for the Future

The Recycling for the Future Project is implemented by MNE and ÇEVKO and represents one of the best examples of public sector-NGO cooperation. The ongoing project educates educators and students on recycling issue. From 2009-2010, the project reached 11,185 teachers and 318,287 students in 653 schools in 15 provinces.

• Environmental and Erosion Education Seminars

This project represents another strong public sector-NGO collaboration that educates teachers in primary schools on environmental and erosion issues. Climate change science and adaptive responses are issues addressed in the seminars and 1,770 teachers were reached in this program between 2007 and 2010.

• Green Pack Education Set

The Green Pack is an education set and has been implemented by REC Turkey with support from the Life 3rd Countries Program. The project began in 2005 in all provinces in Turkey and the second stage continues to supply materials for primary school teachers through support from BOSCH Household Appliances. The project website highlights its efforts to help teachers share materials and experiences (http://www.yesilkutu.net).

• State of the World

Young TEMA implemented a climate change poster contest in 10 high schools in 2009. The 3 winning posters were distributed to almost 100,000 individuals across the country. In addition, the Turkish translation of State of the World 2009 was presented to 500 high school students. The Young TEMA groups has also prepared climate change information stands across 40 universities in Turkey and has organized conferences.

• Young Voices for the Environment Network

The Young Voices for the Environment Network has been established for high school students and implemented by TURCEV. The network produces news on the environment and has 44 member high schools across Turkey. Climate change is one of the 7 issues that the project addresses. The network produces environment related news on local problems and helps young people to establish relationships with students from Europe. Sixty schools, 120 teachers and 1,200 students are participating in the project.

• Eco-Schools

The Eco-Schools Program in Turkey has been implemented by TURCEV. The purpose of the project is to educate primary school students on environmental awareness and sustainable development. The project has been implemented in 45 provinces in Turkey and there are 450 eco-schools working with 246,711 students and 17,901 teachers (http://www.turcev.org.tr).

• Learning about Forest – LeAF

Turkey joined the LeAF program in 2004 through TURCEV. The program aims to help children to develop their knowledge of forests through trips and to share their experience at the international level. In 2011, the program focused on the impact of aforestation and reforestation on the carbon cycle and on the forest life cycle. Fifty-five schools, 33,690 students and 1,849 teacher participate in the program (http://www.turcev.org.tr).

• Traces of the Future – Developing Awareness for Environmental Protection (Global Warming) Project

The Traces of the Future project represents one of the best examples of cooperation between public authorities, the private sector and NGOs. It began in 2008 and is implemented by the MNE, Tuana Foundation of Education for Children Willing to study (TOÇEV), TescoKipa and Unilever. The project addresses climate change education through activities, like theatrical performances. Other parts of the education program include a book on climate change and a theatrical performance for children. The project website offers an agenda for children to follow (http://www.yarininizleri.org.tr). Provinces participating in the province include: Mersin; Ankara; İzmit; and Çorlu. Between 2009-2011, the project reached 23,683 students.

• Climate Class

Climate Class is a capacity development project on climate change education for primary school students. It is part of the Enhancing the Capacity of Turkey to Adapt Climate Change project coordinated by the MEU and implemented by the UN Joint Programme (MDGF-1680). The main focus of the project is to educate educators. It prepared a handbook for educators called the Climate Class-Handbook for Climate Change Adaptation. The handbook is a resource for educators containing detailed, updated and practical information on different aspects of climate change. The project aims to reach 150 teachers and 2,000 children in the Seyhan River Basin in Adana.

• Before it Disappears

The purpose of this project is to develop awareness and sensitivity on climate change in Turkey by exhibiting scientific evidence through artwork. The project will focus on 15 areas of Turkey that are the most vulnerable to the impacts of climate change and exhibit the stories of these areas through photographs. AKBANK volunteers in different areas of the country are informed of regional climate change vulnerabilities and then provide seminars to primary schools students on the issues. Sixty-one volunteers work on this project in the provinces of Istanbul, Niğde, Çanakkale, Hatay, Tekirdağ, İzmir, Adana, Kırklareli, Çorum, Konya and Manisa.

Box 9.1. Program for International Student Assessment (PISA) Survey

According to the results of the PISA survey made in 2006:

- Only 10% of the 15 years old young people in Turkey knew about the increase in the concentration of greenhouse gases in the atmosphere;
- 27% were not interested in the issue at all;
- 64% stated that they know about the impacts of deforestation;
- Young people living in the less developed Eastern parts of Turkey were less aware of environmental problems and were more optimistic about the next 20 years related to problems such as deforestation and air pollution, compared to the young people living in other regions; and
- Awareness, attitudes and individual responsibilities related to environmental problems differ in Turkey based on geographical regions (Teksoz, Tekkaya and Erbas, 2009).

9.3. Training

This section presents training activities to develop the capacity of technical and administrative personnel in Turkey since 2007 (Table 9.2).

Table 9.2. Training on Climate Change – Good Practices

Training Project /Activity	Implementing Organization	Target Population	Project Output/ Reached Population
Hand in Hand for Energy Efficiency ENVER – Energy Efficiency Project	MENR	Industrial zones (OSB), chambers of commerce, local people	
Environmental Education Campaign	MFWW, GDF	Technical personnel, forest workers, children, young people, forest villagers, hunters, farmers	
Promote Climate Change Policies in Turkey Project - LIFE05/TCY/TR164	REC Turkey	Public institutions, private sector, NGOs	564 experts, 208 NGO representatives
Capacity Building in the Field of Environment - IPA 2007	REC Turkey, MEU	Public institutions, private sector, NGOs media	600 persons
Capacity Building for Climate Change Management in Turkey	MEU, UNDP	Public institutions, private sector	1,038 persons
Enhancing the Capacity of Turkey to Adapt to Climate Change-UN Joint Programme (MDGF-1680)	MEU, UNDP	Technical personnel, decision makers, local people	1,443 persons
Kadıköy Municipality Calculating Greenhouse Gas Discharges	Kadıköy Municipality, REC –Turkey	Municipality personnel	
Calculating Carbon Footprint Project	WWF-Turkey, Vodafone-Turkey	Private sector	
Publication: Adapting to Climate Change – Renewable Energy	TTGV	Producers and users of technology	

• Hand in Hand for Energy Efficiency - ENVER

Climate change trainings implemented by the EIE (General Directorate of Electrical Power Resources Survey and Development Administration) have been continued based on the requests of governmental institutions, such as the General Directorate of Religious Affairs, the Ministry of Education, TUBITAK. Energy management for industrial and domestic use and energy efficiency consultancy are some of the topics of trainings offered by EIE.

