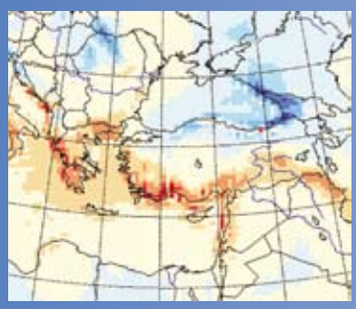

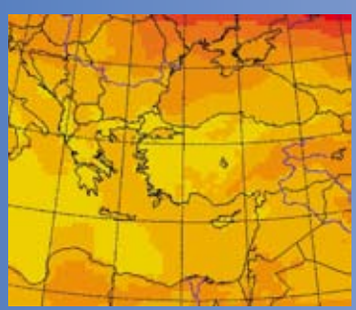

FIRST NATIONAL
COMMUNICATION ON

CLIMATE CHANGE

REPUBLIC OF TURKEY

UNDER THE UNITED NATIONS FRAMEWORK
CONVENTION ON CLIMATE CHANGE

First National Communication of Turkey on Climate Change

Coordinated by

Ministry of Environment and Forestry

Implemented by

United Nations Development Program(UNDP), Turkey

Funded by under the GEF Project for Preparation of First National Communication of Turkey to UNFCCC

Global Environmental Facility -UNDP National Communication Support Program

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FOREWORD

A fundamental step forward was taken in the protection of environment of our planet through the United Nations Convention on Climate Change which is in effect since on 21 March 1994. This represents the institutionalisation of a legal instrument providing for the common concerns of humanity, as a result of scientific evidence concerning the possibility of global climate change caused by human activity.

Turkey had an important decision at the 7th Conference of Parties (COP7) in Marrakech in 2001. This was the deletion of the name of Turkey from the list in Annex II to the Convention and the Invitation of Parties to recognise the special circumstances of Turkey, which place Turkey, after becoming a Party, in a situation different from that of other Parties included in Annex I to the Convention. After these, Law No: 4990 concerning the accession of Turkey to the UNFCCC, was promulgated in the Official Gazette No:16, October 2003. The United Nations Framework Convention on Climate Change (UNFCCC) came into force for Turkey on 24 May 2004, as the 189th Party to the Convention and thus obliged itself to implement the addressed commitments.

Aware of its importance in protecting the Environment of today and that of future generations, Turkey will continue to support all efforts to improve and develop the Convention. This report represents the positive efforts of the Turkish Government for the effective implementation of the Convention and describes some of the activities being carried out in Turkey, taking into consideration that policies and measures for protecting the climate should be appropriate to the specific conditions existing in each country.

Turkey is ready to undertake its commitments and comply with her responsibilities embodied in the Annex I countries to the Convention according to her special circumstances. Because we believe that, on the basis of equity and in accordance with common but differentiated responsibilities and respective capabilities, the country should implement policies and measures to protect the climate system and should promote sustainable development.

Turkey has always been aware of the fact that protection of environment is a matter of concern for human beings, indeed it can be decisive for the survival of the human race and has always supported the Convention's overall objective. It has long been implementing policies and measures for reducing greenhouse gas emissions at the minimum possible cost and safeguarding sustainable development of the country. Such measures mainly focus on increasing energy efficiency in end-use sectors, fuel switching and increasing the utilisation of renewable energy sources, particularly those of hydraulic resources.

Turkey is not yet a Party to the Kyoto Protocol. Therefore there does not yet exist a quantified obligation on the part of Turkey for Kyoto Protocol's first commitment period running from 2008 through to 2012, for limiting or reducing emissions of greenhouse gases.

In order to meet one of our commitments under UNFCCC, the MoEF and UNDP took the responsibility of coordinating the preparation of this document, in collaboration with those ministries involved. Over 20 institutions and more than 100 academicians and experts with recognised capacities in every specific area of the sectors of among others, climate, ecology, energy, industry, forestry, agriculture, waste, and economy have contributed to this document.

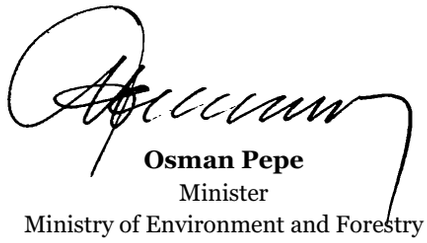
The report aims to: prepare an inventory of greenhouse gases in Turkey for the period 1990-2004; make an analysis of potential measures to abate the increase in greenhouse gas emissions and an assessment of potential impacts of climate change in Turkey and propose adaptation measures; assess cost and benefits of various energy policy alternatives on climate change; capacity building in the areas of scientific and technical potential and institutional relations infrastructure and building a data network for information and data acquisition to enable the development of sustainable information supply in Turkey on a continuous basis. In addition, public awareness activities and crosscutting stakeholder consultations have been a key part the overall course of this exercise.

Therefore, the preparation of the First National Communication is expected to enhance general awareness and knowledge on climate change-related issues in Turkey and help take them into account in the process of national planning and policy making. This report will enable Turkey to play a significant role in international organisations for the implementation of the Convention, with special reference to the development of technological cooperation and joint implementation of programmes for energy efficiency in the Mediterranean, Eastern Europe and Middle East.

It is clear to everyone that the Convention is a significant instrument for the definition and application of global standards for energy efficiency in the industrial and transport sectors, as well as for the protection and extension of forests across the planet. We believe however, that with the nation's effort and with friendly co-operation and help from the international community, Turkey will direct its economy to the path of sustainable development and will implement the commitments. In this context, Turkey can play the role of a major technological and economic transition model, making available its skills and expertise in the energy sector to the neighbouring countries.

This document is important for the dissemination of the pressing issue of climate change, as well as in educating and raising the awareness of society regarding future adverse impacts of global warming, while providing new opportunities for the development of cleaner technologies through fostering the advance of science. Certainly, issues related to climate change will be relevant to the national and international agenda in the future.

Finally, on behalf of the government of Turkey, I would like to take this opportunity to express our appreciation to the Global Environment Facility, to UNDP as its implementing agency and the Secretariat of the UNFCCC for their support in enabling Turkey to prepare her First National Communication to the UNFCCC.



Osman Pepe
Minister
Ministry of Environment and Forestry

TABLE of CONTENTS

6. CLIMATE CHANGE, VULNERABILITY ASSESSMENT and ADAPTATION MEASURES

7. FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

8. RESEARCH AND SYSTEMATIC OBSERVATION

9. EDUCATION TRAINING AND PUBLIC AWARENESS

ANNEXES

CHAPTER 1
EXECUTIVE SUMMARY

1. EXECUTIVE SUMMARY

1.1 National Circumstances

1.1.1 Government Structure

Back in 1923, the foundation of the modern Turkish republic lay on the principles of a peaceful foreign policy, secularism, the rule of law, a pluralistic and participatory democratic system and fundamental human rights and freedoms.

The political system of Turkey is a parliamentary democracy. The Turkish Constitution structures the Republic of Turkey as a democratic, secular and social state in which the executive, legislative and judicial powers are separated.

The constitution of Turkey recognises the right of all citizens to live in a healthy and well-balanced environment, and stipulates that it is the common duty of the state and citizens to protect the environment and prevent pollution.

Established in 2001 in accordance with a circular issued by the Prime Ministry, CBCC has overall responsibility for the implementation of prevention, mitigation and adaptation of policies against climate change. It is also the CBCC who is responsible for fulfilling the requirements of UNFCCC obligations, such as preparation of National Communications on Climate Change.

1.1.2 Population

The country's population of 71.2 million in 2004 is greater than those of all of its neighbours. The estimated population for the year 2006 is estimated at around 73 million.

1.1.3 Geographic and Climate Profile

Turkey is the thirty-fourth largest country in the world with an area of 783,562 km^2. The total land of the country is classified as 35% agriculture land, 18% pastures and meadows, 27% forests and the other uses 20%.

Turkey is located in the Mediterranean macroclimatice zone that lies between the temperate and sub-tropical zones at western parts of the continents, allowing the country to have widely diverse regional and/or seasonal variations ranging from extremely harsh winter conditions to very hot, dry summers. The south and west of the country lie under the influence of the Mediterranean climate with hot and dry summers and cool and rainy winters. The climate on the coast of the Black Sea is colder and more rainy. Northeast Anatolia has the characteristics of a continental climate: winters are long and severe and summers are short and cold. The Central Anatolian plateau is under the influence of a steppe climate with arid and hot summers and cold winters.

1.1.4 Economic Profile

Turkey has achieved a successful transition to a market economy, particularly in the last two decades. Economic resources have started to be used efficiently since privatisation schemes have reduced the influence of the public sector in markets. Moreover, it has been proved after the introduction of the customs union, in 1996, that the Turkish economy, mainly the private sector, is highly durable against international competition. Economic stability and predictability have been substantially improved since the 2001 economic crisis. Previously high inflation has come down to historic lows, political interference in the economy has been reduced and the institutional and regulatory framework has been brought closer to international standards. In 2003, the economy grew by 5.8% in real terms. Price movements were also brought under control through the year and the 12-month average inflation rate in consumer prices went down from 29.7% in 2002 to 9.3% in 2004, and from 50.1% to 11.1% in wholesale prices. Exports recorded as $27.8 billion in 2000, increased by 2.6 times and reached $73.4 billion in 2005.

1.1.5 Energy

Over the period 1990-2004, Turkey's demand for general energy and electricity energy has increased at an annual rate of 3.7% and 7.2% respectively. In parallel, the population growth rate of 1.7% and GDP growth rate with a 1.3% was during the same period. Total primary energy production decreased from 25.5 mtoe in 1990 to 24.3 mtoe in 2004. In 2004, The total coal production amounted to 43%, biomass 23%, oil and natural gas 12%, hydro, geothermal and wind electricity 17%, other renewable sources 5% and of primary energy production.

During the same period, both TFC and TPES have increased with an average annual rate of 3.7% and reached 87.8 mtoe from 53 mtoe. (Figure 1.1) Oil accounted for the largest share of demand with 37%; it is followed by the natural gas with 23%, hard coal with 16%, lignite with 11%, biomass with 6% and, hydro with 5% and other renewables 2% in 2004. In 2004, renewable energy sources, excluding hydro, accounted for 6.8 mtoe. This included non-commercial wood (4.3 mtoe), animal and vegetable waste (1.2 mtoe), followed by geothermal energy (0.9 mtoe) and solar energy (0.4 mtoe). Per capita energy consumption increased from 944 koe in 1990 to 1234 koe in 2004.

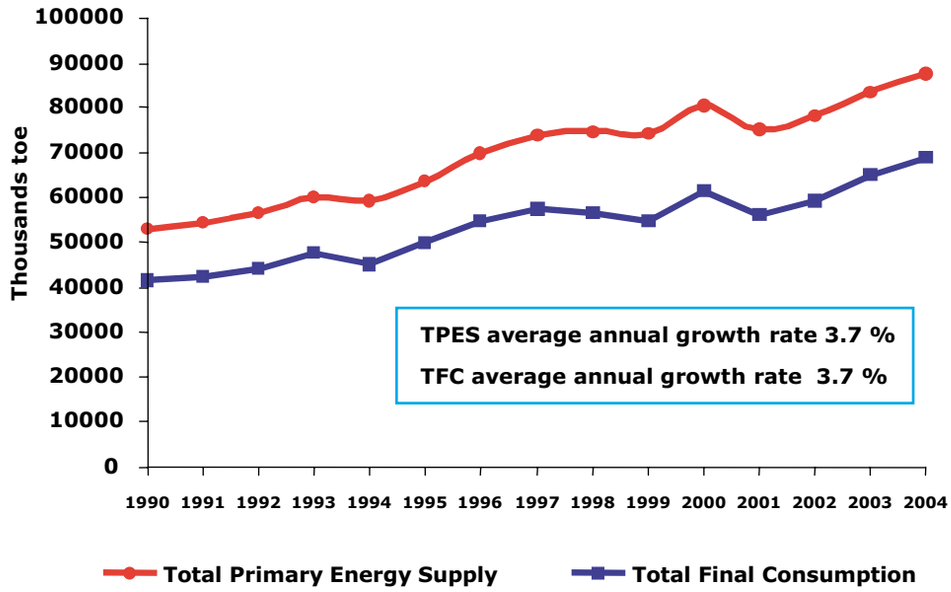


Fig. 1.1 Historical Trend of Energy Use

The changing structure of the Turkish economy is particularly evident in the energy sector. The most significant change in the structure of Turkish fuel consumption has been the increase in electricity and natural gas consumption.

The growing demand for electricity was met mainly by thermal and hydro sources, where these renewables continued to maintain their share of overall production. Installed capacity being 16,318 MW in 1990 has reached 36,824 MW with additional 20,506 MW, by the end of 2004.

Energy intensity is about equal to the world average of 0.32 toe/$1,000 but is higher than the average for OECD countries of 0.20 toe/$1,000. When energy intensity is measured against GDP based on purchasing power parity (PPP), Turkey's is 0.12, the world average is 0.21, and the OECD average is 0.19 toe/$1,000 in 2003.

1.1.6 Transportation

In Turkey, 98% of passenger transportation and almost 100% of freight transportation were conducted by road and rail in 2004. At present, 95% of passenger transportation and 91% of freight transportation are conducted by road. There are currently 5.4 million passenger cars on Turkey's roads and the domestic demand for motor vehicles continues to grow unabated. In spite of momentous changes, Turkey is ranked among the last in terms of car ownership with its ownership rate of 143 per 1,000 habitants, among the European and OECD countries in 2005.

1.1.7 Solid Waste

In 2004, total solid waste collected by municipalities was 25 mt demonstrating an increase of 41% in comparison to 17.8 mt in 1994. According to this figure, the per capita average solid waste produced in 2004 was 1.31 kg.

1.1.8 Agriculture

The agricultural area in Turkey is about 27 million ha, about 35% of the total surface area of the country. However, the total area under cultivation in 2004 was 18 million ha.

1.1.9 Special Circumstances of Turkey

Turkey's position with respect to the UNFCCC process means that the commitments accepted by the Turkish Government is to be based on equity and fairness by duly taking into account the "differentiated responsibilities" and "individual circumstances" of the parties concerned.

On the basis of main economic indicators, Turkey's degree of industrialisation is not yet comparable to that of most other OECD countries. This implies that the special circumstances in Turkey would be taken into consideration for other additional obligations that are defined for Annex I countries.

Turkey managed to produce 12.3% of the total primary energy supply from renewables in 2004. Nevertheless, since domestic resources are not able to meet the demand, the country remains a net energy importer, with a high ratio of import dependency: reaching 72%.

Turkey is calling for equality of sacrifice rather than equal reduction in emissions. The required obligations will only be just if they reflect the different structures and capabilities of the country's economy. Therefore, it is fair to compare the emissions with not only the developed Annex I countries, but with the developing countries not listed in Annex I.

1.2 Inventory of Greenhouse Gas Emissions and Removals

Turkey's total GHG emissions excluding LUCF rose from 170.1 Tg to 296.6 Tg CO_2 eq between 1990 and 2004. Over the period, GHG emissions from the energy sector have risen from 132.1 Tg to 227.4 Tg CO_2 eq placing the sector with the largest share of 76.7%, followed by the waste disposal and industry sectors, with shares of 9.3% and 8.9% respectively. (figure 1.2)

GHG emissions rose steadily between 1990 and 2004 due to Turkey's steady population growth and industrialisation after the mid-1990s. However, the share of emissions from the energy sector within the total GHG emissions (without LUCF) per capita fell from 78% to 76.7% during this period. This fall is a result of several changes mainly including: i) shifting from coal to natural gas in electricity generation and residential consumption, ii) introduction of alternative fuel sources, iii) new technology engines in the transport sector and the removal of old, polluting cars from the road.

In 2004, CO_2 makes up the largest proportion of Turkey's total emissions, accounting for 81.6%, while CH_4 has a share of 15.6%. The next largest share in total emissions is from N_2O with 1.9%, followed by F gases with 1.0%

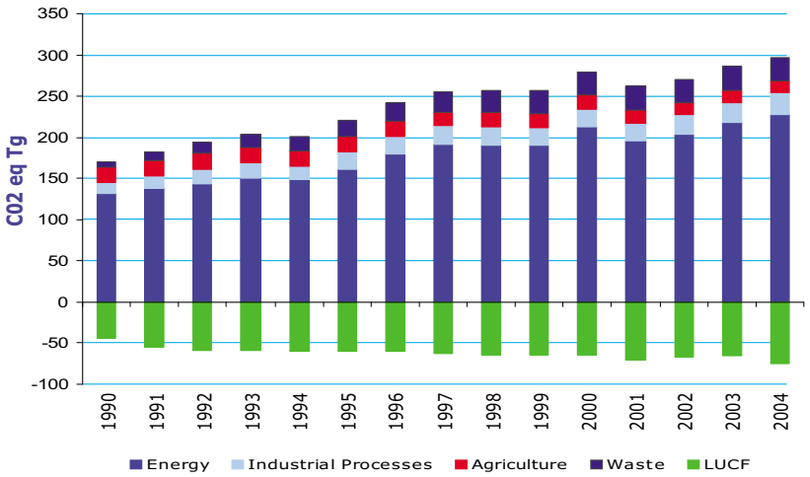


Fig.1.2 Sectoral Greenhouse Gas Emissions and Removals between 1990 and 2004

Turkey as an Annex I country, had the ratio of 3.3 ton CO2 emissions per capita in 2003. The country is listed at the bottom among OECD, EU-15 countries and also below the world level holding respective ratios of 11.1, 9.0 and 4.0 ton CO2 per capita in 2003. (Table 1.1)

Table 1.1 GHG and CO2 Emission Indicators for Turkey and Relative Parties of UNFCCC (2003)

	$C0_2$ Emissions CO_2 eq (Tg)	CO_2 /Per capita without LUCF (ton)	GHG Emissions without LUCF CO_2 eq (Tg)	GHG without LULUCF /capita CO_2 eq (ton)
EU-15	3,447	9.0	4,180	10.9
EU-25	4,064	9.0	4,925	11.0
OECD	12,780	11.1	NA	NA
Annex-I Countries	14,289	12.2	17,288	14.7
Non-EIT Parties	11,633	13.4	13,855	16.0
World	24,983	4.0	NA	NA
Turkey	231,0	3.3	286,3	4.1

1.3 Policies and Measures to Reduce GHG Emissions

Introduction

When the UNFCCC was adopted in 1992, Turkey as a member of the OECD was included among the countries of the Convention's Annexes I and II. On the basis of main economic indicators, Turkey's degree of industrialisation is not yet comparable with that of most of other OECD countries

At the 7th Conference of Parties (COP7) in Marrakech in 2001, Turkey was deleted from the list in Annex II to the Convention, and the parties were invited to recognise the special circumstances of Turkey, which place the country, after becoming a Party, in a situation different from that of other Parties included in Annex I to the Convention on the basis of the "common but differentiated responsibilities" principle of the Convention. Law No: 4990 concerning the accession of Turkey to the UNFCCC was promulgated on the Official Gazette No: 16 October 2003. The United Nations Framework Convention on Climate Change (UNFCCC) came into force for Turkey on 24 May 2004.

Turkey is ready to undertake its commitments and comply with the responsibilities embodied by the Annex I countries to the Convention according to its special circumstances. The specific national conditions of Turkey in this respect have to be considered. With 3.3 tonnes per capita, Turkey possesses the lowest per capita fossil fuel-based CO2 emissions amongst OECD countries whose average is 11.1, the world average is 4.0 and the EU 25 average is 9.0 [2003].

1.3.1 Policy-Making Process

The Ministry of Environment and Forestry (MoEF), is mainly responsible for the environmental legislation and policy development, while other ministries are responsible for integrating environmental policy targets. The main task of MoEF is to ensure legal arrangements with regards the related matters by drafting laws and supervising their implementation process as well as enabling initiation research activities in this field.

The State Planning Organisation (SPO), working under the authority of the Prime Ministry, develops five-year development plans. Turkey's Seventh Five-Year Development Plan (1996-2000) called for the development of a national environmental strategy. The National Environmental Action Plan (NEAP), which is the most comprehensive policy document on environment, was formed to supplement the existing Development Plan with concrete actions for integrating environment and development. The NEAP has detected a degradation in environmental media (air quality, water resources, soils, marine and coastal resources, forests, and biological diversity), insufficient waste management, loss of cultural heritage, and vulnerability to environmental hazards as Turkey's major environmental problems.

The 9th Development Plan, that will cover the 2007–2013 period, set up 55 special expertise commissions, one being the Environment Special Expertise Commission, contains the expression "Turkey is aware of the United Nations Climate Change Operation Plan by preparing a National Operation Plan in agreement with the conditions of Turkey and presenting the policies and precautions for reduction of the greenhouse gasses".

TUBITAK, the "National Technology Research Foundation of Turkey" is responsible for creating national science and technology policies and conducting activities with a focus on identifying and recommending tools that aim at accomplishing existing policies through the use of various policymaking methods and related procedures.

Obligations under International Laws

Turkey's obligations under international law stem from multi-lateral conventions and protocols that it has been a party to. Turkey has ratified over 50 international legal dispositions in relation to the environment
International environmental declarations and agreements mainly related to climate change that Turkey became a party to include:

UNECE Convention on Long-range Transboundary Air Pollution (1979), Convention for the Protection of the Ozone Layer (1985), Montreal Protocol on Substances that Deplete the Ozone Layer (1987), Rio Declaration on Environment and Development, and Agenda 21 (1992), Statement of Principles for the Sustainable Management of Forests (1992), Convention on Biological Diversity (1994), Convention to Combat Desertification (1995), International Energy Agency (IEA) and participates in the work of the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO) and International Union of Railway Companies(UIC)

National Strategy for Action on Climate Change

The Ministry of Environment and Forestry (MoEF) is initially responsible for environmental legislation and policy development, while other ministries are responsible for integrating environmental policy targets laid out in the Integrated National Environmental Strategy for EU Accession (UCES) within their respective fields.

MoEF has the primary intention of harmonising all their policies and applications, and especially the Environment Law, with the general environmental policies of EU. This is based on the concepts of "pollution prevention" rather than "pollution control", the prevention of pollution at source, minimisation of waste, utilisation of best techniques and technologies, the efficient use of energy, effective application of the inspection system and application of the "polluter pays" principle. The cost of investments aiming at environmental protection has the biggest share in the harmonization period expenses of Turkey.

Improving Air Quality

Work related to air quality is being carried out within the scope of the By-law on Air Quality Control issued by the Ministry of Environment and Forestry. And furthermore, the air quality related provisions of the By-law on Air Quality Control are still effective. With the purpose of harmonising EC legislation on air quality with framework legislation, a project named Support to Turkey in the field of Air Quality, Chemicals and Waste Management" was started in 2004. The first component of this project is Air Quality; it is aiming to reflect the contents of EC Framework Air Quality Directive on our National Air Quality Act and to the activities for measuring air quality along with the reflection of the provisions of The Directive of Large Combustion Plants Directive on our domestic legislation. The Draft By-law on Air Quality Assessment and Management was prepared in such a way that it covers four daughter directive By-laws aimed at strengthening monitoring, sanctioning and institutionalisation in the area of controlling pollution and air quality.

Seven directives are included in the scope of the Industrial Pollution Control, among these, the studies related to the Integrated Pollution Prevention and Control Directive (IPPC 96/61/EC) and Large Combustion Plants Directive (LCP-2001/80/EC) have been started.

In addition, the Chemicals and Waste Management Project will be studied within the scope of the Support to Turkey in the field of Air Quality.

Waste Management

Waste is controlled by regulations under the Control of Solid Wastes, Control of Medical Wastes and Hazardous Waste Control Management. The responsible authorities for solid waste management in Turkey are the MoEF, MoIT, Ministry of Interior Affairs, Ministry of Public Works and Settlement, municipalities, chambers of trade and industry and the Turkish Standards Institute.

Only 30% of domestic waste is being stored under control. Systems of controlled storage, composting, incineration and recycling are not common.

1.3.2 Energy Policies and Measures in Turkey

The main objective of Turkey's energy policy is to ensure sufficient and reliable energy supplies at competitive prices, taking into account environmental concerns in order to support economic and social development as in the other developed countries with a special focus on maintaining sustainable development in the country. In achieving these objectives, the fundamental strategy is to encourage the participation of private/foreign investors and regional business partnerships.

1.3.3 Implemented - Adopted - Planned Measures

Energy Sector

Turkey has been attempting to minimise energy-related greenhouse gas emissions through measures aimed at: improving energy efficiency and encouraging conservation measures; increasing the share of renewable energy sources in its energy supply; allowing for fuel switching from high carbon to low carbon fuels; and implementing measures to encourage emission reductions.

For securing a reliable energy supply and diversifying energy resources, optimum use of domestic resources (coal and hydro) and expanded use of alternative and renewable energy sources have been given due priority.

Turkey attaches great importance to more efficient and rational functioning of the energy sector for promoting the competitiveness of the national economy and full compliance with the EU Directives. In this regard, important progress has been achieved in restructuring and liberalizing the electricity and gas markets. The efforts of liberalizing the Turkish energy sector have gained pace in 2001 with the enactment of the Electricity and Natural Gas Market Laws. (Law No: 4628 & Law No: 4646).

The Petroleum Market Law (Law No: 5015) was enacted in 2003, so as to support the efforts of restructuring and liberalization of the Turkish energy sector. A major institutional change has occurred with the establishment of the Energy Market Regulatory Authority (EMRA) in 2001, with administrative and financial autonomy, as envisaged in the Electricity Market Law. Law on Utilization of Renewable Energy Resources for the Purpose of Generating has been put into force.

The nuclear option has been considered within the future alternative energy resources. According to the WOM scenario, the total installed capacity of nuclear power plants is expected to be 4500-5000 MW the end of the 2020.

Improvements in the Conventional Power System

In lignite power plants, due to the high sulphur content of domestic lignite, SO_2 emissions exceed the limit specified in Turkish legislation and so the construction of Flue Gas Desulphurisation (FGD) plants is required. Within this framework, the retrofit FGD plants have been constructed in the existing power plants (Cayirhan I-II, Kemerköy, Orhaneli, Yatagan, Yenikoy). However, it could not be possible to retrofit all of the old thermal power stations in a short period, due to considerably high investment cost of FGD plants. On the other hand, for the new lignite power plants planned after the promulgation of related Regulation (1986), the installation of FGD plants has been considered during the planning phase and contracted together with the power plant (Afsin-Elbistan B, Cayirhan III-IV, Kangal III).

Due to the high ash content of domestic lignite, the control of particulate emissions is also very important. Concerning the particulate emissions, almost all of the coal-fired power plants are equipped with electrostatic precipitators (ESP) operating at high efficiencies.

The subject Rehabilitation Project will cause the improvement of environmental performance of the plant, since the emissions, including CO2 emissions and other discharges per unit of electricity generated will be decreased also as a consequence of the increase in plant efficiency.

Turkey has interconnections with most neighbouring countries and has been actively pursuing synchronisation of its network with the European grid of the Union for the Co-ordination of Transmission of Electricity (UCTE).

Combined Heat and Power (CHP)

According to the statistics, total cogeneration installed capacity is 3,608 MW at the end of 2005 which corresponds to 9.8% of total installed capacity of the Turkish power system. At present, 61.4% of all cogeneration units are natural gas-fired. According to MENR's estimation, the share of cogeneration will reach 12.2% of total electricity generation and all new cogeneration capacity will be natural gas fired.

Promotion of Renewable Energy Sources

MENR considers the exploitation of renewable energy sources (RES) among its energy policy priorities. Electricity generated from renewable energies were the main policy instruments for the promotion of RES.

The economically usable hydropower potential is estimated at 130,000 GWh per annum, 35% of which has been exploited, 3,197MW is under construction and it is projected that 35,000 MW will be reached in hydropower utilisation by the year 2020.

Turkey has significant potential for geothermal power production, enjoying one-eighth of the world's total geothermal potential. However, much of this potential is of relatively low enthalpy but is still useful for direct heating applications. A wind atlas was prepared to assess wind potential throughout the country. Studies are in progress in evaluating the extent to which wind power resources can be expanded in a cost- effective manner.

Solar energy could also provide significant amounts of power for Turkey, given the country's suitability in terms of solar radiation. Currently, solar power is used mainly for domestic hot water production.

Energy Efficiency

Turkey attaches great importance to the use of energy efficiency potential in meeting its goal of satisfying demands without hampering economic growth with a special focus on protecting the environment. The Energy Efficiency Strategy was developed and adopted in 2004.
Policy formulation, coordination and supervision of activities on energy conservation and efficiency are pursued by MENR within the framework of national energy policies and strategies.

With the collaboration of empowered institutions, (EIE) is to prepare and publicise an inventory that depicts the development of energy efficiency situations in industrial enterprises and buildings on a regional and sectoral basis countrywide and the future projections of such data as well as the annual reports based on its own findings and evaluations concerning the public sector according to the Draft EE Law.

The Draft Energy Efficiency Law is envisaged to be enacted in the fourth quarter of 2006. Adoption and enactment of (energy) legislation shall be performed by Parliament, subsequent to its approval by the Council of Ministers.

Labelling of Appliances

The Ministry of Industry and Trade (MoIT) has recently issued a number of regulations on energy efficiency labelling standards for refrigerators (March 2002), electric ovens (February 2003), washing machines, dryers, dishwashers and electric lamps (August 2002). The Turkish Standards Institute (TSE) has functional responsibility for the certification of products and processes in compliance with international norms.

Industry Sector

The regulation issued by MENR in 1995 on "the measures to be taken to increase energy efficiency in industrial establishments", requires industrial establishments with annual energy consumption of 2,000 tons of oil equivalent or more, to set up an energy management system in their plants.

In the production industry, R&D shall be supported, particularly in the fields of information and communication, development of new products and technologies, environmental protection, development of small and medium sized industries, and investment in the reduction of inter-regional differences in development.

Energy Conservation Promotion Studies

In order to increase energy efficiency in industrial sectors, an Energy Conservation Regulation was issued in 1995. Accordingly, factories consuming energy over 2000 toe are obliged to appoint an Energy Manager in their plants.

Building Sector

The Obligatory Standard Notice on Rules of Heating Insulation at Buildings - TS 825 is accepted in 1999. The harmonization activities of Directive for Energy Performance in Buildings and Rules of Heating Insulation at Buildings - TSE 825 has been under implementation

According to the "Thermal Insulation Regulation" for new buildings, the location of the building, architectural details and heating insulation records prepared according to regional values are evaluated, and the maximum energy amount needed for the building is limited in order to control the convenient insulation system. On the basis of preliminary assessments, heat loss is expected to be reduced to 100-150 kWh/m^2; which is nearly a 50% reduction.

It is planned to initiate two new projects. “EU Increasing Public Awareness on Energy Efficiency in Buildings Project” will be launched in 2007. “UNDP/GEF S&L-EUCC Project-Capacity-Building.

Program for the Removal of Barriers to the Cost-Effective Development and Implementation of Energy Efficiency Standards and Labelling in EU Candidate Countries Project” will be launched in 2007 by the GEF Local point of Candidate Countries.

Environment Sector

Within the MoEF, there are departments related to the energy sector responsible for emission control and environmental impact assessment. The respective General Directorates (DG) performs activities on environmental protection and control of air pollution and carry out environmental impact assessments and planning. Harmonising the existing environmental legislation with the EU acquis lies within the activities of MoEF.

International Assistance and Donation to the Turkish Energy Sector

All international aid to Turkey is co-ordinated through the SPO. In the case of loan agreements, contracts between donors and the SPO are counter-signed by the Undersecretariat of the Treasury. Requests for external donor assistance by Turkish applicants have to be made to the SPO in line with specified procedures.

R&D Studies and Related Projects

The “National Energy Technologies Research Program” started jointly by MENR, MoEF, EIE, TTGV and TUBITAK was completed in 2002. The resulting report contains a 10-year National Operation Program.

There are a number of studies, which may play an important role in the renewable energy sources in Turkey.

New Technology and Mitigation Projects of TUBITAK MAM Energy Institute

It is the TUBITAK-MAM Research Centre (Research Institutes: Information Technologies, Energy, Chemistry and Food, Environment, Materials, Earth and Marine Science) that is in charge of implementing the Technology Foresight Project in coordination with related institutions and establishments.

International Centre Hydrogen Economy Technologies (UNIDO ICHET)

In October 2003, an agreement was signed between UNIDO and MENR to establish the "International Centre for Hydrogen Energy Technologies" (ICHET) in Istanbul. The immediate objective of ICHET is to respond to demands from developing countries for energy services by promoting hydrogen energy technologies, which are economically, technically and environmentally appropriate.

Transport Policies

The law covering Highway Transport was passed on 19.07.2003 and by a decision of the cabinet. The General Directorate of Land Transport was founded in 2004. The object of this Directorate is to set the standards for goods and population being transported and the vehicles conducting this transportation.

The General Management of Civil Aviation has been restructured by law 5431, dated 10th November 2005.

One of the primary objectives of Turkish transport policy is to restructure the railways. An ambitious Rail Transport Action Plan has been adopted for restructuring the railway sector by 2008; attention will also be given to rapid modernisation of the railway infrastructure to be realised in harmony with the structure, technical norms and policies of the EU. In this context, within the planned period, rehabilitation of existing tracks of 1,800 km, and completing signalling works of 180 km and electrification works of 160 km are envisaged.

Development of the Bosphorous Tunnel Railway Passage (Marmaray) will be the most important part of the shortest rail connection between Europe and Asia starting from Bulgaria to Georgia, which will enable an uninterrupted passage to the Bosphorus for the East-West railway corridor. .The Marmaray Project is planned by DLH and construction work started in 2004.

It is estimated that the reduction of green houses gasses in the form of NO_2, NMHC, CO and CO_2 as a consequence of the Marmaray Project will be 130,35 tons/year.

Transport Mitigation Measures

LPG-fuelled passenger cars show a reduction in GHG emissions due to higher efficiency obtained and convenient fuel specifications. As of 2000, all imported and domestically produced new automobiles are equipped with catalytic converters and Euro/95 standards are in place. Standards for maximum sulphur content in diesel oil are being tightened so as to comply with EU regulations by the year 2007.
The projection indicates that the number of total light and heavy-duty commercial vehicles will reach 2,550,000 units in the year 2010, corresponding to a 21.5% increase relative to 2004 values. The number of passenger cars, including diesel vehicles, will also reach 5,700,000 in the year 2010:an increase of 17% based on 2004 figures. It seems possible to compensate for this increase in vehicle fleet size by an improvement in fuel consumption technology.

Agricultural Policy

The basic objective of agricultural policies (2006-2010 Agricultural Strategy Paper) is to ensure balanced and adequate nutrition to the increasing population and create an agricultural structure, which is economic, socially and economically sustainable, well organised and highly competitive by taking food security principles into account. The Agricultural Reform Implementation Project (ARIP) was started to establish the farmer registration system and related

land registration-cadastral system, to ensure a change over from crops which are in excess supply, to alternative crops, to restructure agricultural sales cooperatives and unions and to pay severance benefits during this process. The project is financed by a total loan of $600 million from the World Bank, with $200 million being the programme loan. The project was extended to 2007 to enable establishment of the farmer registration system and accelerating supportive cadastral works, land massing, agricultural investment support, preserving agricultural land for environmental purposes and licensed storage.

Watershed

Rural development projects include basin management and small scale agricultural development projects, and cover activities including the development of agriculture and livestock, irrigation, rehabilitation of watery areas, construction of village roads, construction of forest roads, creation of drinking water ponds, providing drinking water, increasing agricultural and livestock production and forestation.

On the other hand, the Anatolian Watersheds Rehabilitation Project came into force. Since a number of successful and satisfactory results have been realised from the project, the new "Anatolian Watershed Rehabilitation Project", supported by WB and the GEF fund was prepared and started to implement in 2005-2011. The total project budget is $45 million, (WB $27 million, GEF $7 million, government contribution $8,65 million, local government contribution $0.9 million, and villagers' contribution $8,45 million.

Land use, Land-Use Change and Forestry

In Turkey, land use and planning is done by various bodies. But by establishing the necessary coordination between all organisations and parties concerned, it is necessary to decide on a National Land Use Plan based on an interdisciplinary approach with precise and up-to-date data and to base all decisions on this plan; moreover, land use plans and policies have to be updated in view of the changing conditions in the country.

In spite of covering 27% of the country's area, almost half of forests in Turkey are unfortunately unproductive and need to be rehabilitated and protected. Furthermore, forested areas in the country are not evenly distributed.

On the 26.5 million ha (all of fields, vegetable fields, fruit gardens and olive plantations) agriculture land, traditional agricultural techniques such as excessive fertilizer use, stubble incineration and heavy tillage are being widely used. In addition to this, plot distribution of the agricultural lands in the country is not suitable for machine operation and irrigation. Farming with irrigation is insufficient and irrigation is inefficient. Average field size is very small. These unsuitable conditions cause 50% of the farming energy to be wasted. The main source of energy in the agriculture sector is fossil based.

With an area of 13.5 million ha (in 2004) of meadows and pastures which have an important position as CO_2 sink, Turkey has a rich potential. But the concept of management of these fields is poor both in administrative level as well as among the villagers.
Turkey has rich wetlands but the development of these lands requires major investment of capital, manpower, technology, and input as well as substantial annual investments in maintenance.

National Forest Policies

The Ministry of Environment and Forestry (MoEF) and its associated branches are primarily responsible for forestry activities across the country.
Turkey has a Forestry Master Plan (FMP) prepared firstly for the period of 1973-1993 and subsequently for the 20-year period 1990-2009. However, its scope needed to be enlarged to cover all economic, social, ecological and cultural perspectives. The preparation of the Turkish "National Forest Program" (NFP) was initiated in 2001 and finalised in 2004.

Since approximately half of the forests of the country are degraded, rehabilitation of these areas by aforestration and other improvement activities has been of special importance for the improvement of forests in Turkey.

National Forestry Objectives

The main objectives of National Forestry Policies are conservation, integrity, biological diversity and natural structures of the forests, protection against harmful biotic and abiotic agencies, improvement of existing forests, rehabilitation of degraded ones, expansion of forest areas by establishing forest cover on suitable land outside forests.

Other objectives include the provision of multi-purpose benefits from the forests on a sustainable basis, at local, national and global levels and their equitable distribution and utilisation in the overall interest of society.

The Master Plan For Forestry Research, which ensures the policy, strategy, priority and principles for forestry research studies, was prepared in 2001.The plan states that the studies should be strengthened and improved by adaptation to the changing roles and needs of forestry.

Waste

Preparatory works are underway for emission control by controlled waste disposal in compliance with Council Directive 1999/31/EC on the landfill of waste. In the meantime, work on organic wastes (Biowaste Directive-3rd Draft) are also underway. As regards organic waste recovery, mechanical and biological treatment is being considered for composting.

Turkey attaches great importance to the building of controlled storage areas, rehabilitation of existing controlled storage areas and increasing the insufficient number of waste water treatment plants, within the framework of sustainable development principle and in ensuring compliance of Turkish legislation to that of the EU in the process of accession to the EU. The "Integrated Adaptation Strategy Project in Environment Field for the Republic of Turkey and the European Union" gives the total cost of adaptation in these sectors and argues that it would be 289% more expensive than for other candidate countries. Turkey is experiencing the difficulty of not being able to find funds to conduct improvement operations in this sector with an estimated cost of 59 billion euros.

1.3.4 Additional Policies and Measures

The following additional policies and measures are being taken to further reinforce the environmental work being performed in Turkey:

- Ratification of Draft Energy Efficiency Law
- Harmonisation of Turkish legislation with the EU acquis
- Participation in international co-operation projects
- Promoting cars that are less polluting
- Testing laboratories

1.4 Projections and Mitigation Scenarios

Emission of greenhouse gases in Turkey account for less than 1% of global emissions and Turkey remains among the least polluting countries in the world. Full implementation of several mitigation policies and measures that have already been approved and the effects of possible additional measures are discussed in the form of the trend scenario of greenhouse gas emissions to 2010/2020.

1.4.1 Energy sector

As expected, the rapid expansion of energy production and consumption has brought with it a wide range of environmental issues at local, regional and global levels. With respect to global environmental issues, Turkey's CO_2 emissions have grown along with its energy consumption. Emissions in 2004 reached 223 million metric tons.

With GDP projected to grow at over 6% per year over the next 15 years, both the energy sector and the pollution associated with it are expected to increase substantially.

In the current study, the analytical methodology is based on the Energy and Power Evaluation Program (ENPEP) and an integrated energy modeling system is used. The horizon for all analyses spans the period 2005-2020 with 2003 taken as the base year.

Macroeconomic Forecasts and Energy Demand Projections

Population, the population growth rate and the GDP growth rate are given below in Table1.2. These values were being used in general energy and electricity projections.

Table 1.2 Population, population growth rate and GDP growth rate

	2005	2010	2015	2020
Population (million)	73.101	78.459	83.340	87.759
Population Growth Rate (%)	-	1.4	1.2	1.0
GDP Growth Rate (%)	-	5.5	6.4	6.4

Sources: SPO

Main Assumptions of WOM (without measures – reference scenario)

The WOM Scenario reflects the current official outlook with regard to energy prospects. With regard to the energy system structure under the WOM (reference) Scenario, the following assumptions are made:

- No additional domestic reserves of fossil fuels will be available
- No limits are placed on crude oil, natural gas, or hard coal imports
- No major changes will be made in the country's energy pricing policies
- No additional major energy conservation or renewable resource programmes will be implemented

The expansion of the electricity system will be on the basis of cost minimisation over the planning horizon and should observe the following policies: The total domestic lignite generating capacity available for power generation is taken as 18,790 MW (120 TWh). As of the end of 2003, 6,520 MW (42 TWh) of this total is already in operation and a further 2,200 MW (11 TWh) is currently under construction or in the licensing process. The remaining 10,070 MW (67 TWh) is assumed available for expansion in the planning study.

Demand Projection

As a result of the reference case scenario TPES is expected to increase from 92 Mtoe in 2005 to 223 Mtoe in 2020 with an annual average growth rate of 6.1% Table 5.2. Consumption pattern of these sources was coal 29%, oil 37%, natural gas 22%, hydraulic 4% and other renewables 8% in 2005 and it is expected to evolve as coal 37%, oil 27%, natural gas 23%, hydro 4%, other renewable 5% and nuclear 4% in 2020. Although renewables supply increases about 1.5 times during 2003–2020, their share decreases from 8.3% in 2003 to 4.6% in 2020.

Per capita energy consumption was realised as 1284 ktoe in 2005 and expected to be 2541 ktoe in 2020. Power demand from the Turkish economy grew by 8-10% in the past and, it is expected to grow by 7-8% in the long run. The gross electricity demand, which was 163 TWh in 2005, is expected to be 499 TWh in 2020; growing by a factor of three over the next 15 years.
Connection with this growing per capita electricity consumption will increase from 1,994 kWh in 2005 to 5,692 kWh in 2020. Recalling that already in 2003 the world average was 2,429 kWh and it was 8,044 kWh for the OECD average, it is very clear that Turkey is an energy- and electricity-hungry country.

Electricity Supply

Total system generation capacity is projected to grow to 544 TWh. Natural gas-fired units will account for 36.5% (198.8 TWh) of total generation capacity by 2020, dropping from 43.8% (97.3 TWh) in 2000. Hard coal and lignite-fired generation increases from 20.0% (44.6 TWh) in 2005 to 25.0% (135.9 TWh) in 2020. Fuel oil and diesel-fired generation declined significantly. These are projected to generate only about 3.6% (19.4 TWh) of total electricity. This is down from 8.7% in 2005. All renewables (hydro, geothermal, solar, wind) account for a combined 22.5% (118.3 TWh), up from 21.7% in 2005. When the share of primary resources for electricity generating capacity are observed, there is a small decrease in natural gas, a considerable decrease in oil products, a slight increase in lignite and imported coal, a sharp increase in nuclear and a relatively stable share of hydro and wind.

Emissions of GHG's under the WOM Scenario (Reference Scenario)

CO_2 Emissions

Total CO_2 emissions by sectors under the WOM scenario (Reference Scenario) increase at an average rate of 6.3% annually between 2003 and 2020, and will reach a total of 604.63 million tons/year by 2020. The most noticeable change in sectoral contribution is in the power sector, where emissions are growing by 7.1% per year and account for 37.0% in 2020 (221.9 mtp.a.), up from 32% in 2003 (68.9 mtp.a.). This is driven by the high growth in final electricity demand as well as the continued reliance on solid fuels in this sector, which will still account for 36% of power-related fuel consumption by 2020, despite the increased penetration of natural gas, nuclear and wind energy.

CH_4 Emissions

Total CH_4 emissions will increase 2.4 times from 175.7 to 421.4 kt p.a. between 2003 and 2020. At the beginning of the planning period, CH_4 emissions are dominated by residential biomass combustion with 56.7% of total CH_4 emissions in 2003. But due to the growth in natural gas and electricity consumption, residential CH_4 emissions increased at a below average rate with sectoral share declining to 35.7 % in 2020. Industry sector CH_4 emissions will grow at a 6.5% annual rate from 6.2-to 18.2 kt p.a. between 2003 and 2020. The industrial share is around 3.5-4% throughout the planning period.

With Measure WM- Demand Side Management (DSM) Scenario and the Total Effect of Policies and Measures

Studies carried out by EIE show that it may be possible to reduce peak energy demand by using Demand Side Management. A reduction of 15% in the industrial sector and 10% in the residential sector are assumed to assess the combined impact on emissions as well as energy and electricity.

However, increasing efficiency requires some investment in the improvement of appliances and infrastructure. The estimated total cost for this investment is calculated to be approximately 100 million YTL annually, from the year 2008 to the year 2020. Yet, a limitation is that an estimated potential and associated cost by 2003 is not available for the transportation sector. The WM (DSM) scenario therefore focuses mainly on industry and residential sectors. One noticeable effect is nuclear power. Although three 1,500 MW capacity nuclear units enter the system by 2012, 2014 and 2015 under the WM (Reference) Case, only two units come into operation under the DSM Scenario in the years 2015 and 2018. Electricity imports also drop by 1.9 GWh by 2020.

Energy Consumption and Energy Supply

By 2020, total final energy consumption will drop by 16.2 mtoe or 9.2% from 176.6 to 160.3 mtoe. Renewables remain at the same level as under the WOM Scenario (Reference Scenario) as they were assumed to be unaffected by the DSM programme. Hence, the largest declines are experienced in hard coal with a drop of 16.4% (6.2 mtoe), natural gas of 13.4% (3.4 mtoe) and lignite of 12.5% (0.5 mtoe). Electricity consumption will fall by 10.8% (4.6 mtoe or 53.7 TWh) while oil products will only decrease by 2.8% (1.5 mtoe), as the majority of that consumption in the transport sector is not affected by the DSM efforts. In accordance with the assumed DSM potential in households, the overall residential final consumption falls by 4.8 mtoe or by 10% (2020). A larger decline can be observed for residential, hard coal and coke (17.4%, 1.1 mtoe), natural gas (13.6%, 1.5 mtoe), lignite (10.6%, 0.1 mtoe), and oil products (10.6%, 0.3 mtoe). Residential electricity demand in 2020 is 19.6 TWh or 10% below Reference Scenario levels (a cut from 16.8 to 15.1 mtoe or 195.2 to 175.7 TWh).

In the industrial sector, the overall drop in final consumption is 15% (11.5 mtoe) in 2020; Industrial hard coal and coke consumption in 2020 will drop- by about 5.1 mtoe (16.3%), oil products by 1.2 mtoe (13.5%), lignite by 0.4 mtoe (14.9%) and natural gas by 1.9 mtoe (13.5%). Industrial electricity demand in 2020 will be 2.9 mtoe or 34.1 TWh (15%) below Reference Scenario levels.

Emissions under the WM (DSM) Scenario

Emission reductions in the WM (DSM) scenario take place in the power, industry and residential sectors. DSM will reduce national CO_2 emissions in 2020 by 75 million tons per year or 12%. Sectoral reductions are as follows:

- 37.2 mtp.a or 16.8 % in the power sector
- 28.7 mtp.a. or 14.6 % in industry
- 9.4 mtp.a or 14.4 % in the residential sector.

The larger percentage reduction in the power sector is due to the proportionally higher decline of fossil fuel, particularly coal use. The 16.8% reduction in the power sector is close to the reduction in coal consumption for electricity since DSM essentially reduces lignite and imported coal-fired generation.