• Capacity Building for Climate Change Management in Turkey

This project has been implemented in cooperation with the Enhancing the Capacity of Turkey to Adapt to Climate Change-UN Joint Programme project. The main focus of the project is to increase the capacity of Turkish institutions to effectively participate in climate change negotiations and gain experiences with voluntary carbon markets. The project has been realized through cooperation with the Turkish Industry and Business Association (TUSIAD) to produce options for participation in voluntary carbon markets. Over three hundrend people participated in a workshop on Public – Private Sector Cooperation for Climate Change and 127 people participated in a workshop on the Carbon Economy. Two hundred and fourty-five individuals from public institutions participated in technical trainings related to international climate change negotiations and the project cycle for decreasing greenhouse gas emissions.

• Enhancing the Capacity of Turkey to Adapt to Climate Change-UN Joint Programme

Some of the trainings realized in the context of this programme are presented below:

Training and Workshop on Systems Approach for Climate Change Adaptation in the Seyhan River Basin

Systems approach training was provided to help participants build awareness of potential climate change impacts, prioritize challenges and develop solutions through systems approach techniques. The outputs of the training and workshop resulted in priorities for the Society Based Adaptation Grant Program. This training took place from February 16-18, 2009 with 95 participants from public institutions in Adana, Kayseri and Niğde, academics and NGO representatives.

Participatory Vulnerability Analysis Workshops

Participatory Vulnerability Analysis Workshops were organized in 11 different provinces (Tekirdağ, Trabzon, Kastamonu, Kars, Sivas, Şanlıurfa, Van, Antalya, Eskişehir, Samsun and İzmir). These workshops examined the impacts of climate change through local knowledge and observations. The 388 participants at the workshops were from development agencies in each of the provinces provinces, research institutions, local representatives of MTC, MEU, MFAL, MTC, MH, MCT, experts from municipalities, universities and NGOs.

Trainings on Eco-Efficiency (Cleaner Production)

Eco-efficiency trainings were undertaken on 28-29 January 2010 to enhance national capacity on clean production methods in cooperation with METU. The first stage of the training for 68 participants consisted of eco-efficiency basic training on eco-efficiency. The second stage of the training involved advanced level practical training for 25 participants from 9-11 February 2010. Participants included representatives from environmental and energy consultancy companies, universities, public institutions, unions, industrial enterprises, chamber of industries, and organized industrial zones. It was expected that participants would disseminate information and continue to implement training in this field.

Trainings on Climate Modeling

Climate modeling trainings were delivered by the ITU Avrasya Institute of Earth Sciences in Kayseri, Niğde and Adana on 1-3 June 2010 and on 4 October 2010 in Ankara. Trainings focused on climate change science, modeling climate change, regional projections and the data delivery subsystem (DDS) through case studies and by evaluating projections. Sixty-seven individuals from public institutions in 4 provinces participated in the trainings.

Certified Training Programme on Climate Change Adaptation Program and Turkey

The Certified Training Programme on Climate Change Adaptation Program and Turkey was implemented by UNEP, FAO, and UNDP in cooperation with METU over the course of four weeks. Thirty-three individuals from public institutions, the private sector, universities, research institutions, and NGOs participated in the trainings. The trainings were based on understanding existing capacities in Turkey, interrelations between the politics of climate change and sustainable development, project management, and human resources establishment for decision-maker mechanisms.

Trainings on Adaptation to Climate Change, Agriculture and Livestock

The FAO implemented this training for 500 participants, who were generally technical personnel, experts and managers from the MEU and MFAL.

9.4. Public Awareness

Projects on developing public awareness of climate change have been implemented since 2007 by various organizations in the public sector, private sector, NGOs, local authorities and cooperations. Examples of such projects are presented in Table 9.3.

Table 9.3. Public Awareness on Climate Change – Good Practices

Project /Activity	Implementing Organization	Target Population	Project Output / Reached People
Hand in Hand ENVER	MENR	Primary schools, parents, industrial zones (OSB), chamber of commerce, local people	53 provinces, 4,800,000 students
Nature Education and Science Schools	TUBITAK	Academics, university students, children, young people	130 projects
Alternative Energy Races: Formula - G / Hydroautomobil	TUBITAK	University students	Number of universities 16 (2005); 32 (2006); 42 (2007); 25 (2008)
Global Warming Children's Ballet	State Opera and Ballet (DOB)	Children and young people	17,000 spectators
Hayata Artı Kampanyası	Coca Cola	Public	
Seven Colored Lives for Seven Colored Lakes	WWF-Turkey, Siemens	Water users, water managers	1,400 persons
81 Provinces 81 Forests	MEU, TEMA, ISBANK	Public	
Good Agriculture and Modern Irrigation Pilot Applications and Trainings (2006 - 2010)	WWF-Turkey, EU, CFCU, Canon-Erkayalar, Eti Burçak, MAVA Foundation, Keyman, Coca Cola, ÖÇK, Siemens, Holland Agriculture Ateche	Farmers	1,515 persons

Table 9.3. Public Awareness on Climate Change – Good Practices

Project /Activity	Implementing Organization	Target Population	Project Output / Reached People
How is the Weather Tomorrow?	REC Turkey, AYGAZ	High school students, local people	11 provinces, 4,000 students
Book: Renewable Energy Again	WWF-Turkey	Public	
World Clock	WWF-Turkey	Public	Kırklareli, İstanbul, Eskişehir (most supportive cities in 2011)
Turkey – International Climate Change Workshop	British Council	Exhibition and seminar followers, online participants	250 persons
Turkish – Greek Climate Train	British Council	Public, National decision makers	15,600 persons, 18 persons
Catch Climate Change Photograph Contest	British Council	Public exhibition and online participants, leaders, national decision makers	38,334 persons, 8,273 persons 297 persons 15 persons
Carbon Meter	TEMA	Public	4,000 persons/month
Don't Let Our Future Melt	TEMA	Public	34,000 persons
Nature and Erosion Education Camps	TEMA	University students, teachers, chaplains	665 persons
Eco-politics	TEMA	Public	
Climate change – Water- Energy - Food – Goods Relationship	Bursa Rotary Club – GEF, Small Grant Programme, Nilüfer City Council	Primary school students, NGO representatives	1,200 students 55 persons
Ozi Project (Importance of Energy Efficiency and Insulation)	IZOCAM	Primary school students	34 schools 9,500 students
Protection of Ozone Layer Video Game Software Competition - Oozy	MEU	University students	
Climate Change as a Life Problem	Çankaya Municipality, ÇEVKO, SIMAT Ltd.	Public	20,000 booklet
Water Foundation Seminars on Climate Change	Water Foundation	Public	
Supporting Agricultural Publications Project (Trainings on Climate Change and Combating Drought)	TMFAL	Farmers, women	1,920 (participant farmers in 2010)
Introducing Zero Carbon City Campaign in Turkey	British Council, REC - Turkey	Public and NGOs	8,500 persons
Climate Adaptation Campaign for Turkey's Future	ETİ Burçak, WWF-Turkey	Farmers, local agriculture directories, administrative districts, farmers organizations	2,700 persons
Climate Court	British Council, UN Joint Program (MDG-F 1680), EU Information Centers	Educators, leaders at various decision making levels	8,273 persons 15 persons
Football for Everybody Education Pack Project	ÜLKER (Yıldız Holding)	Children between 6 and 12 years old	220,000 children in 5 years
Mayors for Sun	Greenpeace	Municipalities	

• Hand in Hand ENVER Project

The Hand in Hand Energy Efficiency Project has been implemented by the EIE, a sub directorate of MENR since 2008, based on the Energy Efficiency Law, which became effective in 2007. The project has started implementation in 53 provinces, where illegal use and loss of electricity is high. Approximately, 4,800,000 energy efficient light bulbs were distributed in these provinces to primary school students by exchanging energy efficient bulbs for old bulbs. The activities within the project target climate change mitigation and adaptation. Other activities of the project and number of participants are presented in Table 9.3.