1.4.2 Other Projections: Mitigation / Evaluation

In order to give a clear and quantifiable picture of the mechanism as to how individual policies and measures result in GHG emission reductions, the input data and the method of calculation is explained in relevant sections. The origin of the input data is diverse and it is due to different individual policies, often either the baseline or the method of calculating the emission reduction is different, too. These differences and the applied methodologies are therefore described in each case.

Besides the analytical methodology based on the Energy and Power Evaluation Program, (ENPEP), hybrid approaches are also used for combinations of econometric and structural approaches. They typically involve separate models for each end use, like structural approaches, but also include econometric analysis in an effort to better incorporate behavioural responses.

These models are typically used for transport demand forecasting and mitigation of alternative measure forecasting in energy intensive industries, such as steel and cement.

The following studies include a series of different approach trend scenarios of greenhouse gas emissions to 2010/2020. Some of the scenarios already include full implementation of several mitigation policies and measures that have already been approved, as described in the policies chapter. Some of the energy intensive industries such as cement and steel have already been implementing abatement measures over the years.

1.4.3 Transport Projections

Transport projection results differ from the results presented in the energy projections, owing to the different models that have been employed.

The transport sector contributes to rising greenhouse gas (GHG) emissions in the form of CO_2, CH_4, N_2O and gases responsible for the formation of such gases as NOx and the VOCs. As carbon dioxide emissions are directly linked to fossil-fuel use in transport, this project will lead to a reduction in greenhouse gasses, as less energy-intensive and zero-emission modes of transport will be promoted.

Two separate approaches were used to estimate the emissions from road transport:
1. Estimating emissions based on the fleet size of motor vehicles (Fleet-based estimation).
2. Estimating emissions based on traffic demand taking into account the modal shift from road to rail (Demand-based estimation).

For railway transportation, demand-based estimation methodology was used. In this study, the estimation of the emissions based on future traffic demand was carried out by the following steps:
a) Analysing the relationship between total transport demand and GDP growth based on data from the 1970–2004 period.
b) Estimating future transport demand by road and rail.
c) Analysing the relationship between transport demand and emissions from road and rail transport.
d) Estimating emissions from road and rail transport in the 2005–2020 period.

There are three main ways in which GHG emissions from transport can be reduced:

Operational – reducing energy use and emissions per vehicle-km driven. Strategic – optimisation of vehicle use, reducing total vehicle-km per passenger-km or per tonne-km. Demand – reducing overall demand (passenger-km or tonne-km) for travel.

A number of policy levers are available for implementing measures in these three categories

For the purpose of preparing a detailed inventory of transport based GHG emissions and to investigate the major parameters effecting these emissions and provide certain solutions to control them. A project is proposed by MoT on "Abatement of Greenhouse Gases Emissions Resulted From Transport sector in Turkey" in collaboration with TUBITAK-MAM, Istanbul Technical University Mechanical Engineering Faculty, Istanbul Technical University Civil Engineering Faculty. The Project is accepted by TUBITAK in Oct 2005 and implementation started in Oct 2006. At the end of this study more realistic and in detail scenarios will be produced in order to provide information to policy makers.

1.4.4 Industrial Projections

Turkey is aware of its responsibilities and has been taking measures in all economic sectors, particularly in the energy-intensive sectors of industry, with the co-operation and contribution of the Manufacturers Associations of these industries, to increase energy efficiency and to reduce impacts on the environment. These applications have pointed up the great financial burden these measures put on the producers. Detailed measures for two industrial sectors, cement andiron and steel; will be discussed here because of their high-energy demands and their strong impact on climate change.

Turkish Steel Industry

In this study, CO2 emissions related to the direct use of energy in the Turkish Iron and Steel Industry were reported. A survey was carried out in the sector and specific energy consumption values, as well as specific CO2 emission values are determined for the years 1990, 2004, 2010, 2015 and 2020. By using the total amount of steel production and specific CO2 emission values, total future CO2 emissions are estimated.

In 1990, 9.31 Mt (million tons) of crude steel was produced in Turkey. About 53% of this amount was produced by electric arc furnaces (EAFs), and 47% was produced by integrated steel plants (ISPs). In the ISPs, 13% of the steel was produced by open-hearth furnace (OHF) and the rest, 87%, by basic oxygen furnace (BOF). In 1990, the total amount of CO2 emissions, related to the direct use of energy in steel production, was estimated at 11.96 Mt. Although the amount of steel produced by EAFs is higher than the steel produced by ISPs, the contribution of EAFs to total CO2 emissions was found to be quite small, only 5.6%. This is mainly due to the lower specific CO2 emission value for the steel produced by EAFs, which is around 0.135ton CO2/ton for crude steel, than the specific CO2 emission values produced by ISPs, which is around 2.59 ton CO2/ton for crude steel.

In 2004, the total amount of CO2 emissions, related to the direct use of energy in steel production, was estimated at 15.2 Mt. About 13% of total CO2 emissions were estimated to be from steel produced by EAFs, and the rest of the CO2 emissions from steel produced by BOF. The specific CO2 emission values for steel produced by EAFs in 2004 were found to be similar to the values in 1990. On the other hand, for steel produced by ISPs, the specific CO2 emission value was estimated to be 2.22 ton CO2/ton for crude steel, which is lower than the value obtained in 1990. There are several reasons behind this reduction. It has to be noted that the emission values used in these projections are based on sector-specific estimates from the Turkish Iron and Steel Producers Association. Whereas in chapter 3 and Annex 4, industrial emission levels are estimated by using IPCC Tier1 methodology

One of the reasons for the lower specific CO2 emission value is the energy efficiency study, which had been done at Eregli Iron and Steel Factories (Erdemir) and Iskenderun Iron and Steel Factories (Isdemir) since 1990.

Another reason is the change in steel production technology at Karabük Iron and Steel Factories (Kardemir). After its privatisation in 1995, Kardemir changed its steel production technology from OHF to BOF.

According to the projections, crude steel production is expected to increase to 28.37 Mt in 2010, 32.36 Mt in 2015, and 33.86 Mt in 2020. In 2010, 63% of crude steel will be produced by EAFs, whereas for the years 2015 and 2020, crude steel production by EAFs will be around 41%. Throughout these years, no change is expected in the specific emission values of the steel produced by EAFs. On the other hand, further reduction in the specific emission values of the steel produced by BOFs is expected. In 2010 this value is estimated at 1.91 ton CO2/ton crude steel, whereas in 2015 and 2020 it is estimated at 1.87 ton CO2/ton crude steel.

In conclusion, since 1990, the Turkish Iron and Steel Industry updated its steel production technology. In terms of CO2 emissions, it seems that the large amount of steel produced by EAFs is a definite advantage. The investments in producing

steel with lower specific energy consumption and hence lower specific CO2 emissions are still continuing. Hence, in the next 15 years, the Turkish Iron and Steel Industry will be in a better situation in terms of quality of production and in terms of emitting less CO2 per ton of crude steel.

Turkish Cement Industry: Sectoral Mitigation Approach

The study presented in this report gives an in-depth analysis of the Turkish cement industry, identifies the energy saving and carbon dioxide emission reduction potentials and develops an implementation schedule of the necessary measures, based on cost-benefit analyses. An aggregated model of the Turkish cement industry was developed for this purpose. Possible measures and their implementation schedule in the years from 2004 to 2020 were determined by using the aggregated model to obtain The Energy Saving Supply Curve (ESSC) of the Turkish Cement Industry. The following three scenarios were studied by using the Escort the interest rate values of 12% and 30%:

Scenario 1: Using the Technology of 1990 for Production
Scenario 2: Using the Technology of 2004 for Production
Scenario 3: Implementing Energy Saving Measures After the Year 2004

If the interest rate is 12%, the specific primary energy consumption drops from 4.00 GJ/ton-cement in the year 2004 to 2.84 GJ/ton-cement in 2020. The required investment to realise this reduction is $525.3 million in the year 2010 and $271.3 million in the year 2020. The specific heat consumption for clinker production reduces from 836.6 kcal/kg-clinker in the year 2004 to 705.07 kcal/kg-clinker in the year 2020, which represents a decrease of 16%. Correspondingly, the specific electricity consumption drops by 32.2% from 107.86 kWhe/ton-cement to 73.12 kWhe/ton-cement. If no waste fuel is used, the specific heat consumption for clinker production goes down to 750.07 kcal/kg-clinker in the year 2020. CO2 emission calculations were carried out also for the same scenarios. The total CO2 emission was 20.59 million ton-CO2 /year in 1990. If using the technology of 1990 in carrying out production, the total CO2 emission would have been 33.29 million ton-CO2/year in the year 2004. The results demonstrate that CO2 emissions in the Turkish cement industry have been reduced by 2.39 million ton-CO2 /year or by 7% from the year 1990 to 2004 as a result of voluntary measures taken during this period. If production is carried out using technologies from1990, total CO2 emissions in 2020 will be 58.29 million ton-CO2 /year, whereas if the technology of 2004 is used, it will be 54.63 million ton-CO2 /year.

However, if energy saving measures are implemented after 2004, total CO2 emissions in 2020 will be 50.90 million ton- CO2 /year for a 12% interest rate. The reduction in the total CO2 emission in 2020 as a result of taking proper measures is 7.4 million ton-CO2 /year, or 12.7% compared to Scenario 1 emissions.
If the interest rate is 12%, the specific CO2 emission of cement with additives, which is 770.66 kg-CO2/ton–cement in the year 2004, reduces to 610.94 kg- CO2 /ton–cement or by 21% in the year 2020. It has to be noted that 30 % additive is a very ambitious limit, which can be difficult to achieve due to the low availability of additives in such high quantities. The specific CO2 emission in the year 1990 was 809.42 kg-CO2/ton–cement. Hence, the specific CO2 emission reduction from 1990 to 2020 is 24.5%. The specific primary energy consumption reduces from 4.00 GJ/ton-cement in the year 2004 to 2.84 GJ/ton-cement in 2020 if the interest rate is 12%. The required investment to realise this reduction is $525.3 million in the year 2010, and $271.3 million in the year 2020. These investment costs are in terms of prevailing US dollars exchange rates in the specified years. Such costs are a huge burden for the industry.

1.5 Climate Change, Vulnerability Assessment and Adaptation Measures

1.5.1 Climate Change Impacts

The most prominent feature of recorded changes proves to be the widespread increase in summer temperatures. Summer temperatures increase mostly in the western and south-western parts of Turkey. Winter precipitation in the western provinces of Turkey has decreased significantly in the last five decades. On the other hand, fall precipitation has increased in the northern parts of central Anatolia.

Precipitation decreases along the Aegean and Mediterranean coasts and increases along the Black Sea coast of Turkey. The most severe (absolute) reductions will be observed on the south-western coast; in contrast, the Caucasian coastal region is expected to receive substantially more precipitation. In summer there will not be much changes in the amount of precipitation over Turkey.

Coastal erosion, flooding and inundation along Turkish shorelines are l problems of national significance, particularly in the middle and eastern Black Sea, the northern Aegean Sea and eastern Mediterranean. Tourist and coastal cities are particularly under threat. Many 'flagship' cultural sites would also be damaged or destroyed by Accelerated Sea Level Rise (ASLR) like ancient cities such as Phaselis and Patara on the southwestern coasts of Turkey. Some of them could be destroyed by increased wave activity, whereas burial by more active sand dunes is also possible (e.g. the ancient city of Pompeipolis [Viransehir] on the Mediterranean coast has recently been covered by sand dunes). Because of the large number of ruins, relocation is impossible in practical terms, and it may change their character and context, as well.

It is projected that nearly 20% of the surface water in the studied basins will be lost by the year 2030. By the years 2050 and 2100, these percentage will increase up to 35% and more than 50%, respectively. The decreasing surface water potential of the basins will cause serious water stress problems among water users, mainly agricultural, domestic and industrial waterconsumers. Furthermore, the increasing potential crop evapotranspiration (up to 10% and 54% for the years 2030 and 2100, respectively) will increase irrigation water demand enormously. In addition to the expected water scarcity problems, land use and land cover of the basins will also be seriously affected by the results of climate change.

1.5.2 Adaptation

Turkey, being a coastal country, recognised the increasing number of problems in coastal zones and many precautions are being taken by several governmental institutions and agencies. For example, most of the protection areas declared by the Turkish government are located in the coastal zones such as Fethiye-Gocek, Gokova, Patara, Kekova, Foca, Datca-Bozburun and Belek etc. The Ministry of Environment is planning to establish a Coastal Zone Department for EIA and the Authority for the Protection of Special Areas has been declaring new areas as protection areas and developing special environmental programmes.

In respect to offsetting the increasing water scarcity problems and desertification,

- Developing techniques for non-traditional use of water resources
- Improving and developing new plant species resistant to drought and salinity
- Developing plant species that may yield quality products with low-quality water

are recognised as adaptation measures.

1.6 Financial Resources and Transfer of Technology

1.6.1 Environmental Finance Policies and Implementations in Turkey

According to the UN Framework Convention on Climate Change, the countries listed in Annex II to this convention are obliged to provide financial assistance, as well as to implement measures aimed at technology transfer, to developing countries. Turkey is not an Annex II country; nevertheless, it participates in many international projects, which are co-financed by the Turkish government.

Due to economic barriers, there is an insufficiency of environmental expenditure in Turkey. The share of the environmental investment expenditure in the gross domestic product for the governmental organisation was 1.60 o/oo in 2003 and 1.26 o/oo in 2004 (TURKSTAT).

TUBITAK is in charge of national science and technology development and research funding in Turkey. The Turkish Research Area (TRA), executed by TUBITAK, aims to provide synergy among institutions carrying out R&D activities and to add complementary public funds to the R&D budget, in order to increase the ratio of R&D expenses to 2% of GDP and to raise the number of full-time equivalent R&D personnel to 40,000 by 2010.

The total of 136 million euros TRA Funds for Public Sector in 2005 are distributed between the benefactors as follows: €53 million to Academic R&D, €30 million to Defence and Space Programmes, another, €30 million to Public Institutions, €15 million to Researcher Development and the remaining €8 million to Science and Society. Additionally, 69 million euros will be allocated to private sector research projects

According to the decisions taken by SCST, TUBITAK has supported the research programmes of related Ministries Research Grant Committees (RGC), these are set up as; Agriculture, Forestry and Veterinary-Basic Sciences-Environment, Earth, Marine and Atmospheric Sciences-Electrical, Electronics and Informatics–Health Sciences–Engineering-Defence and Security Technologies- Space Technologies - Social Sciences and Humanities.

Technology Development Foundation of Turkey (TTGV)

TTGV was established jointly by the private and public sectors as an independent non-profit organisation on June 1, 1991 in order to support national technologic innovation activities of industrial and software companies and to enhance competitiveness in world markets.

TTGV supplies funds for technology development, technological innovation, new products, new processes and new production method development projects of industrial companies. In addition to these funds, it promotes building technology service centres, technoparks and technology development areas and supplies funds for these and takes a catalytic role in development of technology-based venture capital mechanisms and has given start-up support for the first time in Turkey. Besides these, TTGV supports some environmental projects such as "Phasing out of the Industrial Use of Ozone Depleting Substances Project", which came within the framework of the Montreal Protocol in Turkey.

TTGV gives following supports to industry:

- Technology Development Project Support (TDP)
- Technological Entrepreneurship Support
- Environmental Support

European Environment Agency

The breaking point of the development in the field of Turkish environmental information management was when Turkey became a member of the European Environment Agency (EEA) in 2003. MoEF is aiming to establish a link to European Environment Information and Observation Network through the national EIONET system to fulfil the reporting requirements of the EE, capacity building within the involved institutions, and dissemination of the experience and knowledge gained from the EEA to relevant national institutions and experts to enable Turkey to have access to data for inventory preparations and climate change mitigation and adaptation projects.

Turkey contributed financially to EEA for EIONET, with a first year contribution of 2, 033,000 euros, second year contribution of 2,596,000 euros and a third year contribution of 3,127,000 euros (3,088,250 euros of the first two years was financed by MEDA.

Ministry of Industry and Trade

A new project called “SAN-TEZ” has been launched in Sept.2006, for developing university industry collaboration. 75% of the project cost will be funded bf MoIT and 25% will be provided by the industry. Aim of the project is to;

- Commercialize academic knowledge,
- Transfer academic knowledge into high value added technological products,
- Solve problems of industry during production process in cooperation with universities,
- Provide R&D and technological culture for SMEs.

1.6.2 International Funding

Turkey has participated in the FP4 and FP5 on a project basis and is an associated country to the FP6 and is already a full partner of the EU in science and research.

The EU’s 6th Framework Programme supports R&D activities throughout Europe in order to improve Europe’s scientific and technological infrastructure and to increase global competitiveness of the European economy. All members and candidate countries, including Turkey, are eligible. Research projects are funded in 7 priority areas including “sustainable development, global change and ecosystems” which focuses on – Sustainable energy systems – Sustainable transport – Global change and ecosystems.

Global Environment Facility- GEF Contributions

Turkey has become eligible for GEF assistance after becoming a party to the UNFCCC. Turkey as an Annex I country, contributed a total of $23,326,400 to the GEF funding mechanism as annual fees. In the meantime, as a developing country Turkey received $33,134,000 of funding in total: $21,507,000 for national projects and $11,627, 000 for regional projects. The only project directly related to climate change is the NFC Enabling Activity Project with a budget of $420,000. The rest of the GEF projects have indirect relations such as the Anatolian Water Basin and Biodiversity Projects.

The GEF has donated a sum of $33,134,000 to these projects of which $21,507,000 is for national projects and $11,627,000 for regional projects.

1.6.3 Environmental Finance within EU Harmonisation and Bilaterally Funded Projects

To align Turkey's environmental infrastructure with European average standards, 59 billion euros is required. Under the category of non-EU "third countries" and as a Mediterranean country, Environmental Finance within EU Harmonisation has been accelerated. The relevant programs are MEDA Program, LIFE - Third Countries Program and SMAP.

Various institutions of Turkey (public institutions, nongovernmental organisations, universities, private sector and local governments etc.) obtained support for various projects on the environment on a number of occasions from the MEDA programme, Mediterranean countries by the EU, LIFE programme, another support instrument which is being developed for financial cooperation with third countries and METAP.

Funding from the European Investment Bank (EIB) has supported 12 environmental projects. These twinning projects are important elements under the 2004 programme, contributing to the results of 22 projects involving 12 EU member states. Some of the twinning projects are planned in the fields of agriculture, environment and transport. The implementation of programmess related to the Mediterranean and the Black Sea will constitute models for similar regional programmes elsewhere in the world.

Starting from 2000, the Dutch MATRA-PSO Bilateral Cooperation Program has supported 23 projects with a total cost of approximately 50-70 million euros.

A multitude of projects concerned with the environment are supported by donations from International Environment Donors. The most important donors are, United Nations Environment Program (UNEP), Mediterranean Action Plan, UNDP, UNIDO, EU, World Bank, Japanese International Cooperation Agency (JICA), UN Food and Agriculture Organization (FAO), The UNDP- supported Black Sea Environment Program, German Development Bank (KfW), German Development Cooperation (GTZ), Mediterranean Environmental Technical Assistance Program (METAP), Defra and embassies of countries such as the Netherlands, Germany, Britain, Sweden, Norway, Japan, Switzerland and Italy.

1.6.4 Activities Related to Transfer of Technology

The mission of UNIDO - International Centre for Hydrogen Energy Technologies in Turkey (UNIDO-ICHET) is to act as a link between developed and developing countries in bridging the gap between research and development organisations, innovative enterprises and the market, in order to help convert the world economy to the Hydrogen Energy System, particularly in developing countries. UNIDO-ICHET Turkey is supporting and promoting a variety of pilot projects worldwide. The Turkish government - through the Ministry of Energy and Natural Resources - is contributing $40,000,000 to UNIDO in the form of a Trust Fund towards the establishment of UNIDO-ICHET in Istanbul, Turkey. Key international projects are: Wind-Hydrogen (Argentina), Hydro-Hydrogen (Azerbaijan), Hydro-Hydrogen (China), Biological Hydrogen (India), Hydrogen Fuelled Three-wheeled Vehicles (India), Wind-Hydrogen (Morocco), Geothermal-Hydrogen (Portugal), Biomass Hydrogen (Romania) and Hydrogen Fuelled Vehicles (South Korea).

1.7 Research and Systematic Observation

1.7.1 General policy and Financing

The Turkish government and researchers are more and more aware of sustainable management of the environment and its resources through the advancement of knowledge of the interaction between the biosphere, ecosystems and human activities, and developing/transferring new technologies, tools and services, in order to address global environmental issues in an integrated way. In the future, emphasis will be put on the prediction of climate, ecological, earth and ocean system changes; on tools and technologies for monitoring, preventing and mitigating environmental pressures; and risks including health, as well as for sustainable conservation and management of the natural and man-made environment.

TSMS, DSI and EIE are the state organisations responsible for making observations on weather, climate and hydrology and monitoring climate systems. Some military organisations are also involved in oceanographic observations. Air pollution measurement is the responsibility of MoEF, MoH and local governments. Research studies on climate change are performed in universities, public institutions and research centres.

Research and development (R&D) costs are financed mostly by the public sector. This is subsequently followed by the private sector and by other domestic and foreign sources. Where Turkey falls behind is in the finance input to its R&D system. R&D expenditures, as a percentage of GDP, have increased by a factor of two from 0.32% in 1990 to 0.64% in 2000. Starting with the 2005 budget, in order to increase the ratio of R&D expenses to GDP up to 2% in 2010, 446 million YTL (279 million euros) has been added to the 2005 Budget for the Turkish Research Area - TARAL.

1.7.2 Research

In Turkey, research on climate change started in the mid 1990s. These activities mostly focused on the climate process and system studies, as well as climate impacts research and partially related to mitigation. Presently in Turkey, studies in the field of climate change impacts and socio-economic analysis are limited. Another important branch of research is the development of existing and new adaptation and mitigation methods and technologies, which are lacking.

The establishment of TUBITAK (Scientific and Technical Research Council of Turkey) in 1963 marked a turning point in national science and technology policy in Turkey. TUBITAK's main target is to disseminate science and technology culture among Turkish society, thus increasing the demand for R&D and to enhance the quality and quantity of R&D personnel and consequently to increase the share of R&D expenditure in Turkey's GDP.

"Vision 2023: Strategies for Science and Technology" is an ongoing project of TUBITAK, aiming at building a science and technology vision for Turkey and developing science and technology policies over the next 20 years.

TUBITAK, as the contact organisation for the EU Framework Programmes, has a mission to provide every kind of support to researchers in submitting FP6 proposals and participating in project consortia in order to facilitate Turkey's participation in Framework Programmes and the integration of Turkish Research Area – TARAL, with the European Research Area (ERA).

There are several projects related to climate change supported by the EU's FP6. Within the context of research and systematic observation on climate, currently seven projects are financed by TUBITAK. Climate Change Scenarios for Turkey, Integrated Meteorology/ Oceanography Network Of Excellence, and Reduction of Greenhouse Gas Emissions Resulting from the Transport Sector in Turkey and CO_2 Capture and Storage are among these projects.

Being the National Focal Point for the EEA, MoEF is aiming to establish a link to the European Environment Information and Observation Network through the National EIONET system for fulfilling the reporting requirements of the EEA and capacity building within the involved institutions as well as dissemination of the experience and knowledge gained from the EEA to relevant national institutions and experts.

UNIDO – ICHET (United Nations Industrial Development Organization-International Centre for Hydrogen Energy Technologies)

The Turkish Ministry of Energy and Natural Resources signed an agreement with UNIDO to build in Istanbul, a $40 million ICHET, entirely financed by Turkey.

Beyond helping Turkey to increase the amount of energy produced from non-fossil fuels, UNIDO's project is aimed at transferring existing hydrogen technologies from Turkey to other developing countries, to help them to catch up with the developed world in the field of renewable energy resources. UNIDO-ICHET's activities are focused on promoting the development, acceptance and use of hydrogen technologies by demonstrating their viability & applicability through pilot projects.

1.7.3 Systematic Observations

Atmospheric and Meteorological Observations

The TSMS is the only legal organisation responsible for building and operating the precipitation, climatologic, synoptic, and higher atmospheric observation stations, keeping records of these observations, making weather and sea forecasts based on the evaluation of these observations, and informing the public and relevant organisations about its forecasts.