Box 9.2. Hand in Hand for Energy Efficiency (ENVER) Project Activities

MENR – EIE – Hand in Hand for Energy Efficiency (ENVER) Project Activities –

- 4,800,000 electricity efficient light bulbs were distrubted in 53 provinces 2008 – 2009 by exchanging old bulbs;
- ENVER awareness sets were distributed to industrial zones and Chambers of Commerce;
- Advertisements were posted on public transport vehicles, bus stops and billboards;
- The 1st National Energy Efficiency Forum was held in January 2009;
- The 2nd National Energy Efficiency Forum was held in January 2010; and
- Campaigns and promotions were implemented in shopping centers in line with Energy Efficiency in the Retail Industry project to encourage customers to adopt energy efficiency practices.

• Nature Education and Science Schools

The TUBITAK Science and Society Directorate implemented a program to support nature education and science schools. Thirty-six projects related to climate change and renewable energy were supported in the context of this program in 2009 and 2010. TUBITAK also published monthly newsletters known as Science and Technology, Science for Children, and Curious Puppy.

• Alternative Energy Motor Racing: Formula - G/Hydro Automobile

Alternative Energy motor racing has been initiated by TUBITAK since 2005 for the purpose of developing public awareness on alternative energy sources, and encouraging the use of alternative energy sources, especially by university students. University students have been encouraged to design and construct cars that operate on clean energy sources like hydrogen and solar power. University teams from across Turkey participate in racing cars they have designed and produced. Races have created a great interest from the public. Sixteen universities participated in Formula-G in 2005, 32 universities in 2006, 42 in 2007 and 25 in 2008.

TUBITAK Alternatif Enerjil Araba Yarışları: Formula - G / Hidromobil

• Adaptation to Climate Change for Turkey's Future Campaign

WWF-Turkey has implemented trainings and pilot applications on agricultural water conservation, products resistant to drought and good agriculture applications since 2006 in Konya Closed Basin, Menderes River Basin and Catchment Area of Eğirdir Lake. To date, pilot activities have been implemented across 6,028.5 hecares in 24 locations and 1,515 individuals have received training through the project.

Since 2008 WWF-Turkey and ETI Burçak have been working on improved water resource management, and the use of modern techniques for irrigation in the Konya Closed Basin. Impacts of climate change on water resources and agriculture were investigated in 2009 through a project on Turkey's Future. Another project, Campaign for Adaptation to Climate Change for Turkey's Future, was implemented in 2010, as a continuation of "Turkey's Future." A vehicle was outfitted specially for the project and traveled across the most important towns in the Konya Closed Basin that use irrigation to inform local populations about climate change adaptation, and the importance of water resources and water conservation. During the week of travel, 2,700 individuals were reached. The project website is www.iklimeuyumseferberligi.com.tr.

• Climate Train

The Science Projects Department of the British Council and climate advocates from Turkey and Greece launched an activity entitled, We are going beyond the borders with climate train. The project transmits climate change related messages to passenger train travelers in Turkey and Greece. The Climate Train journey had operated daily since 2005 on a 12 hour journey departing each evenging at 20:00 from Selanik, arriving in Istanbul 12 hours later.

• NGOs Accredited by UNFCCC

TEMA was the first NGO in Turkey to be accredited by UNFCCC. After TEMA was accredited in 2008, the targets of the foundation have been revised to include training the public on climate change. Since this time, several additional Turkish organizations have been accredited by the UNFCCC, including the Research and Application Center of the Marmara University (MURCIR), the Economic Development Foundation (IKV), the TTGV, Federation of Consumer Associations, the Turkish Association for Energy Economics, the Turkish Confederation of Employer Associations, and TUSIAD.

• Carbon Meter

TEMA has provided a tool on its website for measuring individuals' carbon emissions from daily activities. The webpage receives an average of 4,000 visits per month.

Don't Let Our Future Melt

TEMA and TURMEPA launched the campaign entitled, Don't Let Our Future Melt, across Turkey. The focus of the campaign is to build public awareness of the causes of climate change and actions that can be taken to reduce impacts. The campaign has been implemented through the use of a mobile education vehicle that has travelled across nine cities since 2009. Through June 2011, 34,000 people have been reached through the project.

• TEMA Nature and Erosion Education Camps

The basic idea of the nature and erosion education camps was to train participants on mitigation of climate change through visual and applied techniques. It aimed to increase the ecological literacy of participants and to build skills for these participants to target other populations. Camps were

implemented in 2007, 2008 and 2009 with TEMA representatives, volunteers, teachers, university students (Young TEMA) and chaplains.

• Hayata Artı, Seven Colored Lives for Seven Colored Lakes & 81 Cities, 81 Forests

The business community has an important role in Turkey's accession process to the EU. TUSIAD, IKV and other organizations have been implementing projects related to climate change. Moreover, it is possible to observe many other cooperative efforts of the public and private sectors on public awareness projects on climate change.

Box 9.3. Examples of Climate Change Projects Launched by the Business Community

Examples of Climate Change Projects Launched by the Business Community

- Hayata Artı Project with Coca Cola
- WWF – Turkey and TOYOTA-SA – Protecting Forests
- Siemens and WWF – Turkey – Seven Colored Lives for Seven Colored Lakes
- Türkiye İş Bankası – TEMA - 81 Cities, 81 Forests
- AYGAZ – REC Turkey – How is the Weather Tomorrow
- ETİ Burçak ve WWF-Turkey – Turkey's Tomorrow
- WWF-Turkey and Turkish Assocation of Banks – Decreasing Carbon Emissions

• How is the Weather Tomorrow?

The project is implememented by REC-Turkey with support from AYGAZ, a Turkish energy company. The project began with the slogan, "A Step to Climate Change." Climate change education activities of the project have been implemented through the Sky TIR mechanism, which has been successful at reaching the public. The project has been the winner of one of Turkey's most prestigious public relations awards, the Sabre Awards and it has been one of the finalists for the Chartered Institute of Public Relations, CIPR Excellence Awards (http://www.yarinhavanasilolacak.org/).

Box 9.4. How is the weather tomorrow?

We set off in 2010 by asking, "How is the weather tomorrow?", because it is necessary to begin somewhere. We know climate change is much deeper than this question, as a global threat. We are trying to understand the issue begining with this question. "How is the weather tomorrow" is a campaign to make everybody aware... Ther purpose is to seek solutions together...

Art and Climate Change

• State Opera and Ballet – Global Warming, a Children's Ballet

The Children's Department of the State Opera and Ballet began to present a children's ballet performance called "Global Warming" in 2010. The performance has been presented by 25 young ballerinas from 2009 to 2011 in Ankara, Hatay and Eskişehir. Almost 17,000 people have seen the performance in these cities and local newspapers have covered the ballet in their articles.

• Catch the Climate Change Photography Contest

Fifteen climate advocates from Turkey's participants in the Challenge Europe project started a photography contest to visualize climate change in Turkey. This activity has been supported by the British Council. Photographs from the contest were published in a Turkish newspaper and were voted on by the public.

• Global Warming and the World Caricature Contest

In 2007 and 2008, the TEMA foundation launched the caricature contest on the subject of Nature and Humans. In 2007, the subject was Global Warming and the World. Participants submitted caricatures over the internet during the eight months of the competition and 20 young trees were planted for each winner.

United Nations Joint Programme on Enhancing the Capacity of Turkey to Adapt to Climate Change

In order to establish strategies and enhance the institutional capacity for Turkey to combat with climate change and manage its impacts, the United Nations Joint Programme was initiated. The Joint Programme aims to integrate climate change adaptation into national, regional and local policies within the framework of Turkey's sustainable development targets. A central goal of the Joint Programme is to enhance capacity to manage the climate change risks that threaten Turkey's rural and coastal development. The Ministry of Environment and Urban Development acts as the leading implementing agency responsible for the technical components of the programme. The Joint Programme is being implemented by United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), Food and Agricultural Organization of the United Nations (FAO) and United Nations Industrial Development Organization (UNIDO). This programme is funded by the Millennium Development Goals Achievement Fund (MDG-F) entrusted to United Nations by Government of Spain. Other relevant ministries such as the former Ministry of Agriculture and Rural Affairs and the Ministry of Trade and Industry will provide technical support for the implementation of the programme.

The Seyhan River Basin, which is the second largest basin after the Nile in Eastern Mediterranean, is agriculturally one of the most productive regions of Turkey and Europe. The basin is also one of the richest regions in the world in terms of biodiversity. It provides various agricultural opportunities for local populations including dry farming, irrigated farming and animal husbandry. According to

preliminary studies conducted by the IPCC, the Mediterranean Region of Turkey, which the Seyhan River Basin is a part of, was identified as the most susceptible and vulnerable region to global warming. Adaptation to climate change is thus a priority in this region.

The Climate Change Adaptation in the Seyhan River Basin Grants Programme is focused on three long-term targets: reducing the negative impacts of climate change; benefiting from the positive impacts of climate change; and ensuring the achievement of the Millennium Development Goals. The first target aims to reduce climate change risks during the process of achieving the Millennium Development Goals. The second target aims to identify priorities for managing climate change risks to build the adaptation capacity in the country, as well as implementing adaptation measures. The third target complements the first two targets and encourages the implementation of sustainable development principles in accordance with climate risks and adaptation needs. Through these three targets, innovative adaptation activities are being supported that empower local people in social and institutional fields while building the adaptive capacity to respond to climate change in the Seyhan River Basin. Launched in 2009, the Grants Programme enhances the capacity of communities and institutions in the Seyhan River Basin through piloting innovative adaptation actions, as well as by supporting changes in institution to decrease the adverse impacts and increase the benefits of climate change.

Eighteen projects are being supported in the basin, including 12 projects from Adana, 4 projects from Kayseri and 2 projects from Niğde. These projects aim in the long-term to improve good agriculture techniques, ensure food security, identify flood risks, ensure the use of alternative irrigation techniques and reduce the impacts of sea level rise while raising awareness and enhancing the capacity to adapt to climate change.

One of the most important features of the Joint Programme is its implementation of the Society Based Adaptation Approach. Related projects, implementing organizations and target populations are presented in Table 9.4.

One of the outputs of the project is a Needs Assessment Report (Tuncok and Yildirak, 2009, pg. 38). Three needs for the climate change education, training and public awareness have been described: i) raising awareness of management and technical aspects, ii) training, iii) in-service training. Training needs at the local, regional and national levels were highlighted. Furthermore, trainings were to be coordinated by governmental authorities.

Table 9.4. Climate Change Public Awareness - UN Joint Programme Grants

Project	Project Implementer	Target Population	Reached Population
Raising the Awareness of Farmers to Risks Encountered in Agricultural Production Relevant to Climate Change in Kayseri Province	Kayseri Provincial Directorate of Agriculture	Farmers	4,458 persons
Climate Scouts	Adana Branch of Society of Ecology Agriculture Organization	Primary school students	3,428 students
Establishing, Supporting and Developing the Adaptive Capacity of the People of Yüreğir Against Climate Change	Municipality of Yüreğir	Farmers, students, Yüreğir public	400 farmers, 25,000 students, 1,500 persons
Girls! Let's Take Pictures	Genç Doğa Association	Girls, parents, future families, calendar distribution, exhibitions	25 girls, 327 persons 1,000 persons 1,500 persons
The Development of Good Agricultural Techniques for the Sustainability of Natural Resources in the Catalan Potable Water Basin	Adana Provincial Directorate of Agriculture	Farmers	250 persons

Table 9.4. Climate Change Public Awareness - UN Joint Programme Grants

Project	Project Implementer	Target Population	Reached Population
Project for Poor Farmers and Women Living in Seyhan River Basin to Breed Saanen Dairy Goats	Central Anatolia Fighting Drought and Ecological Life Association	Poor farmers and women	80 persons
Raising the Awareness Level of Rural People on the Possible Effects of Climate Change in Kayseri Province	Kayseri and Villages Training and Solidarity Association (KAYKÖYDER)	Farmers, technical personnel, students	3,960 persons 286 persons 1,418 students
Climate Change Education for Primary School Children		Primary school students, primary school teachers	2,000 students 70 teachers
Adaptation of Animal Production and Environmental Activities to Global Warming and Climate Change in Seyhan River Basin	Cukurova University Faculty of Agriculture Department of Animal Science	Districts of Adana: Saimbeyli, Tufanbeyli, Karaisalı, Aladağ, Feke Children Farmers	528 children 692 (boys), 501 (girls)
Developing Farmers' Capacity to Adapt through Irrigation and Energy Restriction	Village Services Union of Sariz District Governorate	Farmers	135 persons
Good Agriculture Healthy Society	Adana Commodity Exchange	Seyhan, Çukurova, Karaisalı, Yüreğir, Sarıçam, Karataş, Pozantı, Aladağ, Feke, Saimbeyli ve Tufanbeyli towns, producers, agricultural engineers, related institutions	471 producer, 123 manufacturers, 199 engineers, 176 persons
Designing and Establishing a Climate Change Monitoring and Prediction Social Collaboration Network and an Internet Based Global Climate Change Geographical Monitoring and Prediction Decision Support System in Adana and Niğde Provinces	Adana Provincial Directorate of Environment and Forestry	Experts	70 persons
Screening and Saving of Local Vegetables for Resistance to Drought and Salinity	Cukurova University, Faculty of Agriculture, Department of Horticulture	Farmers, academics	500 persons
Adaptation of Forest Ecosystems and Forestry to Climate Change in the Seyhan Basin: Ecosystem Services (Social), Biodiversity (Environmental) and Forest Products (Economic)	Adana Regional Directorate of Forestry	Experts, implementers	650 persons
Adaptation and Mitigation of the Effects of Sea Level Rise Related to Global Climate Change in the Seyhan Delta	Bird Research Society Adana Branch	Farmers, women, students	250 farmers, 40 women, 300 students
Participants in Vulnerability Analysis Seminars		Public experts, universities, public, NGO	330 persons in 11 provinces