Air quality in the country in general is measured using the semi-automatic measurement devices that belong to the MoH and it is observed in 31 fully automated monitoring stations established in 2005 by MoEF. It is planned to establish fully- automated air quality measurement stations for all 81 provinces in the year 2006 by MoEF. Air pollution monitoring stations measure concentrations of major air pollutants (PM, SO_2). In some stations, NOx and CO are also measured.Sulphur dioxide (SO_2) and particulate matter concentrations have been evaluated and published as monthly, winter season and annual press releases by TURKSTAT.

Participation in Global Atmospheric Observation Systems

There are 7 GSN participating stations, one GUAN participating, one GAW and one WOUDC participating station in Turkey.

Oceanographic Observations

Activities related to oceanographic observations and data base are mostly the responsibility of the Turkish Military. Relevant departments of universities are also interested on a project basis. There are currently 11 mareographs and Turkey is planning to increase their number.

Participation in Global Oceanographic Systems

Since 2001, the General Commandership of Mapping (GCM) of Turkey is a member of ESEAS with their Antalya mareograph station and to the MedGLOSS Project by IOC and CIESM with 4 stations. Within the scope of GOOS, Marine Sciences Institute (MSI) of METU is an active member of EuroGOOS and MedGOOS and founder and Executive Committee Secretary of the Black Sea GOOS.

Terrestrial Observations

Within the scope of terrestrial observation systems, phenological observations are conducted by the TSMS and the MARA, whereas hydraulic observations are conducted by the DSI and the EIE. Additionally, data acquisition and study activities on land use; forests and forest fires are conducted by the MoEF and the MARA.

Space-based Observation Programmes

The TSMS is among the founders of the EUMETSAT. Through the HRUS (High Rate User Station) and the HRPT (High Resolution Picture Transmission) ground receiving stations installed at the TSMS, satellite data is being received four times a day from NOAA and at fifteen-minute intervals from MSG.

1.8 Education, Training and Public Awareness

Training and public awareness activities in the field of prevention of climate change have gained an apparent momentum in Turkey as a result of harmonisation with the EU Acquis Communautaire, legislative arrangements and practices. The Environmental Law amended recently, promotes expansion of environmental training activities and raising public awareness.

An international meeting in Turkey , the "Ankara Conference on Climate Change" was held in 2004 and created much dialogue on the environmental for decision makers and key stakeholders concerning the UNFCCC and the obligations and opportunities brought forward when Turkey became a contracting party to the Convention. The meeting also facilitated various cooperation agreements between Turkish stakeholders and international organisations.

Various capacity building and training activities have been carried out in respect to improving the level of understanding of stakeholders of the Preparation of National Communication and GHG inventories under UNDP's GEF-funded Project for the Preparation of the First National Communication of Turkey to UNFCCC. Again within the same framework, a competition on making paintings and slogans on climate change helped to raise awareness of climate change among young people. Giving priority to business, the public and NGOs, awareness-raising workshops, forums and panels on energy, industry, impact and adaptation disciplines were launched during the preparation of the First National Communication of Turkey. During this term, training to professionals inpublic agencies was given in several technical areas.

Comprehensive insitu training under the Training Bus Program for Energy Efficiency hasbeen undertaken in factories in recent years as well as "Energy Manager Certificate" courses provided to local and foreign experts and technical personnel from factories.

The International Meeting for Kids took place in April 2006, where the issues of climate change and its adverse effects were discussed, recommendations for solutions were also presented, with the participation of 250 children from 39 countries.

The Preparations are under way to initiate an inter-disciplinary postgraduate programme on Climate Change. The programme will admit students in the academic year 2006-2007.

At the local level, "Car free" days as part of preventive campaigns on climate change take place at several cities annually.

The MoEF is conducting the public awareness and training activities in co-operation with REC Turkey

In addition, various climate change web pages initiated by several organisations provide updates to the public and to professionals regarding climate issues, energy and transport, with disseminated information on how to assist both individuals, public bodies and businesses to take action.

References

References have a part in end of other chapters.



CHAPTER 2
NATIONAL CIRCUMSTENCES

2. NATIONAL CIRCUMSTANCES

2 NATIONAL CIRCUMSTANCES

2.1 Government structure

Back in 1923, the foundation of the modern Turkish Republic lay on the principles of peaceful foreign policy, secularism, the rule of law, a pluralistic and participatory democratic system, and fundamental human rights and freedoms. Under the presidency of Mustafa Kemal Ataturk, proclaimed reforms establishing contemporary values in every aspect of social life have been addressed.

The political system of Turkey is a Parliamentary Democracy. The Turkish Constitution structures the Republic of Turkey as a democratic, secular and social state in which executive, legislative and judicial powers are separated. Legislative power that cannot be delegated is vested in 550 members of the Turkish Grand National Assembly. The members are elected for a term of five-years by votes of Turkish citizens over the age of eighteen. With regard to the judicial system, it is independent and consists of independent courts and the National Court of Appeals as well as the Constitutional Court. According to the Constitution, the President together with the Council of Ministers exercises executive power.

The National Assembly elects the President for a period of seven years. The Council of Ministers is composed of the Prime Minister and the Ministers. The President appoints the Prime Minister. Ministers are selected by the Prime Minister but must be appointed afterwards by the President.

Under the Turkish Constitution Article 56, it is the right of every citizen to live in a healthy and well-balanced environment, and it is stipulated that it is the duty of the state and citizens to protect the environment and prevent pollution. Therefore, taking responsibility for the environment is binding on every individual, institution or entity in Turkey.

Recognising fundamental principles such as the polluter pays principle (PPP), the Environment Law enacted in 1983 regulates the framework for environmental management and related consequences.

Experiencing a rapid simultaneous growth in the energy, industry, transport and tourism sectors, Turkey has also been coping with massive levels of immigration from rural to urban and coastal areas that has intensified pressure on the environment. These factors have highlighted the significance of environmental protection and the need to combat environmental pollution.
Within regard to the roles vested in public and state bodies; the legislative, executive and judicial agencies address the key functions of the state responsible for the protection and preservation of the environment. The general administration is divided into two jurisdictions: central government and local governments. Central government is fragmented into provinces, districts and other sections. The centralised administrative bodies functioning under a hierarchical ministerial structure are in charge of delivering public services on a national scale, and are linked with associated ministries. In this respect, local governments provide services for citizens in provinces, municipalities and villages.

Turkey is dedicated to going through a dynamic process of legal, political and economic reforms on the road to European

Union (EU) membership since declaration of the country's candidacy by the Helsinki European Council in 1999, ushering in a new era of EU-Turkey relations after forty years of association with the European Union.

Developments since the Helsinki Council have brought Turkey closer than ever to the goal of EU membership. The EU, at the Copenhagen Council of 12-13 December 2002, committed itself to starting accession negotiations.Work related to the National Programme for the adoption of European Acquis have been in progress since 2003. Turkey has been going through the stages of the harmonisation, approximation, and adaptation processes since the approval of European Acquis. [1]

2.1.1 Central Government in Environment

Statutory Decree no 443 established the Ministry of Environment in 1991. On 8 May 2003, the Ministry of Environment was merged with the Ministry of Forestry under Law no 4856. The new ministry was called "The Ministry of Environment and Forestry (MoEF)[1]". [2]

The main task of the MoEF is to ensure legal arrangements by drafting laws and supervising their implementation as well as enabling initiation research activities in this field. [3]
The MoEF is the main governmental authority responsible for

- Protection and rehabilitation of the environment and forestry
- Ensuring the most appropriate and. efficient use and protection of natural resources and lands in rural and urban areas
- Protection and enhancement of the country's flora and fauna together with its natural resources
- Prevention of any type of environmental pollution
- Protection, development and expansion of forests and forest sites
- Enabling the human development of rural people living in and next to forests and taking necessary measures in this regard
- Ensuring the demand for forestry products is met and developing the industry of forest-related products.

The organisation chart of MoEF is given in figure 2.1.

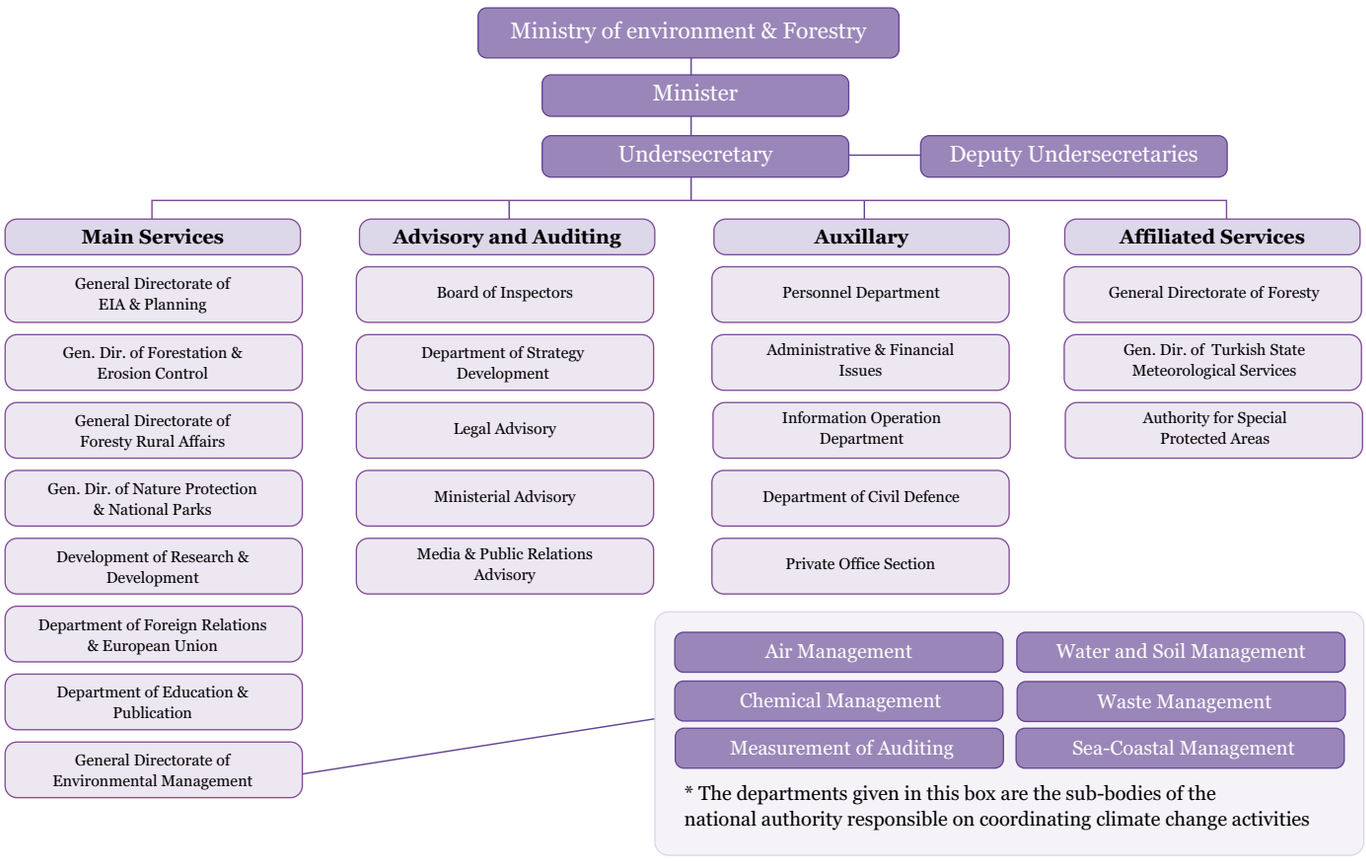


Fig. 2.1 The Central Institutions Affiliated to the Ministry of Environment and Forestry

1. Official Gazette no.25102, dated on 08.05.2003

In parallel to international developments in the field of the environment promoted by the 1972 Stockholm United Nations (UN) Conference on Human Environment, Turkey has entered into a responsive period for developing national policies in the environmental field. In particular, great efforts were made to put the philosophy of "sustainable development" at the centre of Turkish environmental policy after the decisions made by the 1992 UN Rio Environment and Development Conference. In this framework, Turkey has signed the majority of international agreements and conventions in the field of the environment. These are listed in Annex 1. [2]

Strengthening the structure of environmental legislation continues ata EU shifted pace in order to address the EU Acquis requirements.

The scope of the recently enacted Environmental Law dated 26 April 2006 with law no.5491, is to ensure the protection of the environment is a common property of all livelihoods in line with the principles of a sustainable environment and development.

The law consideres further binding cases compared to the former law in terms of environmental liability, audits and common reporting obligations in respect to the share of information.

The State Planning Organization(SPO) prepares development plans that are accepted as the basic instruments of government policies in economic and social issues for the efficient use of resources. The goals and the developments in the field of the environment have been recognised in the country development plans since the Third Five-Year Development Plan (1973 – 1977).

The sustainable development concept was adopted in the Sixth Five-Year Development Plan, and next, the National Environmental Action Plan (NEAP) was set up in 1999 and adopted in the Seventh Five-Year Development Plan (1996-2000) committing the nation to efficient environmental management. The NEAP was prepared with the technical support of the Ministry of Environment under the coordination of the SPO, drawing remarkable interest and involvement from related institutions and individuals. Within this framework, (i) the importance of the implementation of essential activities for the development of efficient environmental management system, (ii) the importance of the need for environmental data and better public awareness, (iii) new investment proposals in different thematic areas, (iv) compliance to the environmental standards of the EU and adoption of related regulations thereof were emphasised. The SPO also published an expert commission report on climate change in 2000.

Specific to the context of the protection of the global climate system, a clause in the Eight Five-Year Development Plan (2001-2005) was articulated enabling the country initiating efforts in order to become a party to United Nations Framework Convention on Climate Change(UNFCCC). The plan also included controlling and reducing greenhouse gas (GHG) emissions by increasing energy efficiency and ensuring energy savings. Over the period, a national report on Sustainable Development, which included a specific chapter on Climate Change, was prepared under the co-ordination of SPO in co-operation with United Nations Development Programme (UNDP) and submitted to the World Summit on Sustainable Development in 2002. In 2005, the First Council on Environment and Forestry was held with the participation of stakeholders from crosscutting sectors.A working group on climate change produced a strategy paper on the issue.

As a next step, the Seven-Year Development Plan (2007-2013) is considering addressing the requirements of UNFCCC in line with the country's conditions and is preparing of the National Climate Change Action Plan.

Moreover, permanent councils established at the Ministry Council level have also prioritised responsibilities for ensuring the efficacy of the MoEF. These consist of the Supreme Environment Council, the Environment and Forestry Council, the Local Environmental Councils and the Central Hunting Commission. The Supreme Environment Council is in charge of various duties, such as development of programmes for raising awareness of the environment; advising on the participation of Turkey in prospective conventions; determination of principles of urban environmental management; guidance on legislative dispositions in terms of prevention of conflicts arising from the distribution of power among various agencies; developing programmes for the exploitation of environmentally compatible energy sources in responding to the nation's energy requirements, and determining Specially Protected Areas, along with the principles of implementation in these areas.

2.1.2 Local Administrations in Environment

As a result of recent legislation, more environmental roles have been assigned to municipal councils and metropolitan municipal councils acting within municipal boundaries, while the tasks for the entire areas have been vested in special provincial administrations. Those administrative units have been also vested with new responsibilities. [2]

Besides the central and local bodies affiliated to MoEF, the ministry does not have any organisation either at district level or at regional level excluding the General Directorate of Forestry and the Turkish State Meteorological Services(TSMS). However, preliminary activities for restructuring of the MoEF in respect to establishment of subsidiary regional bodies have been initiated and a draft bill is being prepared. Those regional level organisations will be tasked with implementation, controlling and monitoring operations in this field.

2.1.3 Coordination Board on Climate Change

Climate Change activities are executed by the Ministry of Environment and Forestry coordination of the undersecretary under the inter-ministerial Coordination Board on Climate Change (CBCC). Established in 2001 in accordance with a circular issued by the Prime Ministry, CBCC has overall responsibility for the implementation of the prevention, mitigation and adaptation of policies against climate change. The CBCC is also responsible for fulfilling the requirements under UNFCCC obligations, such as the preparation of National Communications on Climate Change. Therefore, the board has a key role in strengthening dialogue among different stakeholders involved in the field of climate change. CBCC has been revised 2004.

Operating under CBCC, a Technical Working Commission on Climate Change (TWCCC) which comprises the coordinators and sub-group members, has official responsibility for contributing to the preparation of National Communications. perates through 8 scose eight thematic are as follows:

WG 1 - Researching the Effects of Climate Change: Coordinated by the TSMS, the group is responsible for systematic observation about of the climate and the assessment, identification and monitoring effects of climate change on a national scale.

WG 2 - Emission Inventory of Greenhouse Gases (GHG): The Turkish Statistical Instituite (TURKSTAT) is the coordinating institution for GHG emission calculations, the validation of estimates and preparation of CRF tables and National Inventory Reports.

WG 3 - Mitigation of GHG from Industry, Building, Waste Management and Service Sector: The General Directorate of Electrical Power Resources Survey and Development Administration (EIE) functioning under the Ministry of Energy and Natural Resources (MENR) is the group coordinator and in charge of the development and implementation of energy efficient activities in industry, building and service sectors.

WG 4 - Mitigation of GHG from Energy Sector: Coordinated by the General Directorate for Energy Affairs (EIGM), as an affliated institution of MENR it is mainly responsible for performing energy demand model studies and making cost-benefit analyses in order to determine appropriate GHG reduction policies and measures.

WG 5 - Mitigation of GHG from Transportation: Representing the Ministry of Transport(MoT), Directorate of Railways, Harbours and Airports Construction (DLH) is the coordinating institution of the WG-5. It it tasked with providing advice to the sector and regulates mitigation measures for climate change effects and supervises affiliated institutions on the issue.

WG 6 - Land use, Land Use Change and Forestry: The Research and Development(R&D) department of MoEF has a role as the group coordinator providing technical expertise related to GHG emissions and removals due to Land Use, Land Use Change and Forestry (LULUCF) sector in co-operation with the Ministry of Agriculture and Rural Affairs(MARA).

WG 7 - Development of Policies and Strategies : Coordinated by the General Directorate of Environmental Management(CYG) of the MoEF, the group is tasked with the supervision and coordination of policy making studies and crosscutting issues among stakeholders in terms of the establishment of state policy on climate change.

WG 8 - Education and Public Awareness: Again the MoEF has the group coordination role responsible for the implementation and coordination of education and public awareness activities among National Education institutions, Academia, Private Sector, Non-govermental Organisations (NGOs) and Unions on a national scale.

The organization chart for CBCC is given in the figure 2.2. [4]

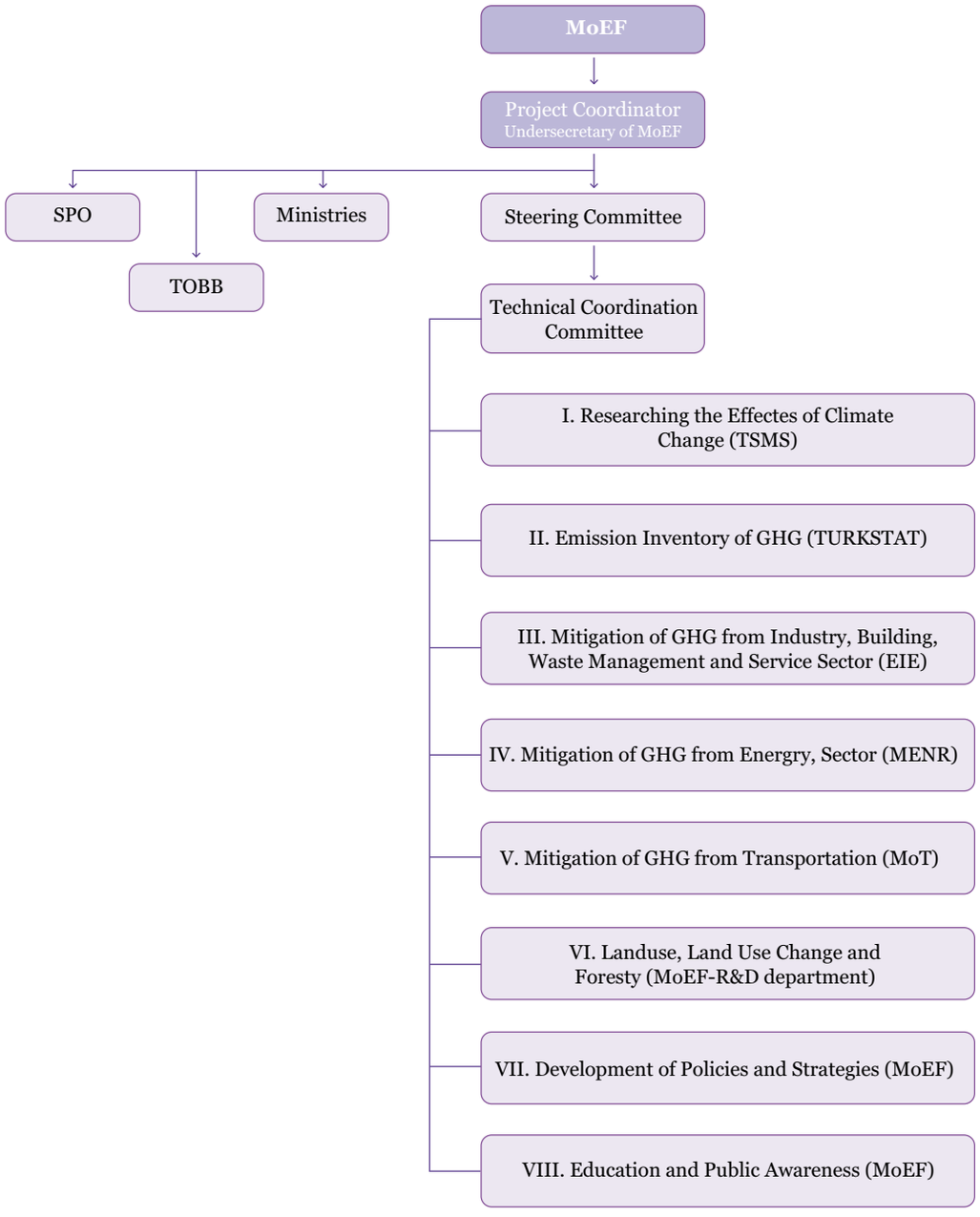


Fig. 2.2 Coordination Board on Climate Change

2.1.4 Activities and Institutional Framework for Preparation of the First National Communication under UNDP GEF funded Project

In respect to the preparation of the First National Communication (FNC) of Turkey, a Self-assessment Exercise Project funded by the GEF was completed within the framework of co-operation between UNDP and MoEF in 2005. The submission of the outcome report of this project enabled Turkey to benefit from medium-scale GEF project funds for the preparation of the FNC of Turkey. During the evaluation phase of the GEF project proposal, UNDP`s Turkey office continued providing support in the field of climate change. Four Research & Development project proposals submitted to the Technical Research Council of Turkey (TUBITAK), were prepared with country funds from UNDP. The goal of this support was to enable Turkey to improve policy making capacities by giving momentum to long-term research and implementation activities and strengthening

and sustaining climate change activities for the preparation of further National Communications. The four projects[2] received approval and were launched by the government funds under TUBITAK with implementing partners which included various universities, institutions and private companies.

By August 2005, the GEF project for the preparation of the FNC for Turkey was boosted by the realisation of 35 concrete outputs that are listed in Annex 2.

In order to contribute to the preparation of the FNC, a Project Steering Committee (PSC) through the GEF Project was set up before the launch of the project in 2005. The PSC represented by members of TWCCC had an important role in being responsible for ensuring the implementation of climate change projects by providing necessary assistance and by overseeing, monitoring and evaluating activities when required. Besides, a secondary group of stakeholders, consisting of Project Steering Committee members, members of participating ministries, research institutions, UNDP, NGOs, the private sector etc., undertook direct or indirect tasks during the project[3].

The institutional framework of the GEF Project for preparation of FNC of Turkey is shown in Annex 2.

2.2 Population Profile

Turkey is situated at the meeting point of the three continents of the old world and stands at the crossroads between Asia and Europe. Its population has risen from 56.5 million in 1990 to 71.2 million in 2004. Its population in 2004 is greater than each of its neighbours. Having a population density of 94.8 people/km2 and an annual growth rate of 1.2% since 1990, the population in 2006 is estimated at around 73 million. [5]

The urbanisation ratio reached 62.7% in 2006 from 52.9% in 1990 [2]. If urbanisation stays the same level, the urban/rural population ratio in Turkey is predicted to be similar to EU countries by the year 2015. [3]

Population density[4] of 184 people/km² doubles on coastal provinces. Additionally, higher migration tocoastal areas leads to increasing pressure on coastal urban areas. The ratio of net migration by province between 1995 and 2000 is depicted in figure 2.3.