Societal Gender and Climate Change

One of the strong outcomes of the Enhancing the Capacity of Turkey to Adapt to Climate Change United Nations Joint Programme has been the Girls Let's Take Pictures project. The title of the project resembles another successful project, Girls Let's Go to School, which focuses on empowering young girls to receive an education. This climate project emphasizes the impacts of the mitigation and adaptation processes on women and men, and consideration of their different roles in society.

Girls! Let's Take Pictures

The Girls! Let's Take Pictures project aims to raise the awareness of primary school girls and their families living in the Çamardı area in the Seyhan River Basin on issues of adaptation to climate change and other environmental topics. The project also aims to ensure that girls transfer their knowledge to their children in the future. The project is implemented in the Çamardı district of Niğde by the Genç Doğa Association and it will reach 25 primary school girls. The girls will be selected by a committee consisting of Genç Doğa and Niğde Environmental Protection and Development Association officials, the project coordinator and officials of the District Directorate of National Education. Importance has been given to selecting the successful children of families with low incomes living in surrounding villages. Twenty-five girls from fourth, fifth, sixth and seventh grades who meet these requirements have been selected (Photograph 1). By working with these girls, the project aims to increase awareness and knowledge of families and future generations regarding environment and climate. In order to achieve this goal, trainings will be provided on the environment and activities will help these women begin to consider climate change adaptation processes at an early age. The trainings were supported with field visits. Training on photography was provided to girls so that they could document the changing environment of the Seyhan River Basin where they have grown up. This training helps the girls to look at the Seyhan River Basin through an objective perspective but with new knowledge. This connection may help children to decide to remain in Seyhan River Basin as they have families of their own. The girls are expected to take photographs with a newly acquired environmental sensitivity. Girls are asked to photograph what they see and write their feelings to express their sensitivity towards the basin. These works have been shared with the public through a photograph album and exhibitions (http://www.iklimmdgf-tr.org/proje).

9.5. Public Access to Information

There is an increasing access in Turkey to internet sites, and as a result, to climate change related webpages. This is particularly important as students and teachers are increasingly relying on the internet as their primary information source. In addition, most project implemented in Turkey have webpages, but there is no central data on the number of users of these pages. Other sources of public access to information on climate change in Turkey are TV programs, newspapers and periodicals. Public access to climate change information in Turkey is presented in Table 9.5.

In addition, gender has been taken into consideration in other ways through the Enhancing the Capacity of Turkey to Adapt to Climate Change United Nations Joint Programme. The topic of Women and Societal Gender Roles has been included to a workshop that took place in June 2011 and the status of female farmers within the context of climate change had been discussed in such sessions.

There are several other activities related to women and climate change in Turkey. In December 2009, for example, the UNESCO National Commission launched a seminar on Environment, Women and Climate Change and subsequently, in cooperation with KA-DER, implemented an awareness project that targeted collaboration between NGOs on women and (Talu, 2010). Finally, almost all projects implemented on climate change in Turkey include women as a target audience (Tables 9.1 and 9.3).

Table 9.5 Public Access to Information - Good Practices

Project /Activity	Project Implementer	Target Population	Project Output / Reached Population
A Trip to Seyhan River Basin – Documentary – (MDGF-1680)		TV audiences	2,400,000 persons
Television Programs	Turkish Radio and Television Corporation	General public, children	50 documentaries, 60 program on culture, 500 children's program (2010)
	Private TV Channels	Audiences	
Periodicals	TUBITAK	Academics, children, young people	31,350 persons/month 101,729/month (circulation rates)
News from the Environment Bulletin	MEU – Press and Public Relations Department	Decision makers, academics, municipalities, chaplains	77,000/week
Newspapers			

9.6. Public Participation

The private sector, NGOs and local populations have cooperated in both legal and awareness raising processes. Related information is provided in the following sections.

International Negotiations

The contribution of Turkish NGOs and the private sector to the climate change negotiations has been increasing. There was only one NGO in 2008 with UNFCCC accreditation and the number has since increased to 8.

Participation in National Processes

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

The National Action Plan on Climate Change was prepared through the participation of many public institutions, NGOs, private sector representatives and universities.

- Preparation of National Communications

The participation of many public institutions, NGOs, private sector representatives and universities has been acheived in the preparation of the Second National Communications. Ten meetings were undertaken that included the participation of more than 1,000 persons.

Participation of the Private Sector

- Carbon Disclosure Project – 2011

The Carbon Disclosure Project (CDP) has been implemented by Sabancı University with the support of AKBANK. The first step of the project included inviting the IMKB-100 member companies to describe their climate change policies and carbon emissions. The number of participating companies doubled in the second year. In addition, the companies have been trained on technical matters in replying to the CDP questionnaires.

- Climate Platform

The Climate Platform was initiated by REC Turkey and TUSIAD in 2008 through the financial support of the Strategic Program Fund of the UK Foreign and Commonwealth Office (FCO). It supports works related to low carbon economy. Representatives of the 19 member companies of the platform form the Turkish Leaders Group on Climate Change, which contributes to the climate change policies in Turkey (www.iklimplatformu.org).

Participation of Local Administrations

- Climate Associated Cities Campaign

The Climate Associated Cities Campaign, launched by REC–Turkey in 2009, targets support to municipalities that are working on climate change mitigation. Participants from fourteen municipalities (Alanya, Beyoğlu, Bodrum, Çankaya, Halkapınar, Kadıköy, Karadeniz Ereğli, Keçiören, Muğla, Nevşehir, Nilüfer, Sivas, Şişli, Yalova) shared their experience with the public through the project. Kadıköy (Istanbul) Municipality, Çankaya (Ankara) Municipality, Trabzon Municipality, Yalova Municipality and Nilüfer Municipality and Nilüfer City Council have implemented concrete projects related to climate change mitigation. Most of the projects implemented by the municipalities have focused on climate change, recycling and energy efficiency.