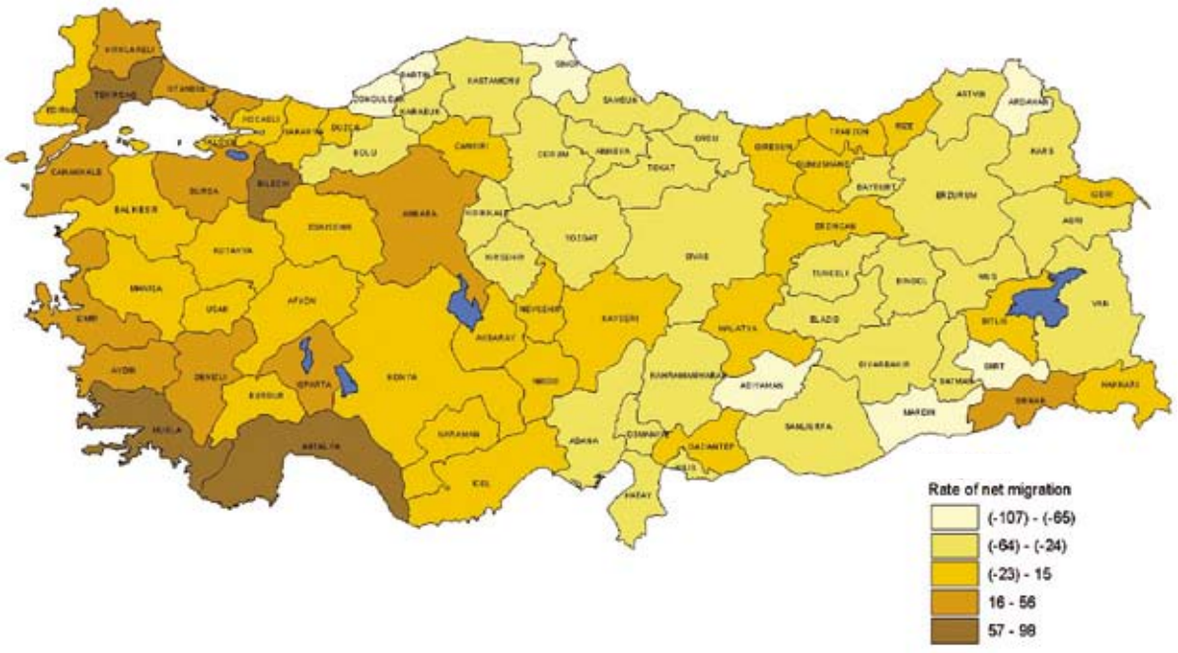


Fig. 2.3 Ratio of Net Migration by Provinces, 1995-2000
Source: TURKSTAT, 2006

2. See Chapter-8 for further information on TUBITAK project
3. The various research activities conducted during the FNC project is given in Chapter 8 and information about public awareness and capacity buildingof the project is available in Chapter 9.
4. The population density on coastline provinces are estimated with the Population Census Data (2000) obtained from TURKSTAT.

2.3 Geographic Profile

Turkey is situated in southeastern Europe and southwestern Asia stretching from a longitude of 36 degrees to 42 degrees North and a latitude of 26 degrees to 45 degrees East. The country has common boundaries with Bulgaria and Greece on the European side and with Iran, Iraq, Syria, Armenia, Azerbaijan and Georgia on the Asian side.

As a land bridge between Europe and Asia, the Black Sea in the North, the Mediterranean in the South and the Aegean Sea in the West, Turkey is surrounded by seas on three sides.

The country is well endowed with certain natural resources, such as lignite, coal, iron, copper, chrome, magnesium,boron, salt and small amount of oil and natural gas. Although water resources inTurkey are somewhat unevenly distributed in area and are not plentiful, they meet the need for drinking, irrigation, industrial development and hydraulic power generation.

2.3.1 Area

Turkey is the thirty-fourth largest country in the world with an area of 783,562 km2. Of this, 759,507 km2 (namely Anatolia) lies in Asia and the remaining 24,055 km2 (namely the Thrace) in Europe.

The total land of the country is classified as 35% agricultural land, 27% forests, 18% pastures and meadows, the other uses account for the 20%. Overall, 31% is cultivable land and nearly three quarters is prone to erosion. The unique diversity in the physical geography of the country affects the climate, vegetation, population and socio-economic life of Turkey.

2.3.2 Boundaries and the Seas

The length of Turkey's land borders is 2,753 km. The country shares borders with six Asiatic and two European states. Turkey has 8,333 km of coastline, most of it suitable for tourism. The country includes an inner sea, namely the Sea of Marmara, that connects the Black Sea with the Aegean Sea through the straits of Istanbul (Bosporus) and Canakkale (Dardanelles). The Aegean and the Mediterranean shorelines together are 4,500 km long, the Black Sea coastline stretches about 1,700 km. All these seas are branches of the Atlantic Ocean linking the continents of the old world. Therefore, Turkey is a country situated in the middle of these continents but connected to the ocean by waterways. The Sea of Marmara and the Turkish Straits are waterways of vital importance as they connect the Black Sea Basin with the rest of the world.

2.3.3 Mountains

The geological evolution of Turkey, which is situated on the Alpine-Himalayan mountain ranges or orogenetic belt geologically, had began in the late Palaeozoic period, and continues today, during the post-Quaternary period. Mountain ranges in the Black Sea and the Mediterranean Sea run parallel to the coastline. In the North, chains of Northern Anatolia Mountains, 3,932 m high, extending through the Black Sea are separated by wide plain areas from 3,068 m high Toros (known as Taurus) Mountains lying throughout the Mediterranean. The mountains arising to 500 m in the West and to 2000 m encircle the Central Anatolian Plateau. The Eastern Anatolia Region is the country's highest region. The Agri Mountains, with Turkey's highest peak reaching 5,165 m high, cover the borderwith Iran.

Lying on highlands with an average altitude of 1,130 m, the country has the potential to benef from hydropower utilising rivers as well as bodies of water lying at altitude. Mountains cover a great proportion of the country's land. Mountain ranges stretch along the north and south coastal zones from east to west.. The middle part of the country consists of the Anatolian plateau. This plateau separates the high mountain ranges in the north and south from each other, although they traverse it in the east. Besides, there are many plains and low basins in inland parts of the country, and in coastal plains and delta-flood plains along the coastal zone. Deltas formed by the Kizilirmak and Yesilirmak rivers, and the Adana plain large coastal plains in the country. [8]

2.3.4 Water Resources

Inland water covers 1.6% of the country's surface. Most of Turkey's rivers flow into the seas that surround the country:

- The Kizilirmak, Yesilirmak and Sakarya, the country's longest rivers, flow into the Black Sea
- The Susurluk, Biga and Gonen rivers flow into the Marmara Sea
- The Gediz, Kucuk Menderes, Buyuk Menderes and Meric rivers flow into the Aegean Sea
- The Ceyhan and Goksu rivers into the Mediterranean Sea
- Fırat and Dicle starting from Eastern Anatolia form a single basin flowing into the Persian Gulf.

In Turkey, in addition to 200 natural lakes, covering an area of 906,000 hectares, dam rivers also correspond to 380,000 hectares.

Turkey's largest natural lake, Lake Van, is situated in Eastern Anatolia, with an area of 374,000 hectares. The water of this lake is salty. Most salty and shallow lakes are found in Central Anatolia, among which is Turkey's second largest lake, Tuzgolu, covering an area of 128,000 hectares. With the construction of dams, several dam lakes such as the Ataturk Dam Lake have been created.

2.3.5 Flora-Fauna

Situated in the middle of the world triangle and being equally close to Asia, Europe and Africa, Turkey has a tremendously rich flora and fauna.

Turkey's fauna consists of 120 species of mammal, more than 400 bird species and around 400 fish species, 192 of which are freshwater. Reptile species account for around 130. Around 1,787 fish species are found in the surrounding seas. [3] Having around 9,600 plant species, Turkey is home to at least 8,650 vascular plant species, 30.9% of which are indigenous to Turkey. About 75% of the plants that grow on the European continent are found in Turkey.

Two of the three main bird migration pathways lying alongside Europe, Asia and Africa attract millions of migrating birds passing through Turkey. The number of bird species in Turkey is equal to bird species within the whole of the European continent. 0.7% of the total land of Turkey is protected under IUCN categories I-V.

2.4 Climate profile

Turkey is located in the Mediterranean macroclimate zone that lies between the temperate and sub-tropical zones at western parts of the continents, allowing the country to have widely diverse regional and/or seasonal variations ranging from extremely harsh winter conditions to very hot and dry summers. [6]

The South and West of the country lie under the influence of a Mediterranean climate with hot and dry summers and cool and rainy winters. The climate on the Black Sea coast is colder and more rainy. Northeast Anatolia has the characteristics of a continental climate: winters are long and intense and summers are short and cool. The Central Anatolian plateau is under the influence of a steppe climate with arid and hot summers and cold winters. [7]

The existence of different types of climates within regions creates disparities in agricultural productions, the nature of habitation, density of population as well as tourism and industrial activities.

Turkey is divided into five basic climatic regions as depicted in figure 2.4.

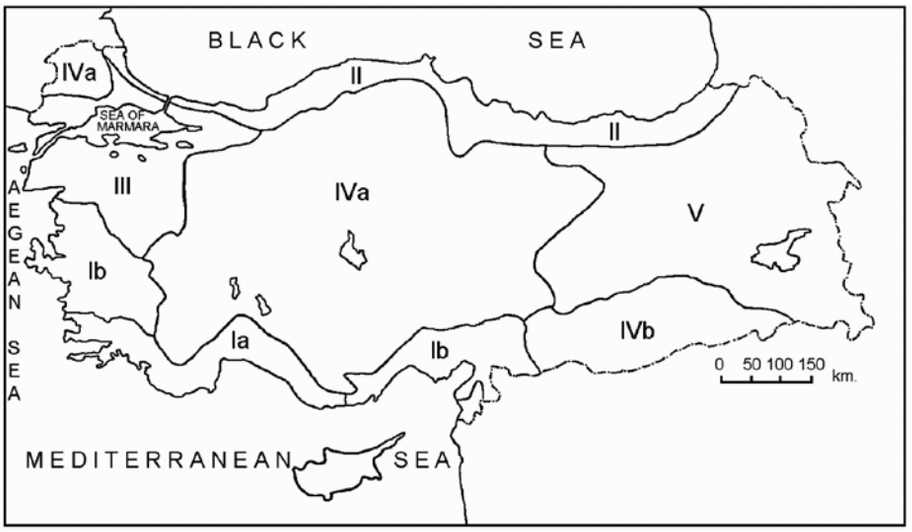


Fig. 2.4 Climatic Regions of Turkey
Source: TSMS (redrawn by Murat TURKES on a new base map according to Kocman, 1993.)

I. Mediterranean Climate: Dominant mainly in the Mediterranean and Aegean regions. The most marked characteristic of this climate is hot and dry summers with mild and rainy winters. Highest mean annual temperatures are observed along the Mediterranean coast (Figure 2.5). Mean annual temperatures reach about 20°C on the eastern part of the coast. Mediterranean climate is divided into two sub-types:

Ia. Humid Mediterranean Climate: Snow and frost are very rare on the low coastal belt. Mean January temperature varies from 8°C to 10°C. July temperatures are high with a mean of 27°C- 28°C. The rainy season is in winter. Summer dryness lasts for a long period, from late spring to mid-autumn. Annual rainfall is about 1,000 mm (Figure 2.6).

Ib. Semi-humid Mediterranean Climate: Mean temperatures vary between 5°C and 8°C in the coldest month of January. The rainy season is again in winter. The annual amount of precipitation is 600-800 mm.

II. Black Sea Climate: Along the Black Sea coasts, all seasons are rainy and maritime effects appear strongly. During the year, almost all parts of the region are generally under the influence of humid air masses associated with mid-latitude frontal cyclones. The mean annual temperature is about 8-12 °C.

Turkey's annual precipitation quantity depends on the distance from the coasts, influence of wind and altitude of the area. The rainiest region appears to be the Black Sea area and the most arid is the Southeast of Turkey. Annual amount of the precipitation is above 1,000 mm on the west and east coasts. Most of the annual precipitation falls in autumn and winter.

III. Semi-humid Marmara Climate: It influences almost the entire Marmara Region, except the Black Sea coast of the region. Mean temperature is approximately 23-24°C in the hottest month of July. The mean temperature of the coldest month of January is about 3-5°C. Maximum amount of precipitation is in winter. Mean annual precipitation amounts vary from 500 mm to 700 mm. Snow is quite normal. Frost is more common than in the Mediterranean climates.

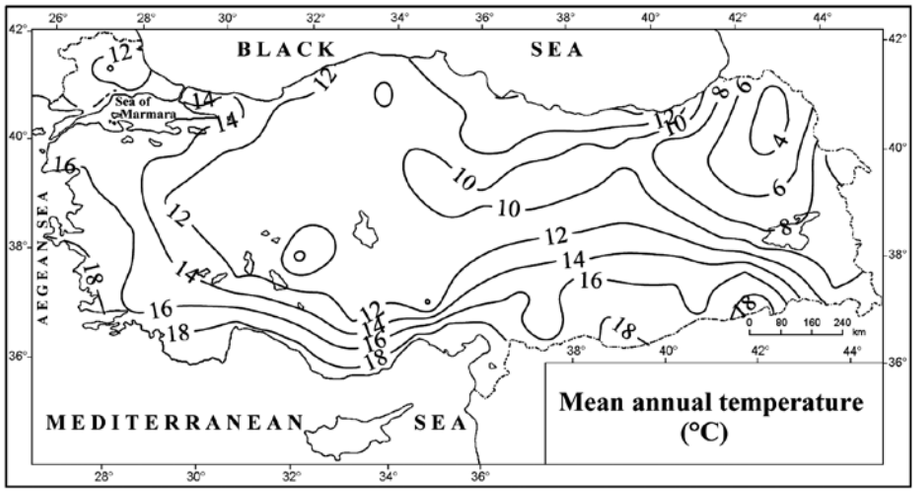


Fig. 2.5 Geographical Distribution of Mean Annual Temperatures (°C) over Turkey

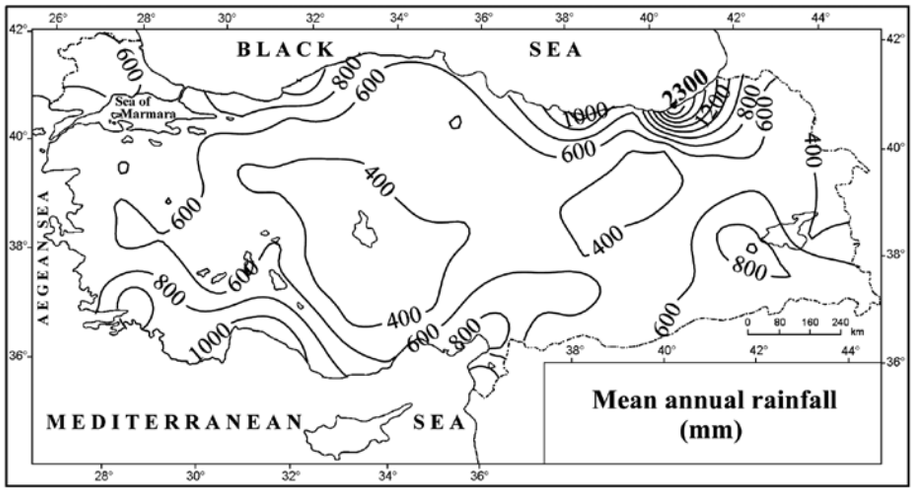


Fig. 2.6 Geographical Distribution of Means Annual Precipitation Totals (mm) over Turkey

IV. Steppe Climate: Central Anatolia and its surrounding area including the Lakes District, the mid-western Anatolia, western districts of Eastern Anatolia and the South-eastern Anatolia show characteristics of this semi-arid climatic type. Due to its distinctive thermal and humidity peculiarities, steppe climate is divided into two main sub-climatic types:

IVa. Semi-arid Central Anatolia Climate: Winters are cold and the intensity increases towards northeastern part of Central Anatolia. Mean temperatures in the coldest month of January vary from 0°C to -3°C. Mean July and August temperatures are about 20°C and 22°C. Most of the rainfall is in the spring and in some districts in winter. Mean annual precipitation varies between 350 mm and 500 mm.

IVb. Semi-arid Southeastern Anatolia Climate: Summers are very hot and mean temperatures are greater than 30°C in the hottest months of July and August. Mean temperatures in the coldest month of January are between 2°C and 5°C. Summer dryness is intensive and long lasting. Amount of the annual precipitation varies between 350 mm and 800 mm.

V. Continental Eastern Anatolia Climate: Mean winter temperature is less than 0°C. Mean temperature in the coldest month of January varies from -8°C to -10°C. Mean temperature of the warmest month does not exceed 20°C. The amount of annual precipitation is more than 500 mm except low basins, plains and deep valleys. The maximum precipitation falls mostly during the period from late spring to mid-summer in the northeastern Anatolia, and in the rest of the region during the winter and spring. This region is covered with snow during the cold period and frost is much more common.[6]

The Mediterranean Climatic Region of Turkey has the highest cooling and average heating requirements, while the Eastern Anatolia Region and some parts of the Central Anatolia Region are the regions with the highest heating requirements.

2.5 Economic profile

The Turkish economy has the profile of being a truly “open economy” – a macroeconomic environment where its commodity trade and capital accounts are completely liberalised, and the process of financial deregulation has been completed.

2.5.1 Turkish Economy / 1990-present

The post-1980[5] Turkish adjustment path can be divided into two broad phases: “1981-1988” and “1989-1998”. The main characteristic of the first phase is structural adjustment with export promotion, albeit under a regulated foreign exchange system and controls on capital inflows. Over this period, integration into global markets was achieved mainly through commodity trade liberalisation. The period was also characterised by wage controls.

Beginning in 1989, an overall increase in both the share and level of public salaries, and investment in social infrastructure enabled working and middle class people to attain improved living standards, led to significant costs with a consequent rise in public deficits and inflation rates. With the advent of the elimination of controls on foreign capital transactions and the convertibility of the Turkish Lira in 1989, Turkey opened up its domestic asset markets to global financial competition. The

5 The post-1980 developments in the Turkish economy are depicted in a nutshell, given in Annex 3.

immediate three-year period after the 1989 reforms was marked by a virtual elimination of the "foreign exchange gap" which had crippled the Turkish macro balances for almost four decades. With the eruption of hot money inflows, Turkish commodity markets were all of a sudden flooded with cheap imports. Consequently the rise in real wages was financed by such import flows.

In 1990, two major developments in the international arena resulted in additional challenges for the Turkish economy. These developments are the end of the Iran-Iraqi war and the 1990 Gulf Crisis. These two international developments resulted in Turkey losing its two major markets and thus they had a negative impact on Turkey's exports. The pressure of the country`s public deficits on inflation, the prevailing foreign exchange rate policy and overall negative economic developments, prepared the ground for the 1994 crisis.

Growth returned after 1995. Growth in real GDP averaged above 7% between 1995 and 1997. Yet, the contagion effects of the 1997 Asian crises as well as the 1998 Russian moratorium on its public debt was felt in Turkey in 1998 and the economy went into crisis again. A devastating earthquake in 1999 had also led to the postponement of stabilisation efforts. Yet, in August 1998, conditions for macroeconomic adjustments were already laid out by a new round of International Monetary Fund`s (IMF) Staff Monitoring Program, were put into effect in December 1999. The IMF has provided financial assistance totalling $20.6 billion net, between 1999 and 2002. The aim of the Staff Monitoring Programme of 1998 and the consequent December 1999 stand-by was to decrease the inflation rate to a single digit by the end of 2002. The amendments of the Staff Monitoring Program introduced in 1999, included privatisation in the Constitution for the first time. Besides, tax reform had been introduced to enlarge the tax base and to formalise the informal economy.

However, in early 2001, Turkey suffered from a fully-fledged financial crisis and the Central Bank declared the surrender of the pegged exchange rate system as next, thereby letting the exchange rates float freely.

Consequently, the growth path of the Turkish economy over the post-2001 period has been erratic and volatile, mostly subject to the flows of hot money. In 2003 the economy grew by 5.8% in real terms. Price movements were also brought under control through the year and the 12-month average inflation rate in consumer prices has receded from 45.0% in 2002 to 10.6 % in 2004, and from 50.1% to 11.1% in wholesale prices.[9] The growth in efficiency played a significant role in the improved performance of the economy. The contribution of total factor efficiency to the economic growth was 24.5% between 1996 and 2000 and reached to 42% during the period 2001-2005. Over that period, the contribution of capital accumulation to growth was 51.7% and a 6.3% by the employment growth. [14]

Overall, the macro-economic profile of the Turkish economy has fallen into distinctive phases since 1990. When the country was in financial crisis, there was a direct relation to the level of Greenhouse Gas (GHG) emissions[6]. More over, Turkey committed itself to fulfilling her obligations regarding the EU Pre-accession Fiscal Surveillance Procedure in the near term.[1]

Turkey's growth trend in terms of the targeted GDP growth rate according to the present Country Development Plan (2007-2013) is depicted in figure 2.7, together with the growth of CO_2 emissions and the population.

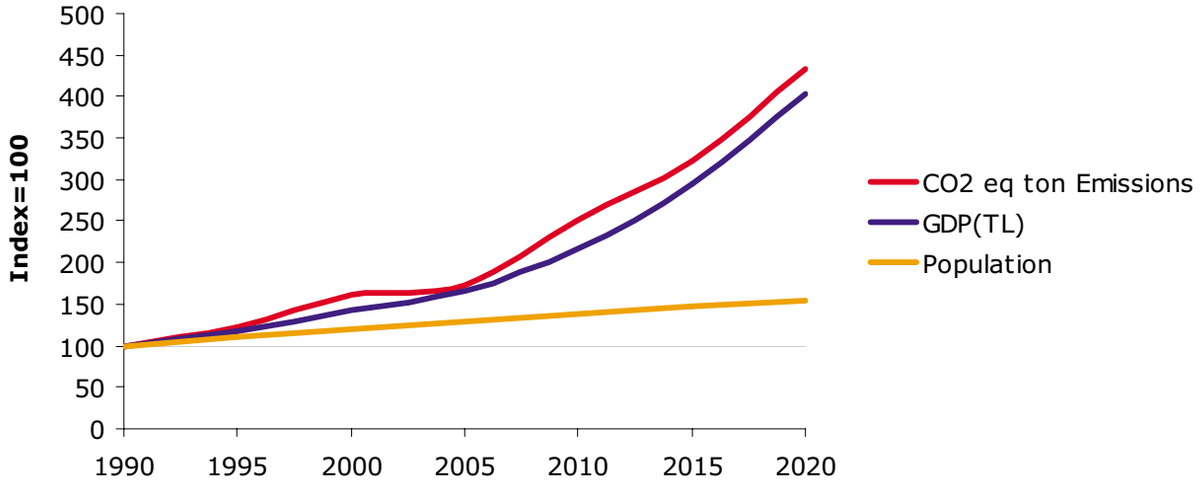


Fig. 2.7 Trends and Projections of GDP-CO_2 Emissions-Population

Data source: Real data (1995-2004) by TURKSTAT; projections (2005-2020) according to business as usual scenario by MENR[7]

6. see chapter 3, fig. 3.12
7. see chapter 5 for further information

2.5.2 Gross Domestic Product

During the recent years, Turkish economy has displayed a significant growth performance. As a matter of fact after the post crises period that consists of the years of 2002-2005, Turkish economy succeeded 7.5 % growth rates in its GDP. Hnece Turkish GDP has reached to 363.4 billion USD by the end of 2005.

During the period of 2002-2005, economic growth was driven by private sector, private consumption increased at an annual average rate of 6.8 percent and the annual average increase of private investments reached 19.7 %.

Increase in productivitiy played an important role in this high growth performance as well. The contribution of the total factor productivity yo growth realised as 42 % during the 2001-2005 period, which was 24.5 % at an annual average during the 1996-2000 period. Efficiency increase in growth of economy played a significant role for rapid growth of GDP together with the structural reforms and transformation in the economy. However Turkey is a member country of the Organization for Economic Co-operation and Development (OECD) and a EU-accession country, its development has reached that of other countries as can be seen in Table 2.1.

Table 2.1 General Economic Indicators

	Turkey		EU-15	Total OECD
	2000	2004	2004	2004
GDP (billion US $, Current Price.)	200.0	302.0	12,213.6	33,130.4
GDP per capita (GDP, US$)	2,879	4,187	31,700	27,200
Population (million)	67.4	71.2	383.6	1,160.5
Employment Level (million employee)	21.6	22.1	248.9	757.8
Employment level / population	32.0	30.7	64.9	65.3
Unemployment rate (%)	6.5	10.3	8.1	6.9

Source: The country data by SPO 9th Development Plan (2006); EUROSTAT and OECD Statistics

In terms of economic performance, industry and trade sectors sustained the highest ratios in the overall GDP in recent years. These are followed by transport and communications and agriculture. The contribution of the agricultural sector decreased during the period. (see table 2.2.)

Table 2.2 Gross National Product by Economic Sector

	2000	2004
Agriculture	14%	11%
Industry	23%	24%
Construction	5%	3%
Trade	20%	20%
Transport & Communication	14%	14%
Financial Institutions	4%	5%
Ownership of Dwellings	5%	4%
Business & Personel Services	4%	3%
(-) Imputed Bank Serv. Charges	3%	2%
Government Services	10%	9%
Private Non-Profit Institutions	0%	1%
Import Duties	4%	4%
G.D.P. (In Purchasers' Value)	100%	100%

Source: Main Economic Indicators, SPO, (2006)

Although listed as an Annex-I country in the UNFCCC and an accession country to the EU, Turkey Turkey's purchasing power parity in terms of GDP per capita is still the lowest among EU-15 and OECD countries. The values for 2004 are depicted below in figure 2.8

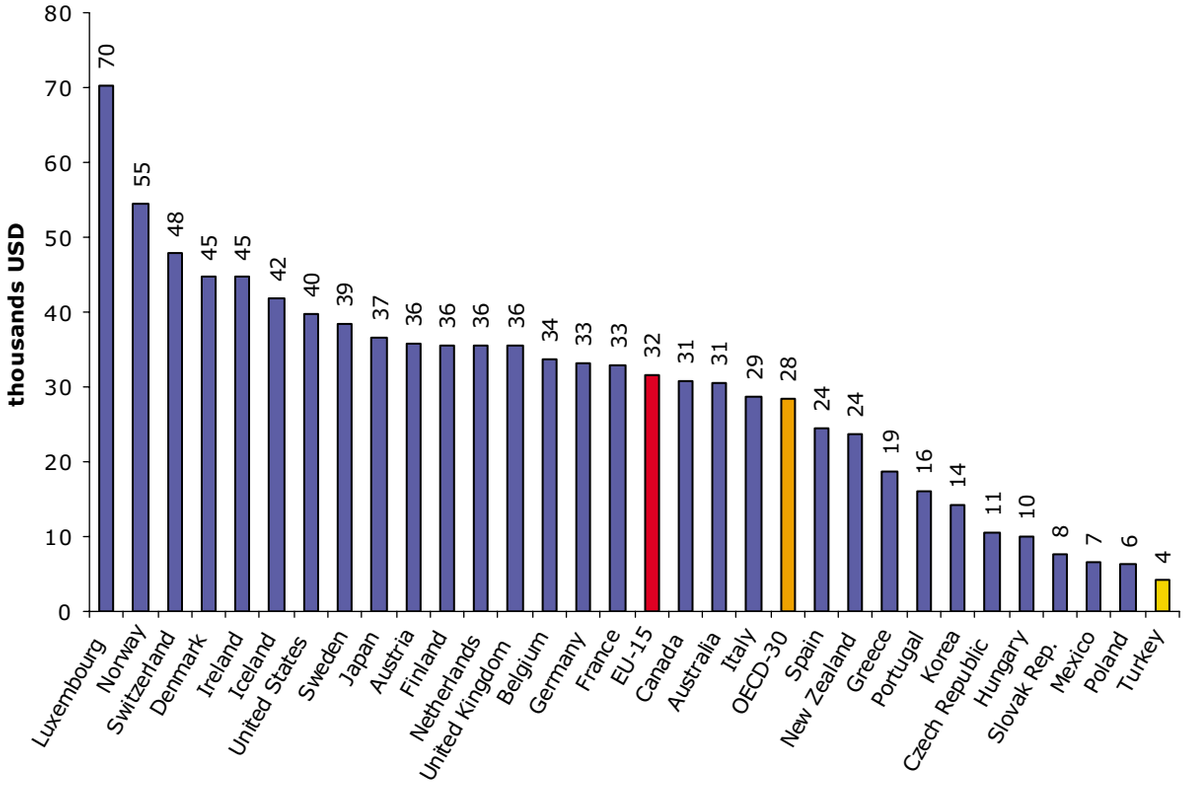


Fig. 2.8 GDP per capita[8] in OECD, EU-15 and Turkey, year 2004

Source: Data sources are OECD estimates, National Accounts of OECD countries, OECD, Paris, 2005.

2.5.3 Import-Export

In recent years, the Turkish economy has been further integrated into the world economy and the volume of foreign trade has grown remarkably.

In comparision to the figures for 1990 when there was unregulated financial liberalisation in place, import (14.6%) and export (8.5%) rates as a share of GNP increased more than two fold by 2004, resulting in the rates of 30.2% and 22.2%, as can be seen in figure 2.9.Export recorded as worth $27.8 billion in 2000, increased more than two times and reached $73.4 billion in 2005. [5]

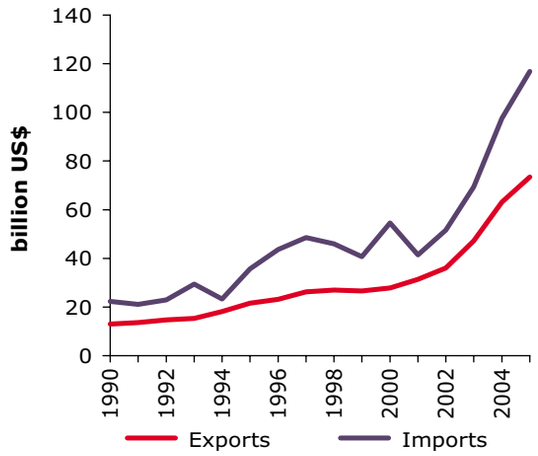


Fig. 2.9 Export and Import Values, 1990-2005
Source: TURKSTAT, 2005

8. Based on at current market prices

In 2005, the share of manufacturing export had the highest proportion (94%) of overall foreign trade, followed by agriculture and forestry (4%) and others (2%).

In terms of import by economic activity in 2005, the manufacturing sector again has the largest share (81%), followed by mining and quarring (14%), agriculture and forestry (2.4%) and others.[5]

2.6 Energy

Over the period 1990-2004, Turkey's demand for energy, particularly for electricity, has increased with at an annual rate of 3.7% and 7.2% respectively [10]. Since domestic energy resources are limited to meeting increasing demand, the country is highly dependent on energy imports. The import dependency of the country has shown an increasing trend within the past years and reached 72% in 2004. This was mainly due to an increase in natural imports. The natural gas consumption in TFC increased from 2% in 1990 to 13% in 2004.

2.6.1 National Energy Resources

In order to cover the increasing energy demand, Turkey has been making use of the diversified energy resources of the country. (Table 2.3)

Table 2.3 Primary Energy Reserves of Turkey, 2004

Reserves	Proven	Probable	Possible	Total
Hard Coal (mt)	550	425	368	1,343
Lignite (mt)	7,339	626	410	8,375
Asphaltite (mt)	43	29	7	79
Bituminous Shale (mt)	555	1,086		1,641
Hydro (GWh/year)	130,000			127,381
Hydro (MW/year)	36,260			36,260
Crude Oil (mt)	42.8			42.8
Natural Gas (bcm)	8			8
Nuclear resources: Uranium (mt) Nuclear resources: Thorium (mt)	9,129 380,000			9,129 380,000
Geothermal electricity (MW/year) Geothermal heat (MW/year)	98 3,348		412 28,152	510 31,500
Solar electricity (MW/year) Solar heat (MW/year)				87

Source: MENR, 2004

Lignite: Lignite is one of the most important domestic energy resources of the country and is found in almost all regions. The total reserves are about 8.4 billions tons. In 2004, lignite production was 43.7 billions tons. The main lignite-consuming sectors are the residential, power and industrial sectors. In Turkey, lignite with a lower calorific value is consumed in power plants and higher quality lignite is used in residential and industrial sectors.

Hard Coal: A total of 1.3 million tons (mt) of hard coal reserves are estimated in the Black Sea Region and 0.6 mt of total reserves are proven. Much of domestic hard coal is used in iron and steel production and residential heating. Hard coal production reached 1.9 mt in 2004. In the same year, 16.4 mt of hard coal was imported. Over 90% of final hard coal consumption was in the industrial sector. The iron and cement industries consumed 26% and 11% of the imports respectively. The remaining hard coal was used in the residential sector, particularly in large towns, to alleviate air pollution.

Asphaltite: Asphaltite (sub-bituminous coal) reserves of 79 mt are found in the Southeast Anatolia Region. Asphaltite, which is consumed mainly in the residential sectors in east and southeast Anatolia, is a valuable energy source. Asphaltite production in Turkey reached 722 kt in 2004.

Oil: It is estimated that there are 940 mt of oil reserves in Turkey in already explored areas. About 162 mt of this reserve is economically recoverable. As of the end of 2004, a cumulative total of 119.6 mt of this had been extracted leaving remaining recoverable reserves of 42.8 mt. in 2004 and crude oil production was 2.3 mt. in the same year.

Natural Gas: Total natural gas reserves in Turkey are 20.1 bcm with recoverable reserves of 14.1 bcm. As of the end of 2004, cumulative production of natural gas was 6.2 bcm, leaving remaining recoverable reserves of 8 bcm. In 2004, domestic natural gas production was 0.7 bcm. The use of natural gas has grown rapidly, since the start of imports from the former Soviet Union in 1987. In 2004, 14.1 bcm natural gas was imported from Russia, 3.2 bcm from Algeria, 1 bcm from Nigeria and 3.5 bcm from Iran. The total gas supply was 20.4 bcm in 2004.

Renewable Energy

Turkey has substantial renewable energy resources. Renewable energy production reached 12.3 % of total primary energy supply, i.e. 10.8 mtoe, in 2004. Electricity generation from renewables was 31% in 2004. Renewables are the second largest contributor to domestic energy production after coal. Renewable energy supplies in Turkey are dominated by hydropower and biomass. The contribution of wind and solar is limited but is expected to have a higher pace of growth in the future. [11]

Hydropower: The economically recoverable hydropower potential of Turkey is about 130 TWh., of which approximately 35% has already been developed. Hydropower generation climbed from 2 mtoe (23.1 TWh) in 1990 to 4.0 mtoe (46.1 TWh) in 2004 with an annual growth rate of 5.1%.

Geothermal Energy: Turkey has considerable geothermal energy resources. The total geothermal potential for electricity generation is approximately 510 MWe. Thermal capacity for agricultural greenhouse heating and district heating is 31,500 MWth. Currently, two geothermal electricity generation plants with capacities of 15 MW and 8 MW are operational. Many residential buildings, several touristic establishments and many greenhouses in different locations of Turkey are heated by geothermal means.

Wind Energy: The Marmara, Aegean and Southeast Anatolian regions were found to be the most favourable locations for wind potential. Technical wind potential is approximately 88,000 MW and economically viable wind potential is approximately 10,000 MW.

Solar Energy: Turkey is geographically well located with respect to solar energy potential. Meteorological data shows that the average annual solar irradiance intensity is 308 Cal/cm2 (3.6 KWh/m2) per day and the average annual sunshine duration is 2,640 hours in Turkey. [10] Total solar energy potential is about 87 mtoe. Total solar collector capacity is about 11 milion m2 and 0.4 mtoe of solar energy was produced in 2004.

Biomass Energy : Biomass resources (wood, animal, and plant wastes) have traditionally been used as fuel for cooking and heating in rural areas of Turkey. The share of biomass in total primary energy production was 23% in 2004. Most of this was in the form of wood with a share of 18%. Overall, biomass potential is approximately 15 mtoe of which 6 mtoe is being used. More over, some part of agricultural areas are used for beet and wheat production that are suitable for bioethanol production producing 1.5 million tons of biodiesel and 3.0 million tons of bioethanol.

In order to get maximum benefit from our renewable energy resources, it is required that investments should be supported, long term and low interest ratio loans should be given and also per cash gurantee with competitive price should be given in a sufficient term to eliminate these advantages which requires high cost of primary investment and production in comparision with the fossil fuels.

2.6.2 Primary Energy Production

Total primary energy production has decreased from 25.5 mtoe in 1990 to 24.3 mtoe in 2004. (figure 2.10) Oil and natural gas production are relatively lower, and the main domestic energy source is coal, mostly lignite, whose production of which amounted to 9.1 mtoe in 2004. Optimum use of domestic resources constitutes one of the main components of the national energy policy. Thus, Turkey assigns the utmost importance to optimum use of her domestic coal resources and pays due consideration to the use of clean coal technologies. Another important increase was recorded in hydro-electricity production. Between 1990 and 2004, hydro production increased 5.1% per year and increased from 2 mtoe (23,148 GWh) in 1990 to 4 mtoe (46,084 GWh) in 2004.

In 2004, total coal production amounted to 43%, oil and natural gas 12%, hydro, geothermal and wind electricity 17%, other renewable sources 5% and biomass 23% of primary energy production.

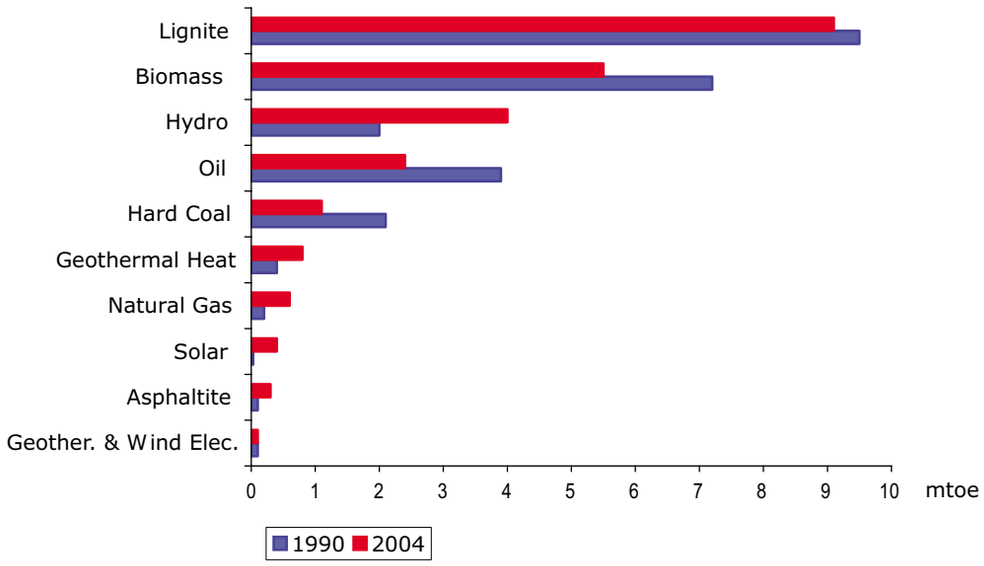


Fig.2.10 Primary Energy Production
Source: MENR, 2006

2.6.3 Total Primary Energy Supply

Turkey is rapidly growing in terms of both its economy and its demand for energy particularly for electricity. Total Primary Energy Supply (TPES) of Turkey is increasing at a fast pace. Over the period 1990-2004, Turkey's TPES has increased at an annual rate of 3.7% and reached 87.8 mtoe from 53 mtoe.(figure 2.11) Oil accounted for the largest share of demand with 37%, it is followed by natural gas with 23%, hard coal with 16%, lignite with 11%, biomass with 6%, hydro with 5% and other renewables 2% in 2004.

In 2004, renewable energy sources excluding hydro, accounted for 6.8 mtoe. This included non-commercial wood (4.3 mtoe), animal and vegetable waste (1.2 mtoe), followed by geothermal energy (0.9 mtoe) and solar energy (0.4 mtoe). Per capita energy consumption increased from 944 koe in 1990 to 1,234 koe in 2004.

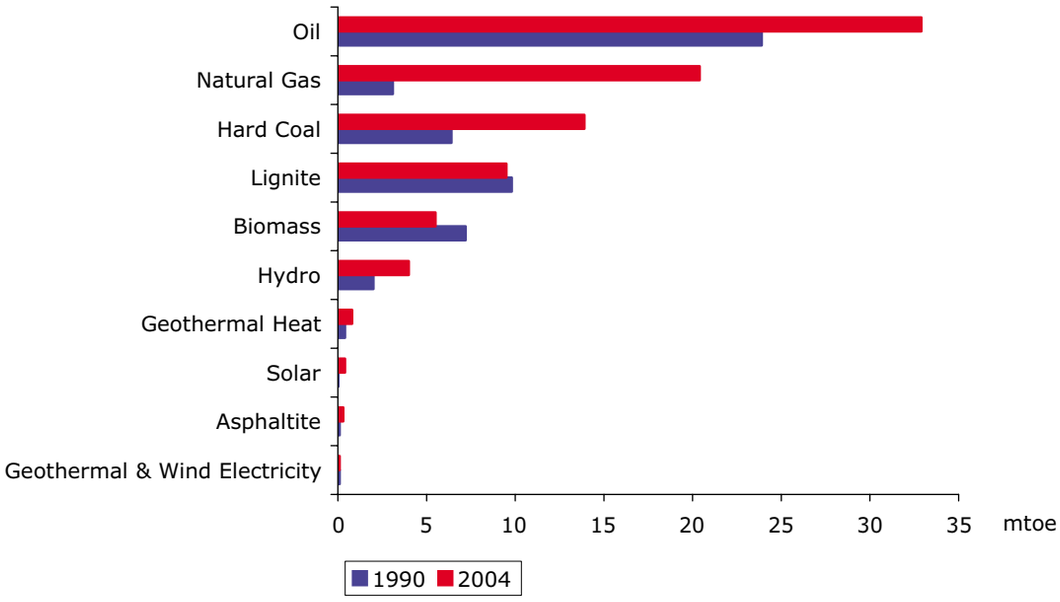


Fig.11 Total Primary Energy Supply
Source: MENR

2.6.4 Total Final Consumption

Over the period 1990-2004, both TFC and TPES have grown at an average annual rate of 3.7% (figure 2.12). The changing structure of the Turkish economy, is easily seen in the energy sector.

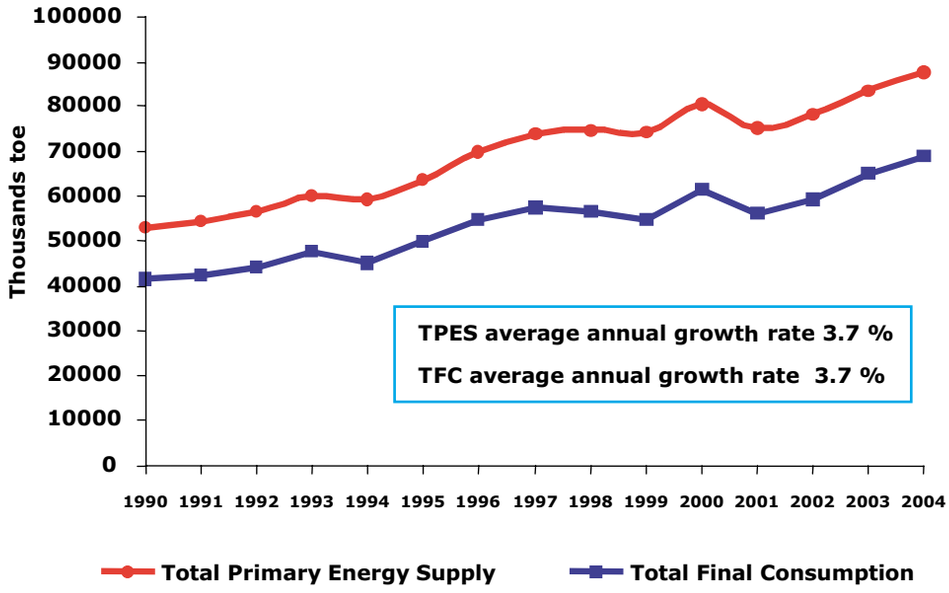


Fig. 2.12 Historical Trend of Energy Use
Source: MENR, 2006

The most significant change in the structure of Turkish fuel consumption has been the increase in electricity and natural gas consumption. The share of natural gas consumption increased from 2% in 1990 to 13% in 2004 and electricity increased from 9% to 15% over the same period. The share of oil decreased from 48% in 1990 to 39% in 2004 which still has the largest share in TFC in 2004. The share of other sources are: hard coal 10%, lignite 5%, secondary coal products 6% and renewable sources 13% in 2004. Over the period 1990-2004, TFC had an increase of 66% with an average annual growth rate of 3.7% and reached 69 mtoe in 2004 from 41.6 mtoe in 1990. (Figure 2.13)

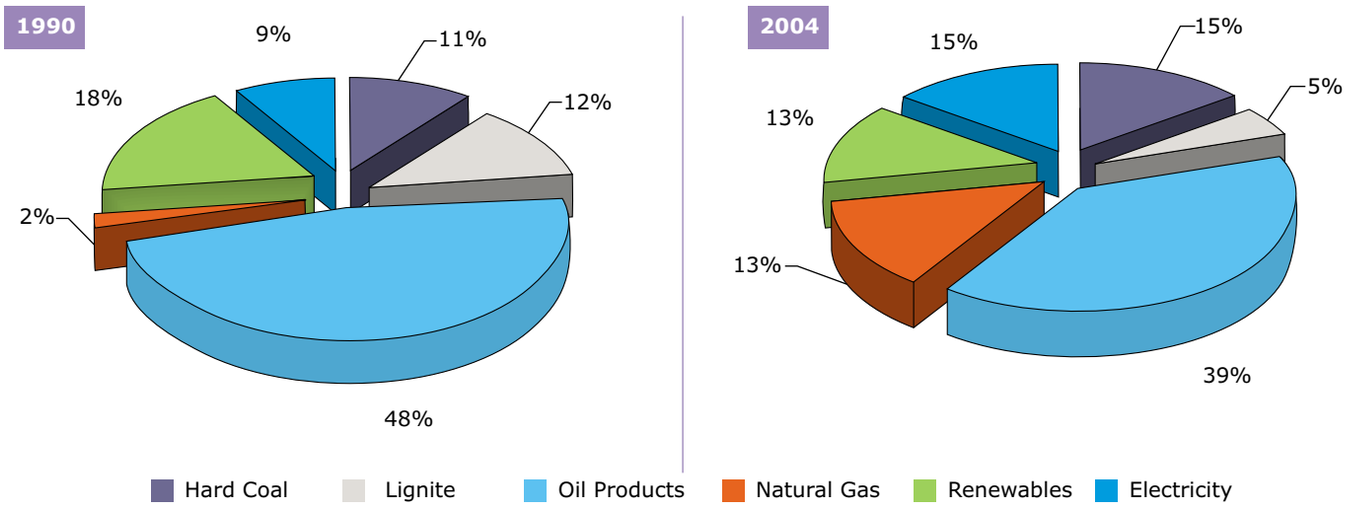


Fig. 2.13 The Distribution of Final Energy Consumption by Fuels in 1990 and 2004
Source: MENR, 2006

Figure 2.14 shows the distribution of final energy consumption by sector in 1990 and 2004. While the other sectors' consumption shares have shifted only by small amounts, households & services and industrial consumption have shown significant changes over the period. While its share was decreasing in TFC, households and services energy consumption increased from 15.4 mtoe in 1990 to 21.0 mtoe in 2004. This sector's consumption grew by 36% during this period.

The share of the industrial sector energy consumption in total final consumption increased from 35% in 1990 to 42% in 2004. This reflects the rate of industrialisation the country achieved and its shift to heavy industries and privatisation. In spite of a decrease in relative terms, oil remains the major fuel consumed in the industrial sector.

The share of the transportation sector in total final energy consumption decreased from 21% in 1990 to 20% in 2004.