- Climate Change Round Table Meetings

Circle Table meetings have been implemented since 2009 by WWF Turkey in Antalya, Gaziantep, Konya, Aydın and Bursa with the participation of the public sector, NGOs and the central and local administrations. Related activities in Bursa and Gaziantep municipalities are presented below.

Box 9.5. Climate Change Circle Table Meetings

A message to Kopenhag from Gaziantep: “World leaders shall make concrete steps for climate change”

The fourth meeting related to climate change by WWF-Turkey was launched on 8 December 2009 in Gaziantep. The focus of the meeting was to discuss possible impacts of climate change on Gaziantep, one of the most important industrial cities of Turkey and the most important producer of nuts, olive, peas and lentils (http://www.wwf.org.tr). 08/12/2009.

Box 9.6.Green Bursa is possible

Green Bursa depends on its being climate friendly.

The focus of the meeting was to discuss possible impacts of climate change on Bursa, the 4th largest city of Turkey. Participants included central and local administrators, private sector and local NGOs. (http://www.wwf.org.tr). 10/12/2009

9.7. International Cooperation

There have been 49 protocols prepared between Turkey (MEU – International Relations Department) and other countries on environment, meteorology, forestry, climate change and water and there are an additional 20 protocols still under preparation. The parties of climate change protocol are Greece, and Syria Arab Republic. The aim of the protocols is to share information and experience, and develop relationships between the nations. (http://did.cevreorman.gov.tr/did).

- World Meteorological Organization Regional Education Center

The World Metrological Organization (WMO) Regional Education Center has been implementing education programs on climate change since 2001 (http://www.rtc.dmi.gov.tr/courses). Related information on education activities through the WMO is provided in the Table 9.6 below.

Table 9.6. WMO Regional Education Centers – Good Practices

Course	Date	Place	No. of International Participants	Country
International Course on Regional Climate Models for Projecting Natural Disasters of Meteorological Character.	29 October – 2 November 2007	Alanya / Turkey	15	United Arab Emirates, Bosnia Herzegovina, Bulgaria, Georgia, Iranian, Turkish Republic of Northern Cyprus, Lithuania, Egypt, Pakistan, Poland
Climate Applications International Course	7-11 June 2010	Alanya / Turkey	11	Bulgaria, South Africa, Croatia, Hong Kong, Iraq, Kazakhstan, Libya, Namibia, Romania, Thailand, Jordan
Climate Variability and Projections for the Mediterranean Basin Education Workshop	27 July 2010 - 4 August 2010	Alanya / Turkey	9	Bosnia Herzegovina, Bulgaria, Algeria, Fas, Croatia, Lebanon, Macedonia, Egypt, Slovenia

9.8. Future Works

The National Climate Change Action Plan (2011-2023), based on the National Strategy Document on Climate Change, contains actions that will contribute to the development of institutional capacities, climate education and public awareness on climate change. Several of these proposed actions are related to the following:

- Increasing the capacities of CBCC members on mitigation and adaptation to climate change;
- Developing programmes for intermediate staff in technical education institutions;
- Embedding topics on mitigation and adaptation to climate change in university curricula, mainly in engineering, law, international relations, economy and natural sciences;

- Including topics related to combating and adaptation to climate change in formal education programmes; and
- Raising public awareness on the role of individuals with regard to climate change and creating reliable information channels to change consumption patterns.

There are documents prepared in Turkey related to capacity evaluations on education, training and public awareness. In this respect, Turkey's capacity requirements have been reported by the project launched by the MEU (Evaluating Turkey's National Capacity in the Context of Rio Conventions Project). The followings are the outputs of the project related to Turkey's capacity requirements for climate change education, training and public awareness:

- Supporting participation at international meetings to enhance the technical capacity of personnel;
- Establishing a National Climate Change Center/Institute;
- Concretizing public awareness established by directing to politics/votes;
- Creating effective public awareness through competitions in the media, religious affairs, and national education; and
- Supporting the establishment of climate change centers in universities.

The National Capacity Action Plan of the same project published in 2011 (MEU – International Affairs Department, 2011) contains short, medium and long term targets related to education, training and public awareness, as presented below:

Short Term: (1-3 years)

- Delivering basic training on climate change negotiations to the related personnel through in-service trainings in Ministries;
- Revising the content of in service trainings;
- Making the decision makers aware of the issue;
- Education personnel on the complementary feature of the Rio Conventions; and
- Education personnel working on one of the Rio Conventions on the other Conventions.

Medium Term: (3-5 years)

- Disseminating the results to all stakeholders through a workshop;
- Developing and updating education and training programs; and
- Establishing centers in Turkish universities.

Long-term/Integrated Efforts:

- Educating all personnel to ensure sustainability of the projects.

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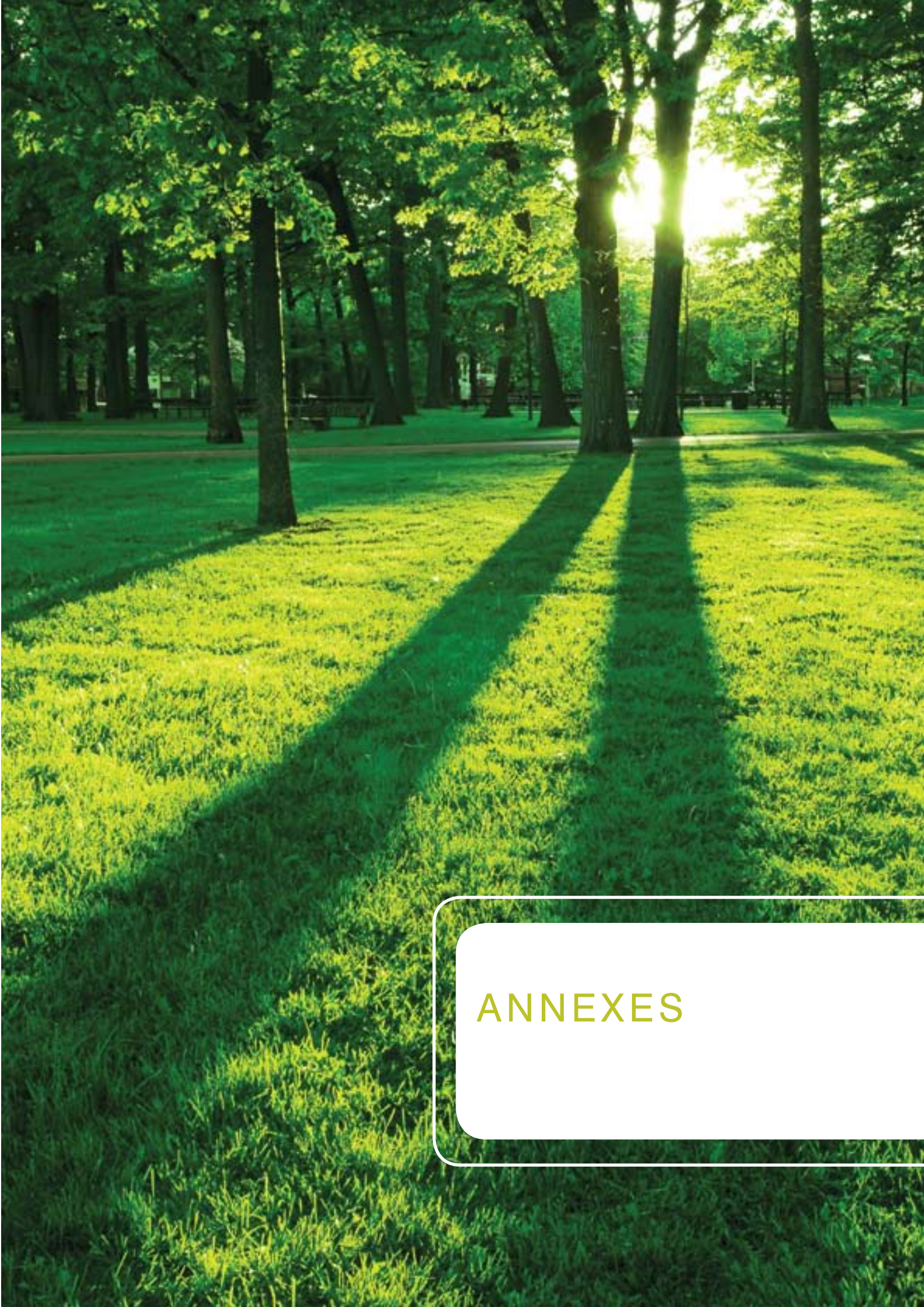