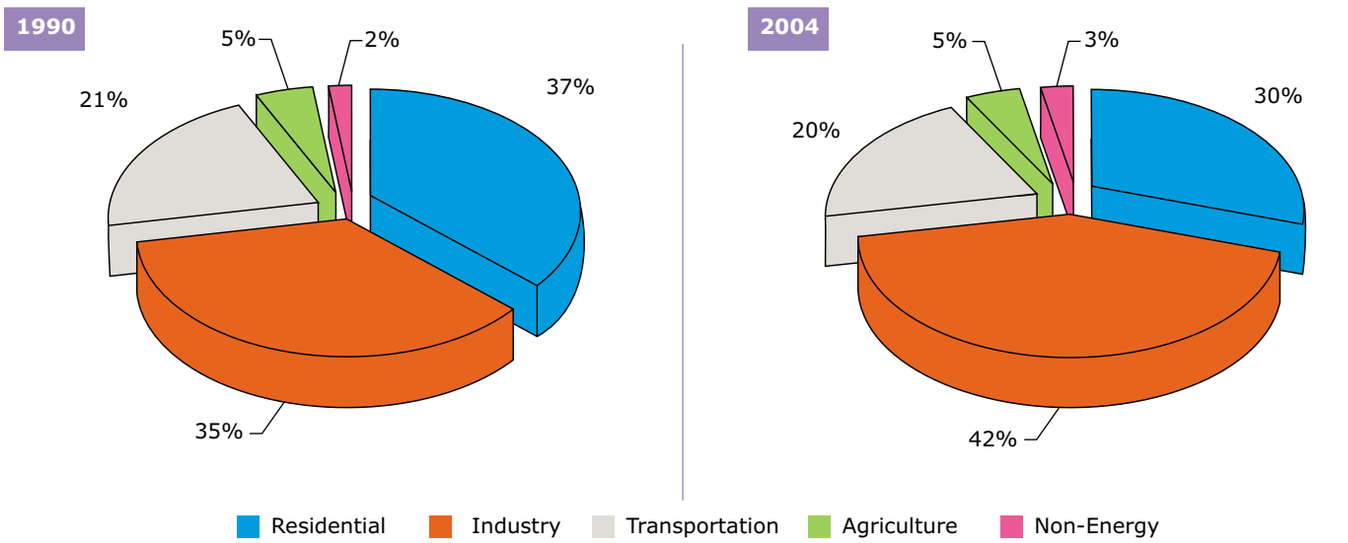


Fig. 2.14 The Distribution of Final Energy Consumption by Sectors in 1990 and 2004
Source: MENR, 2006

Electricity

The growing demand for electricity was met mainly by thermal and hydro sources, where renewables continue to keep their share of overall production. Installed capacity being 16,318 MW in 1990 reached 36,824 MW with an additional 20,506 MW, by the end of 2004. Electricity generation has encountered a rapid growth. The increase was from 57.5 TWh in 1990 to 150.7

TWh in 2004 with an annual average growth rate of 7.1%. While net electricity consumption was 46.8 TWh, per capita net consumption was 834 kWh and per capita gross consumption 1,012 KWh in 1990, these amounts reached 120.3 TWh, 1,703 kWh and 2,108 kWh, respectively in 2004 (Table 2.4).

Table 2.4 Development of Electricity

	1990	2004	% Change
Installed Capacity (MW)	16,318	36,824	126
Production (GWh)	57,543	150,698	162
Import (GWh)	176	464	164
Export (GWh)	907	1,144	26
Gross Supply (GWh)	56,812	150,018	164
Growth Rates (%)	-	7.2	-
Net Consumption (GWh)	46,820	120,305	157
Growth Rates (%)	-	7.0	-
Per Cap. Cons. (net) (kWh)	834	1,703	104
Per Cap.Cons. (Gross) (kWh)	1,012	2,108	108

Source : MENR, 2006

The capacity of power plants has been steadily improved and was almost doubled in size over the period 1990-2004. The share of thermal resources increased to 65.7% of total installed capacity (24,179 MW) and the rest 34.3%, (12,645 MW) was from hydro resources. Until 1985, lignite power plants had had the largest share of total thermal capacity. After this year, the share of lignite plants decreased gradually and a rapid increase was recorded in the share of natural gas plants, which accounted for 52.1% in 2004, coal plants' share was 34.3% and oil plants 13.3% (Table 2.5).

Table 2.5 Development of Installed Capacity By Sources (MW)

	1990	%	2004	%
Hard Coal	332	2.0	1,845	7.6
Lignite	4,896	30.0	6,451	26.7
Oil	2,098	12.9	3,215	13.3
Natural Gas	2,210	13.5	12,606	52.1
Geothermal	18	0.1	15	0.1
Other(*)		0.0	47	0.2
Total Thermal Plant Capacity	**9,554**	**58.5**	**24,179**	**65.7**
Total Hydraulic Plants Capacity	**6,764**	**41.5**	**12,645**	**34.3**
TOTAL	**16,318**	**100**	**36,824**	**100**

*Wind, Biomass and multi fired plants.
Source: TEIAS, 2006

As given in Table 2.6, the electricity consumption of industrial sector increased from 29.2 TWh in 1990 to 58.0 TWh in 2004 while its share decreased from 62% to 48%. On the other hand, both volume of consumption and shares increased from 16.7 TWh (36%) in 1990 to 57.6 TWh (48%) in 2004 in the households and services sector. Over the same period, there was no real change in the transport sector.

In particular, heat power (cogeneration) has been extensively utilized among textile, paper, ceramic, wood and food sectors.

Table 2.6 Electricity Consumption by Sectors (GWh)

	1990	2004
Industry	29,212	58,042
Households & Services	16,688	57,367
Agriculture	575	3,895
Transport	345	731
Total	**46,820**	**120,305**
Per Capita Net Cons. (KWh)	834	1,703

Source: TETC, 2006

2.6.5 Energy-intensity

The overall energy intensity of Turkey (based on TPES) increased from 0.377 toe/ $1,000 (2000 prices) of GDP in 1990 to 0.382 toe/$1,000 (2000 prices) of GDP in 2004. The energy intensity is about equal to the world average of 0.32 toe/$1,000, but it is higher than the average for OECD countries of 0.20 toe/ $1,000. When energy intensity is measured against GDP based on purchasing power parity (PPP), Turkey's is 0.12, the world average is 0.21, and the OECD average was 0.19 toe/$1,000 in 2003. [10] Compared with industry overall, the iron and steel and cement sectors have the highest energy intensity values (Table 2.7). Those sectors also demonstrated remarkable progress during recent years in terms of reduction of intensity throughout process rehabilitation and technology deployments (Table 2.7). [12]

Table 2.7 Min., Max. and Average Energy Intensity Values on Sectoral Basis (2000 to 2004, Estimations based on Consumer Price Index)

Sector	Minimum	Maximum	Average
Cement	2.92	3.32	**3.09**
Steel-Iron	2.19	2.83	**2.54**
Food	0.21	0.30	**0.27**
Pulp, Paper and Print	0.70	0.75	**0.73**
Glass	0.82	0.93	**0.87**
Fertilizer	0.89	1.09	**0.96**
Refinery	0.56	0.64	**0.60**
Automotive	0.02	0.04	**0.03**
Rubber	0.80	1.01	**0.89**
Ceramic	1.04	1.58	**1.24**
Textile	0.16	0.23	**0.20**

Source : EIE, 2006

2.7 Transportation

In Turkey, 98% of passenger transportation and almost 100 % of freight transportation were conducted by road and rail in 2004.

2.7.1 Road Transport

The cities in Turkey are linked by a good network of 64,000 km of highways. Investment to improve the road system resulted in highways dominating cargo and passenger transport. As a part of the Trans European Motorway (TEM) project, 1,851 km of motorways have been built in the last two decades (figure 2.15).

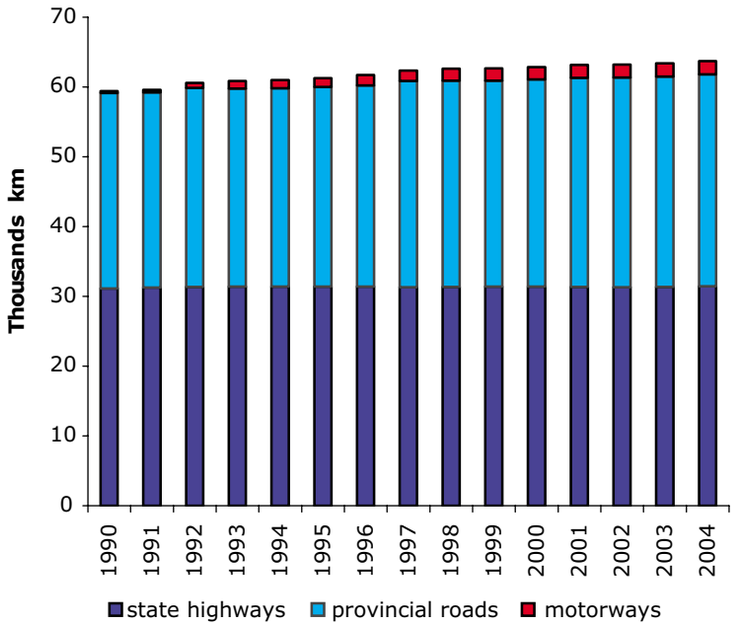


Fig. 2.15 Road Network during 1990-2004
Data Source: MPWS, 2006

At present, 95% of passenger transportation and 91% of freight transportation are conducted by road. Inland and international transportation is carried out by 8.8 million registered vehicles[9]. Number of motorcycles and construction machines are not included in the total number as in line with the GHG inventory estimations. The international transport fleet of Turkey, which is one of the largest fleets in the region, consists of 27,000 vehicles. The number of vehicles following the EURO-1 and EURO-2 norms that are enforcing EU standards is 16,000.[1]

There are currently 5.4 million passenger cars on Turkey's roads and domestic demand for motor vehicles continues to grow unabated. About 750,000 vehicles were sold in 2004, including 450,000 cars. The number of motor vehicles in the 1992-2004 period in Turkey is given in figure 2.16. Vehicle ownership (number of vehicles per 1,000 inhabitants) has increased from 78 in 1992 to 143 in 2005. Automobile ownership has increased from 37 to 75 per 1,000 people over the same period. In general, there is a strong relationship between GDP per capita and vehicle ownership. [13]

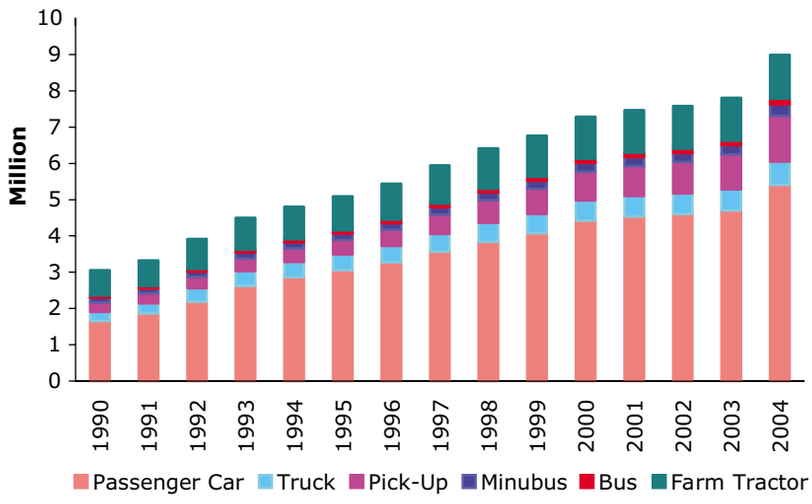


Fig. 2.16 Change of Automotive Vehicle Park in Turkey between 1990-2004
Source: TURKSTAT

In spite of these momentous changes, Turkey is ranked as having one of the lowest vehicle ownership rate of 143 per 1,000 habitants, among European and OECD countries in 2005.

9. Number of motorcycles and construction machines are not included in the total number as in line with the GHG inventory estimations.

2.7.2 Maritime Transport

Turkey has a coastline with a length of 8,333 km and emphasises port development and sea transport. The country possess 15 principal state-owned ports, around 30 municipal wharves, some 35 special purpose wharves belonging to industrial complexes and a number of private wharves and quays. The capacity of existing public ports is some 50 million tons a year. With private and semi-private port facilities, overall capacity is 200 million tons a year.[13]

Between 1993 and 2003, the carrying capacity of Turkey's commercial fleet decreased from 8,255 Dead Weight Ton (DWT) to 7,623 DWT with an overall decrease of 7.6%.[18]

2.7.3 Air Transport

In total, 34 airports of different sizes are in service for civilian air traffic in Turkey. The number of international airlines operating in Turkey has been increasing in recent years and their number reached 14 by the end of 2003. [17]

As given in figure 2.17, the number of overflights has increased steadily over the period of 1990-2003 and reached 154,218 in 2003.

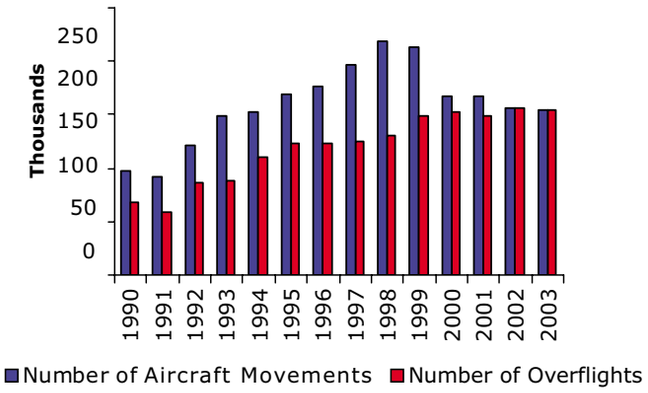


Fig.2.17 Number of Planes and Flights between 1990-2003
Data Source: MoT, 2006

2.7.4 Railways

The Turkish railway network is relatively underdeveloped and has been inefficient for decades in terms of infrastructure and management due to the absence of modern technology and management techniques. Most trains are powered by diesel locomotives. At the end of 2004, the railway network of Turkey was 10,984 km long, of which only 2,305 km (21%) was electrified (Fig. 2.8). The renewal, electrification and signalisation of the lines are ongoing. The length of electrified lines is planned to be increased to 2,956 km following the completion of ongoing projects. In this respect, the share of electrified main lines over the entire main lines will increase from 22% to 25.4%.

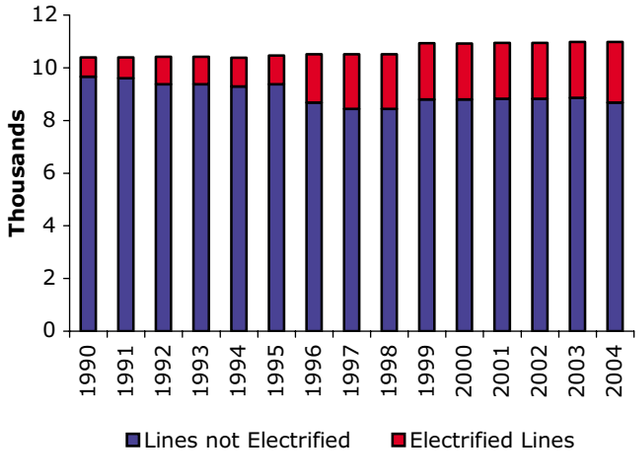


Fig. 2.18 Rail network (km)
Data Source: TCDD, 2006

The existing railway network is concentrated on a few major routes and thus limited rail transportation available between certain destinations and cities. Furthermore, the railways are state-owned and operated with an old structure and technology. Thus, there has been a decrease in recent years in terms of the utilisation of railways in parallel with the declining number of railway routes mirrored by the CO2 emissions from this sector. Investment in the sector aims to enable rail transport to be a competitive alternative to other modes of transport. [13]

2.8 Industry

Industry has demonstrated remarkable progress after the 1980s resulting in increases in industrial growth rates, industrial employment, the volume of exports and imports and the share of manufacturing industry in total exports.

Considering the period 1980-2005, exports and imports grew at an average rate of 5.2%. Following the accession to the Customs Union in 1996, the annual average increase in both exports and imports reached nearly 13%.

The share of industry in GDP reached 25.4% in 2005 (in current prices, 8.3% in 1980) and the most important impact of industrial growth has been observed in foreign trade. The share of manufacturing goods in total export has reached 93.7% in 2005. The volume of import in both investment and intermediate goods has also increased.

The share of industry in the GDP reached 25.4% in 2005 (at current prices, 8.3% in 1980) and the most important impact of industrial growth has been observed in foreign trade. The share of manufacturing goods in total exports reached 93.7% in 2005. The volume of imports in both investment and intermediate goods has also increased.

Turkey's long-term industrial performance for the period 1980-2005 has also had significant effects on the industrial employment rate (4.3 million in 2005). During that period, the share of industry in employment increased from 11.6% to 19.4%.

The share of manufacturing industry in national GDP was 19.2% in 2000 and reached to 20.8% in 2005. When sector-specific distribution of growth is considered, the industrial sector ranked first with a growth rate of 5.1% in 2005.(Table 2.8)

Table 2.8 Manufacturing Industry Indicators

Indicators (%)	2000	2005	2001-2005[10]	EU (2004)
The Share in GDP	19.2	20.8	20.4	20.5
Increase in Production	6.5	4.8	4.9	2.8
Increase in Exports (over current prices)	6.7	15.2	21.9	9.5
Increase in Imports (over current prices)	29.8	41.4	16.3	8.8

Source: TURKSTATand EUROSTAT, 2006

While the dominant industrial export were food, textile-clothing, iron and steel during the 2001-2005 period, the automotive, machinery, electronics, metal goods, petroleum products and rubber-plastics sectors have also increased their share (table 2.9). Around 52% of the exports in the manufacturing sector was to EU-25 countries during the period in question. [14]

Table 2.9 Shares of Primary Sectors in Manufacturing Industry

Share in Production (%)	2000	2002
Food	20.1	20.9
Textile-Clothing	20.2	21.5
Chemicals	7.2	6.9
Automotive	6.5	4.8
Petroleum Products	5.9	6.9
Iron and steel	4.6	4.9

Source : SPO, 2003

10. Average Annual Rate over the period 2001-2005

The Ministry of Industry and Trade (MoIT) has supported the foundation of Organised Industrial Zones (OIZs) since 1962 and Technology Development Zones (TDZs) by 2001, resulting in the establishment of 87 OIZs and 20 TDZs. The share of manufacturing industries in production and export ranked with average or high technology density has been increasing significantly in recent years as shown in Table 2.10. [14]

Table 2.10 Production and Export Structure of Manufacturing Industry (%)

Technology Density	Turkey						EU Export 2003
	Production			Export			
	2000	2002	2005	2000	2002	2005	
High	5.9	5.1	6.3	7.8	6.2	6.0	21.5
Above Average	22.5	18.2	25.3	20.4	24.3	28.5	41.9
Below Average	30.4	26.7	27.0	20.5	22.8	26.9	15.9
Low	41.2	50.0	41.4	51.3	46.8	38.7	20.7

Source: TURKSTAT, OECD STAN Database

The share of small and medium sized enterprises (SMEs) in the manufacturing industry plays a significant role especially in terms of employment rates. The SMEs (1-250 employees) holds a share of 99.6% in total number of establishments and 64.4% in overall employment. [14]

2.9 Housing

During the period 1990-2000, the number of buildings increased at a rate of 78.6% and the total number was 7,838,675 in the year 2000, in parallel with the growing number of municipalities .(Table 2.11)

Table 2.11 Number of Buildings, Floor Area and Storey Numbers in 2000

	1990	2000	%
Number of Dwelling Units	8,262,171	16,235,830	97
Number of Buildings[11]	4,865,137	7,838,675	61

Source: TURKSTAT Building Construction Statistics (1990) and Building Census(2000)

The average floor area of dwelling units has grown from 126 m2 to 141 m2 between 2001 and 2004. However, production of dwelling units per thousand people decreased from 3.6 to 2.3 throughout those years, despite the increasing demand for housing.

In 2000, the total number of households was 15,070,093 whilst the total population was 67,809,048. According to the findings of the 2000 Population Census, the households with four people made up the largest share (24%) among the household size ranging from one to more than seven people. This is followed by three (17%), seven (and more) (16%) and five (15%) households. (figure 2.19). Although the number of single-person households has been increasing in recent years, the average household size is distinctive when compared with OECD countries. This prevents large energy consumption in dwelling units in the country

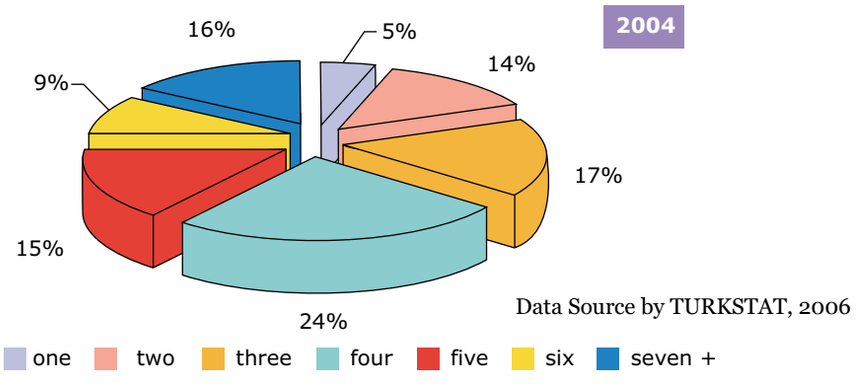


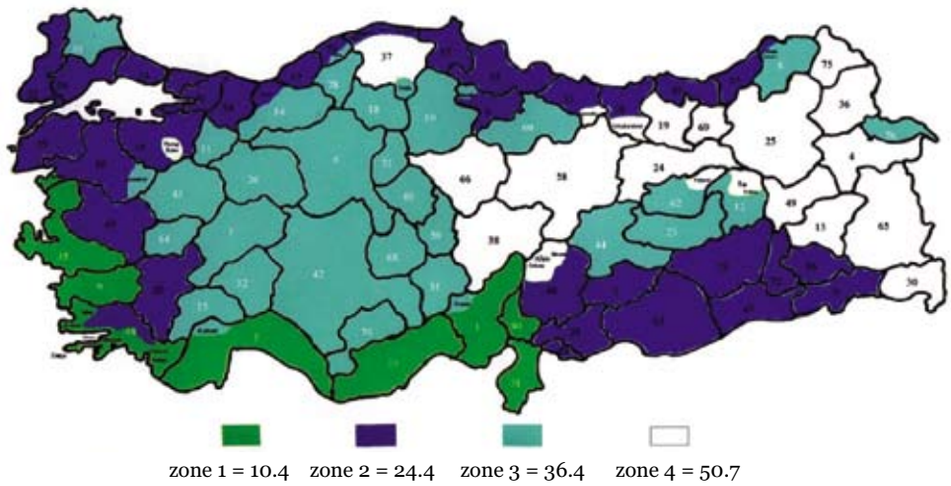
Fig. 2.19 Size of Households

11. The figure presents the total number of buildings according to their use of purpose (industry, agriculture, settlement, etc.)

Furthermore, Turkey demonstrated a progressive period by placing natural gas heating systems with coal combustion units in residential buildings within densely populated cities. This trend should continue in the future with new natural gas pipelines reaching more urban areas.

According to data from 2004, Turkey's total final energy consumption was 67.8 million TEP in that year. The building sector had a share of 31% in final energy consumption with 20.7 million TEP. Figures obtained from calculations made according to proper insulation criteria laid down in "TS 825 Heat Insulation Standards in Buildings" and "Regulation on Heat Insulation in Buildings" provide an energy saving potential of 30-50 % in the buildings.[12]

According to TS 825 Heat Insulation Standards in Buildings, Turkey was divided into four heat zones, according to which the energy need of these four zones shall be decreased to 50-150 kWh/m2 Due to cold climatic conditions during winter, the heating requirements are higher than 36.4 (kWh/m2,a) in major zones of the country.(Figure 2.20)



Source: TSE, 2006

Fig. 2.20 Building Heating Requirements by zones, Unit: (kWh/m2, a)

2.10 Solid Waste

In 2004, total solid waste collected by municipalities was 25 mt, demonstrating an increase of %41 in comparison to 17.8 mt in 1994. According to this figure, the per capita average solid waste produced in 2004 is 1.31 kg.