ANNEXES

Table A-1. Change in sectoral emissions and their contributions to total emission.

							Variation (%)		Sectoral Contribution (%)		
	1990	1995	2000	2005	2008	2009	1990-2009	2008-2009	1990	2000	2009
1. Energy	132,13	160,79	212,55	241,75	277,71	278,33	110,65	0,22	70,65	71,56	75,3
A1 Energy Industries	34,14	47,49	77,04	88,83	106,27	102,82	201,14	-3,25	18,26	25,94	27,82
A2 Manufacturing Industries and Construction	37,73	42,2	60,22	67,77	56,27	55,4	46,82	-1,54	20,18	20,28	14,99
A3 Transport	26,29	33,28	35,52	41,31	47,8	47,44	80,47	-0,76	14,05	11,96	12,83
A4 Other Sectors	32,53	36,37	38,15	42,36	65,42	70,67	117,22	8,02	17,39	12,85	19,12
B. Fugitive Emissions from Fuels	1,43	1,45	1,62	1,48	1,94	2,00	39,75	3,18	0,76	0,54	0,54
2. Industrial Processes	15,44	24,21	24,37	28,78	29,83	31,69	105,2	6,23	8,26	8,21	8,57
3. Solvent and Other Product Use	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	-	-	-	-	-
4. Agriculture	29,78	28,68	27,37	25,84	25,04	25,7	-13,7	2,61	15,92	9,22	6,95
5. Land Use, Land-Use Change and Forestry (LULUCF)	-44,87	-61,84	-67,56	-69,53	-80,58	-82,53	83,93	2,42	-23,99	-22,75	-22,33
6. Waste	9,68	23,83	32,72	33,52	33,92	33,93	250,49	0,03	5,18	11,02	9,18
7. Other	NA	NA	NA	NA	NA	NA	-	-	-	-	-
Total (including LULUCF)	142,16	175,67	229,45	260,36	285,92	287,12	101,97	0,42	76,01	77,25	77,67
Total (excluding LULUCF)	187,03	237,51	297,01	329,90	366,50	369,65	97,64	0,86	100,00	100,00	100,00

Table A-2. Summary Inventory Table.

GHG Source and Sink Category	CO_2 (1)	CH_4	N_2O	HFCs (2)	PFCs (2)	SF_6 (2)	Total
	CO2 eq (Gg)						
Total (Net Emissions) (1)	216.577.76	54.367.97	12.531.09	2.839.25	C,NA,NE	803.47	287.119.55
1. Energy	271.109.03	5.706.98	1.514.83				278.330.84
A. Fuel Combustion (Sectoral Approach)	271.109.03	3.708.15	1.514.83				276.332.01
1. Energy Industries	102.516.14	33.47	269.64				102.819.24
2. Manufacturing Industries and Construction	55.097.39	112.25	194.11				55.403.75
3. Transport	46.707.15	124.73	607.83				47.439.72
4. Other Sectors	66.788.34	3.437.70	443.25				70.669.30
5. Other	NA,NO	NA,NO	NA,NO				NA,NO
B. Fugitive Emissions from Fuels	NA,NE	1.998.83	NA,NE				1.998.83
1. Solid Fuels	NA	1.998.83	NA				1.998.83
2. Oil and Natural Gas	NA,NE	NA,NE	NA,NE				NA,NE
2. Industrial Processes	27.997.04	47.22	C,NA	2.839.25	C,NA,NE	803.47	31.686.98
A. Mineral Products	27.997.04	NA	NA				27.997.04
B. Chemical Industry	C,NA,NE	47.22	C,NA	NA	NA	NA	47.22
C. Metal Production	C,IE,NA	NA	NA	NA	C,NA	NA,NE	C,IE,NA,NE
D. Other Production	NE						NE
E. Production of Halocarbons and SF_6				NA	NA	NA	NA
F. Consumption of Halocarbons and SF_6 (2)				2.839.25	NA,NE	803.47	3.642.72
G. Other	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	NA,NE		NA,NE				NA,NE
4. Agriculture		16.433.61	9.262.32				25.695.93
A. Enteric Fermentation		14.859.21					14.859.21
B. Manure Management		1.179.87	2.214.42				3.394.29
C. Rice Cultivation		203.18					203.18
D. Agricultural Soils(3)		NA,NE	6.989.93				6.989.93
E. Prescribed Burning of Savannas		NA	NA				NA
F. Field Burning of Agricultural Residues		191.34	57.98				249.32
G. Other		NA	NA				NA

Table A-2. Summary Inventory Table.

GHG Source and Sink Category	CO_2 [1]	CH_4	N_2O	HFCs [2]	PFCs [2]	SF_6 [2]	Total
	CO2 eq (Gg)						
5. LULUCF[1]	-82.528.30	0.02	0.00				-82.528.28
A. Forest Land	-57.364.76	0.02	0.00				-57.364.74
B. Cropland	-18.529.14	NA	NA				-18.529.14
C. Grassland	-6.634.39						-6.634.39
D. Wetlands							
E. Settlements							
F. Other Land							
G. Other	NA						NA
6. Waste	IE,NA	32.180.15	1.753.94				33.934.08
A. Solid Waste Disposal on Land	IE,NA	30.169.77					30.169.77
B. Waste-water Handling		2.010.38	1.753.94				3.764.32
C. Waste Incineration	NA	NA	NA				NA
D. Other	NA	NA	NA				NA
7. Other (as specified in Summary 1.A)	NA	NA	NA	NA	NA	NA	NA

Memo Items: [4]							
International Bunkers	2.018.64	2.89	5.11				2.026.64
Aviation	1.147.58	1.69	2.99				1.152.25
Marine	871.07	1.20	2.13				874.40
Multilateral Operations	NO	NO	NO				NO
CO2 Emissions from Biomass	NA,NO						NA,NO

Total CO_2 eq Emissions without LULUCF	369.647.82
Total CO_2 eq Emissions with LULUCF	287.119.55

(1) For CO2 from LULUCF and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

ANNEX B

NATIONAL SCIENCE, TECHNOLOGY AND INNOVATION SYSTEM AND PERFORMANCE INDICATORS

Figure B.1. National Science, Technology and Innovation System

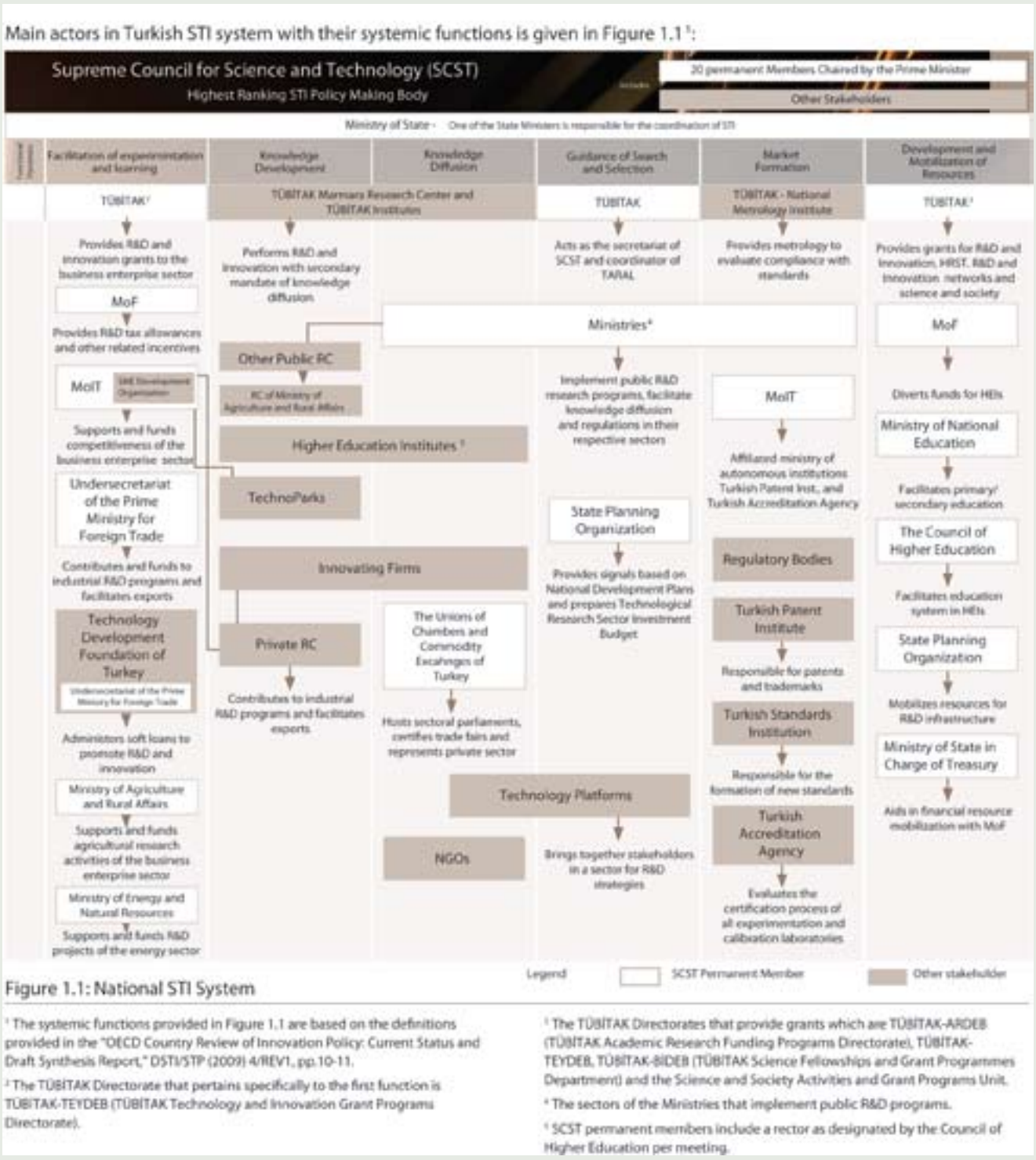

Figure 1.1: National STI System

[1] The systemic functions provided in Figure 1.1 are based on the definitions provided in the "OECD Country Review of Innovation Policy: Current Status and Draft Synthesis Report," DSTI/STP (2009) 4/REV1, pp.10-11.

[2] The TÜBİTAK Directorate that pertains specifically to the first function is TÜBİTAK-TEYDEB (TÜBİTAK Technology and Innovation Grant Programs Directorate).

[3] The TÜBİTAK Directorates that provide grants which are TÜBİTAK-ARDEB (TÜBİTAK Academic Research Funding Programs Directorate), TÜBİTAK-TEYDEB, TÜBİTAK-BİDEB (TÜBİTAK Science Fellowships and Grant Programmes Department) and the Science and Society Activities and Grant Programs Unit.

[4] The sectors of the Ministries that implement public R&D programs.

[5] SCST permanent members include a rector as designated by the Council of Higher Education per meeting.

Source: TUBITAK, 2010. Turkey Science, Technology and Innovation System and Performance Indicators.

Table B.1. Science, Technology and Innovation Indicators.

Indicator	1998	2000	2005	2008	2009	EU27 Total (2009)	OECD Total (2008)
GERD as percentage of GDP (by 1998 base GDP)	0.37	0.48	0.59	0.73	0.85	1.91	2.34
GERD per capita population (PPP$)	32	44	67	106	122	598.6	803.2
Total Researchers (thousand FTE)	19	23	39	53	58	1531	43903
Total R&D Personnel (thousand FTE)	23	27	49	67	74	2479	-
Business Enterprise Sector R&D expenditures (% of GDP)	31.6	33.4	33.8	44.2	40.0	61.6	69.6
Government Sector R&D expenditures (% of GERD)	7.3	6.2	11.6	12	12.6	13.5	10.9
Higher Education sector R&D expenditures (% of GERD)	61.1	60.4	54.6	43.8	47.4	23.7	17.0
Scientific publications per million population	86	100	243	324	348	1262	14165
Number of triadic patent families	7	4	12	21	-	14525	46691

Source: TUBITAK, 2010. Turkey Science, Technology and Innovation System and Performance Indicators.

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