In 2004, out of 25 mt of solid waste collected from municipalities, 47.3% was disposed of in municipal dumps, 28% in controlled landfill sites, 15.3% at metropolitan municipality dumps, 3.2% was disposed of in another municipality's dump, 1.7% was disposed of by burial, 1.4% in composting facilities and 0.6% was disposed of into creeks and lakes. It can be concluded that 30% of municipal solid waste was disposed of in controlled landfill sites.

In parallel to the increasing trend of total municipal wastes, the ratio of managed wastes has also been increasing in recent years as presented in Table 2.12.

Table 2. 12 Municipal Solid Waste Indicators Between 2001-2003

Municipal Solid Waste Indicators	2001	2002	2003
Average per capita solid waste (kg/person-day)	1.31	1.34	1.38
Number of landfill sites	12	12	15
Capacity (thousand tons)	261,282	277,195	278,015
Amount of solid waste disposed (thousand tons/year)	8,304	7,047	7,432
Number of composting facilities	3	4	5
Capacity (thousand tons)	299	664	667
Amount of solid waste disposed (thousand tons /year)	218	383	326
Number of incineration facilities	3	3	3
Capacity (thousand tons)	43.9	43.9	44

Source: TURKSTAT, 2005

According to data on manufacturing industry in 2004, 119 mt of hazardous waste were produced annually, 6% (71,000 tons) of these were recycled, 21% (248,000 tons) sold or granted, 73% (877,000 tons) were disposed of.

2.11 Agriculture

The agriculture area[23] in Turkey is about 27 million ha, with a ratio of 35% in the total surface area of the country. However, the total area under cultivation in 2004 is 18 million ha. (figure 2.21) [15]

Although still an agrarian economy in the mid-1970s, transformation in 1980 led the Turkish economy to encounter an increase in the share of agricultural activities. The sectoral GDP ratio of the agricultural economy declined from 24% in 1980, to less than 12% by 2005. In parallel, the ratio of employment in the agricultural sector to the total economically active population decreased from 53.6% in 1990 to 48% in 2000.

The number of cattle has decreased by 13.4%, sheep and goats decreased by 38.3%, while poultry increased by 66.2% since 1990. If camels, horses, donkeys, mules and pigs are added, total livestock numbers have increased by 106% since 1990. The total number of livestocks in 2004 was 345 million.

The value of crop production was 22.5 billion euros in 2004 and the rest of agricultural production was shared by animal products, with 6.5 billion euros. Holding a share of 77%, the production from crops is diversified with arable crops, vegetables and fruits.

Total field crop production led by wheat, sugar beet, barley, potato and maize has shown an overall increase of 6% since 2000,

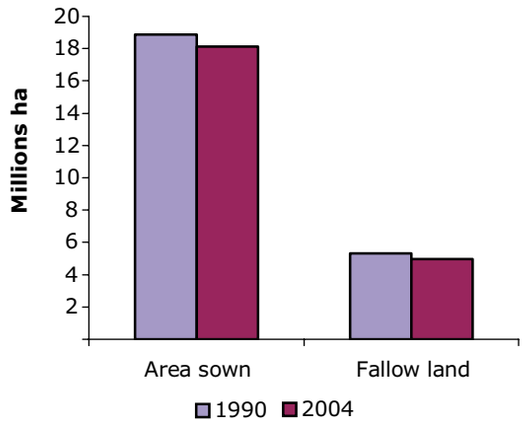


Fig. 2.21 Fallow and Sewn Areas
Data Source: TURKSTAT, 2006

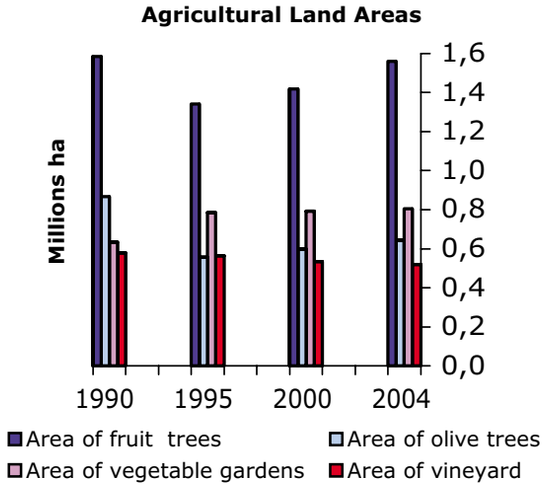


Fig. 2.22 Other Agricultural Land Areas
Data Source: TURKSTAT, 2006

In 2004, major export products in the agriculture sector included hazelnuts, tobacco, raisins, apricot, wheat flour, tomatoes and cherries with a total production value of 2,381 million euros while major import products were cotton, sheep and lamb hides, wool, wheat, palm oil, corn and tobacco, i.e. accounting for 2,565 million euros. [15]

2.12 Tourism

Turkey, a country surrounded by seas on three sides with a significant geographical location, has been the cradle of several great civilizations throughout history. The country owns 9 heritage properties and other 18 of which are tentatively inscribed on the World Heritage List[24]

Ranked as one of the countries in Europe with the longest coastline at 8,333 km, Turkey has many advantages and tourism is a major foreign currency earner. Turkey is ranking 12th in terms of tourist numbers and increases in foreign exchange revenues and 8th in terms of tourism revenues among the list of countries welcoming the largest number of tourists in the world. Total revenues from the tourism sector increased from $ 8 billion in 2000 to $ 18.2 billion in 2005. [14]

23. Excluding pastures and meadows
24. Turkey has ratified the World Heritage Convention on March 16, 1983 and has been addressing its requirements accordingly.

The bed capacity certified by the Ministry of Culture and Tourism in 2000 was 352,000, this increasedto 450,000 in 2005, whereas bed capacity certified by the municipalities was 350,000 and climbed to 400,000 . A capacity of 260,000 more beds is under construction. There are 4,825 tourism agencies active in the sector. The domestic tourism volume is estimated to be approximately 20 million tourists per year while the employment capacity of the sector itself is 1 million. [14]

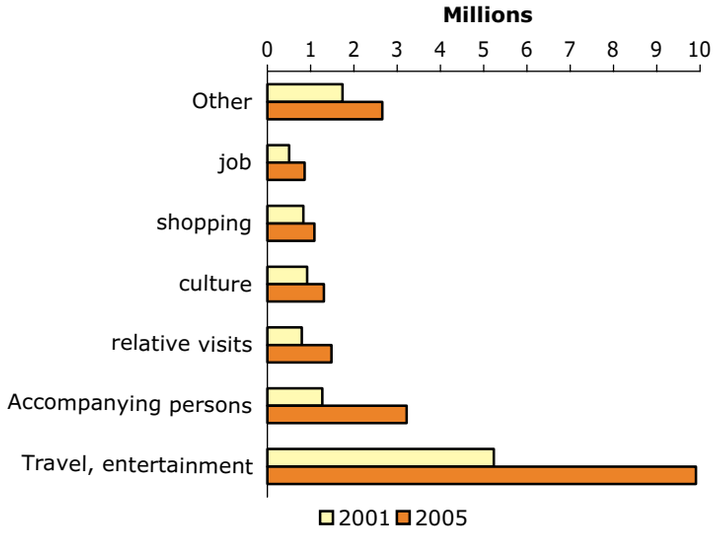


Fig. 2.23 Foreign visitors by purpose of visit
Data Source: TURKSTAT, 2006

As given in figure 2.23, the number of foreign visitors doubled year by year for the 2001-2005 period in line with the number of tourists visiting the country for travel, entertainment and cultural purposes.[5]

2.13 Forestry

Turkey is among the richest countries regarding biodiversity in moderate climate. An important part of this richness is located in its forest areas. Turkey has moderate climate mixed rain forests in the north, Mediterranean forest ecosystems in the south, dry and semi-dry forest ecosystems containing mainly oak species in eastern and southeastern Anatolia and transition zone forest ecosystems between coastal and inland regions. Turkey's forests, mostly natural, also have rich biodiversity values in terms of plant species other than trees, non-wood forest products and fauna sources. Forests are of vital importance to both urban and rural people.

In 2004, Turkey had approximately 21.2 millions ha of forest area. The figures concerning forest resources in Turkey are given in the below tables:

Table 2.13 Forest inventory results of Turkey at the end of

Tree Species	High Forests (Ha)			Coppices (Ha)[3]			TOTAL (Ha)		
	Normal[1]	Degraded[2]	Total	Normal	Degraded	Total	Normal	Degraded	Total
Coniferous	7,083	5,689	12,772				7,083	5,689	12,772
Deciduous	1,857	0,810	2,667	1,681	4,068	5,749	3,538	4,878	8,416
Total	8,940	6,499	15,439	1,681	4,068	5,749	10,621	10,567	21,188

Areas (*1,000,000)

Table 2.14 Growing Stock

Tree Species	High Forests (m^3)			Coppices[3] (m^3)			TOTAL (m^3)		
	Normal[1]	Degraded[2]	Total	Normal	Degraded	Total	Normal	Degraded	Total
Coniferous	818,556	51,070	869,626				818,556	51,070	869,626
Deciduous	310,014	14,367	324,381	70,464	23,654	94,118	380,478	38,021	418,499
Total	1,128,570	65,437	1,194,007	70,464	23,654	94,118	1,199,034	89,091	1,288,125

(*1,000,000)

Table 2.15 Annual Volume Increment

Tree Species	High Forests (m^3)			Coppices[3] (m^3)			TOTAL (m^3)		
	Normal[1]	Degraded[2]	Total	Normal	Degraded	Total	Normal	Degraded	Total
Coniferous	22,235	1,165	23,400	-	-	-	22,235	1,165	23,400
Deciduous	7,674	0,353	8,027	3,926	0,929	4,855	11,600	1,282	12,882
Total	29,909	1,518	31,427	3,926	0,929	4,855	33,835	2,447	36,282

(*1,000,000)

Source: Forest Management Planning Department of General Directorate of Forestry.

1) Crown Closure between 0.11 – 1.00
2) Crown Closure between 0.01 – 0.10
3) 0.75 coefficients was used in order to convert the ster volume into cubic meter (m3) volume

Pinus brutia, Pinus nigra and, Pinus silvestris are the most important coniferous species among the other coniferous trees such as 4 kinds of Abies, Picea orientalis, Cedrus libani etc. In portion of these three pine species is more than 80 % as in total volume of growing stock. Fagus orientalis and 22 Quercus spp have 80% ratio in total volume of the deciduous trees such as Tilia, Ulmus, Alnus, Castanea species.

In Turkey, 99% of forests belongs to the state. 4.1 million ha of total forests (19 %) are unmanaged (out of felling) forests consisting of national parks, protected areas, and other kinds of conservation forests. The rest, occupying 17.1 million ha (81%), are the commercial forests.

2.14 Other Circumstances : *Special Circumstances of Turkey*

Turkey's position with respect to the UNFCCC process is outlined such that the commitments accepted by the Turkish government should be based on equity and fairness by duly taking into account the "differentiated responsibilities" and "individual circumstances" of the parties concerned.

Turkey has had an important decision taken at the 7th Conference of Parties (COP7) in Marrakech in 2001. This is the deletion of the name of Turkey from the list in Annex II to the Convention, and Invitation of parties to recognize the special circumstances of Turkey, which place Turkey, after becoming a Party, in a situation different from that of other Parties included in Annex I to the Convention.

On the basis of the main economic indicators, Turkey's degree of industrialization is not yet comparable to that of most of the OECD countries. This implies that special circumstances of Turkey needed to be taken into consideration for other additional obligations that are defined for Annex-I countries.

Turkey possesses the lowest per capita fossil fuel-based CO_2 emissions amongst OECD countries. In 2003, emissions were as low as 3.3 tons per capita compared to an OECD average of 11.1, the world average of 4.0 and the EU 25 average of 9.0.

The Turkish energy sector is rapidly expanding in line with the demand for growth. Turkey has been experiencing demand growth rates of 3-4 % per annum in primary energy and 7-8% per annum in electricity. The growth in economy and rising living standards will continue to stimulate demand growth and the need for investment in different segments of the electricity and gas sectors.

The current installed electricity capacity of Turkey is 38 GW. The projections predict that around 55 GW of additional capacity will be needed until 2020 so as to meet growing demand with sufficient reserve capacity. This capacity need forces the utilisation of remaining indigenous lignite and hydro potential together with substantial amounts of generation and environmental investments.
The high consumption figures, rapid demand growth and significant amounts of investment required for the energy sector of Turkey, all necessitate the formulation of solutions to take into account the specific requirements of Turkey within the UNFCCC.

Turkey managed to produce 12.3% of its total primary energy supply from renewables in 2004. Nevertheless, since domestic resources are unable to meet the demand, the country is destined to bea net energy importer, with a high ratio of import dependency reaching 72%.

Consequently, optimum use of domestic resources constitutes one of the main components of the national energy policy. Turkey assigns the utmost importance to optimum use of its domestic coal resources and pays due consideration to the use of new and clean coal technologies transfer, use of which requires substantial amounts of financial resources.

Turkey's level of GHG reduction should be parallel to the level of development which is needed to the country to compete in the global economy but in the same time taking into account the necessary obligations to comply with the global need that is the reduction of global warming. Hence the proposed and accepted obligations in this term should reflect Turkey's current and future conditions without jeopardizing her long term development.

Policies to remove economic and social disparities, in the EU and the OECD in particular, were put into practice with the aim of minimising development disparities among countries, regions and sub-regions. Turkey, with its geo-strategic position, has the potential capacity to contribute to the region, as well as to improved world peace and welfare through increasing economic, social, political and cultural interaction within the region.

At the beginning of this, the21st century, the establishment of intercontinental transport networks, natural resources, historical values and touristic potential has assisted and continues to assist Turkey in its social transformation. Turkey is a transit country in terms of regional/international transportation on the East-West and North-South axes. Substantial progress has been achieved regarding international oil and gas supply projects, on the basis of the "East-West Energy Corridor Concept", highlighting the importance of Turkey in transportation of hydrocarbons from the Caspian and Middle East regions to hungry Western markets.

Turkey's "Special" condition with respect to the environment and climate are outlined below.

- Turkey is bordered by three major regional seas, namely the Mediterranean, the Black Sea and Aegean Sea and 70% of industries are located in coastal zones. The 8,333 km coastline of Turkey, which is the longest coastline among EU countries, has global significance in terms of the economy, geo-political standing and ecology.

- The country has a high potential for enhancement of prevention effects against climate change through accruing carbon stocks in its forests. Turkey has 21.2 million hectares forest cover (27 % of country area) and vast agricultural land together with other diverse ecosystems which can be further strengthened and enhanced through sustainable natural resource management enabling prevention measures against natural degradation. The climate pattern of 10.6 million ha of degraded forests can be turned into a challenging condition by fulfilling the requirements of sustainable forest management that would create an immense potential for carbon sequestration in near future.

- It has exceptionally rich wetlands compared to the Middle East and European countries - except for the Commonwealth of Independent States(CIS). The wetlands, which cover an area of 783,562 km². of Turkey, including artificial lakes, provide crucial habitats for water birds and aquatic species. 58 out of a total of 200 wetlands of Turkey are classified as having "international importance".

- Turkey also plays an important role in terms of biological diversity. There are 9,000 plant species present, of which 3,000 are endemic. The richest region in Turkey with regard to endemic species is the Mediterranean region, hosting 631 species. A similar conclusion can be reached for fauna. More specifically, while on the European continent there are 500 and 125 bird and reptile species respectively, Anatolia provides homes for 413 and 93 bird and reptile species respectively.

- Turkey is a cultural and natural bridge between Africa, Europe and Asia and Anatolia has, experienced several civilisations in the course of its history. Due to its unique position, Turkey has been the destination for numerous immigrants, many of which left the indelible marks of their cultural heritage during their settlement in this area. Turkey caries the economic and ethical burden of preserving all these natural and cultural entities, on behalf of the rest of the world.

- Being an important economic and social sector in Turkey, agriculture will require special attention, since studies show that it is the most vulnerable to climate change. Turkey, by signing the convention, is prepared to accomplish the necessary steps to fulfill the objectives outlined in the convention. Yet this contribution is expected to be proportional with respect to the sustainable development objectives of the country as well. This argument has also proven with a macro economic analysis with climatic dimension which was conducted during the preparation of Turkey's First National Communication to UNFCCC. The aim of this study was to shed light on potential measures that may include broad, market-based incentives designed to accelerate technology development and deployment in Turkey as part of its possible national objective towards reductions in aggregate CO2 emissions. Its main objective is an analytical attempt to enable Turkey to integrate sustainable development principles into national development planning and implementation of environmental policy objectives both at the macro economic and sectoral levels. To this end, a dynamic, multi-sectoral macroeconomic model for Turkey to study issues of environmental and macroeconomic policy interactions over both the commodity and the factor markets; the impact of various policies on the environment and on abatement; and to investigate various alternatives on environmental policy design along with their likely consequences from the points of view of growth, income distribution, social welfare and economic efficiency was built. The implemented model is in the tradition of computable general equilibrium (CGE) paradigm where the production — income generation — consumption — and saving — investment decisions of the economy are depicted within a market equilibrium setting. Optimizing economic agents are modeled as responding to various price signals as affected by the government's various tax/subsidy policies.

Therefore, it is fair to compare the emissions with not only the developed Annex I countries, but with the developing countries not listed in Annex I.

Moreover, the burden of preserving the vast number of natural and historic entities overwhelms the capabilities of Turkey and has to be shared with the rest of the world.

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CHAPTER 3
INVENTORIES of GHG and REMOVALS

3. INVENTORY OF GREENHOUSE GAS EMISSIONS and REMOVALS

3 INVENTORY OF GREENHOUSE GAS EMISSIONS and REMOVALS

This chapter presents the results of the Greenhouse Gas Emission (GHG) inventory for the years 1990-2004. Further information on the GHG inventory of Turkey can be found in the Emission Trends given in Annex 4.

3.1 Summary

Turkey's total GHG emissions excluding LUCF rose from 170.1 Tg to 296.6 Tg CO2 eq between 1990 and 2004. (Figure 3.1)

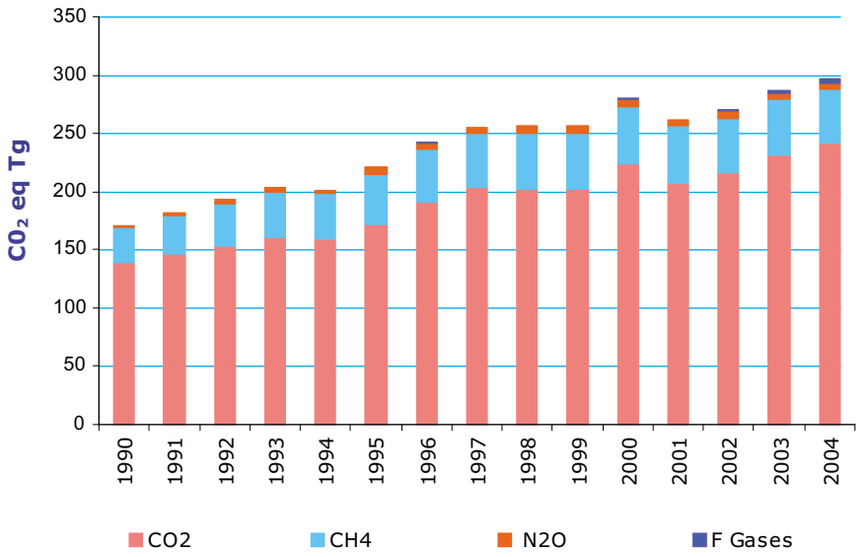

Fig. 3.1 Total Greenhouse Gas Emissions per Gas between 1990 and 2004
Data Source is TURKSTAT, 2006

Over the period, GHG emissions from the energy sector have risen from 132.1 Tg to 227.4 Tg CO2 eq placing this sector with the largest share of 76.7% followed by the waste disposal and industrial sectors with shares of 8.9% and 9.3% respectively. (figure 3.2)

The GHG emissions rose steadily between 1990 and 2004 due to Turkey's steady population growth and industrialisation after the mid-1990s. However, the share of emissions from the energy sector within the total GHG emissions (without LUCF) fell from 78% to 76.7% during this period[1] . This fall is a result of several changes including: i) A shift from coal to natural gas in electricity generation and residential consumption, ii) the introduction of alternative fuel sources iii) new engine technology in the transport sector and the removal of old, polluting cars from the register.

1. Ratio estimations based on the Country CRF Data

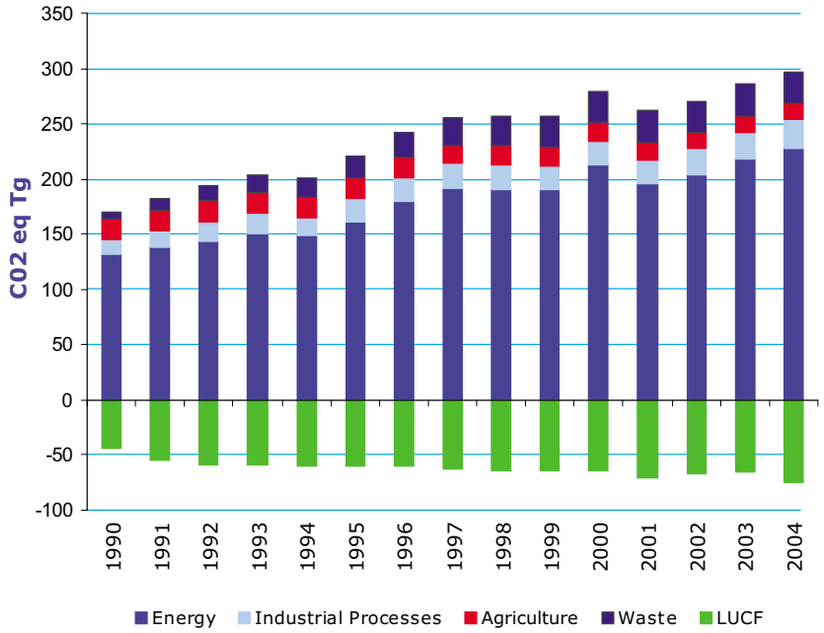

Fig.3.2 Sectoral Greenhouse Gas Emissions and Removals between 1990 and 2004
Data Source: TURKSTAT, 2006

Turkey as an Annex-I country had a ratio of 3.3 ton CO2 emissions per capita in 2003. The country is listed at the bottom of OECD countries, EU-15 countries and also below the world levels, having the respective ratios of 11.1, 9.0 and 4.0 ton CO2 per capita in 2003.(Table 3.1)

Table 3.1 GHG and CO2 Emission Indicators for Turkey and Relative Parties of UNFCCC (2003)

	CO_2 Emissions (Tg)	CO_2 /Per capita (ton)	GHG Emissions without LUCF CO_2 eq (Tg)	GHG Emissions without LUCF /capita CO_2 eq (ton)
EU-15[1]	3,447	9.0	4,180	10.9
EU-25[1]	4,064	9.0	4,925	11.0
OECD[2]	12,780	11.1	NA	NA
Annex-I Countries[3]	14,289	12.2	17,288	14.7
Non-EIT[1] Parties[3]	11,633	13.4	13,855	16.0
World[4]	24,983	4.0	NA	NA
Turkey[5]	231,0	3.3	286.3	4.1

Source: [1] Emission data from EEA Report No:8/2005, Greenhouse Gas Emission Trends and Projections in Europe 2005, population data from EUROSTAT
[2] OECD Fact-book for year 2003
[3] UNFCCC Key GHG Data : GHG Emissions Data for 1990-2003
[4] Emission Data from OECD Statistics (2006), Population data from UNFPA (2006)
[5] GHG Data from Turkey's First GHG Inventory Submitted to UNFCCC in August 2006 population data from TURKSTAT(2006)

3.2 National System for GHG Emission Inventory

Turkey has been a keen observer of the UNFCCC process since its adoption. It presented its position paper[3] entitled "Turkey and Greenhouse Gas Emissions" at the Third Conference of the Parties convened in Kyoto in December 1997, as an official document of the conference [1].

2. Non-EIT countries are the Annex-I Parties under the Convention excluding the Parties with Economies in Transition (EIT)
3. Turkey and Greenhouse Gas Emissions, FCCC/CP/1997/MISC.3

Ratifying the United Nations Framework Convention on Climate Change on 24 May 2004 and pursuant to Convention Article 4, paragraph 1(a), and Article 12, Turkey committed itself to prepare and annually update the National Inventory of Emissions and Releases of Greenhouse Gases. Hence, Turkey has been fully committed to national efforts to produce the First GHG Emission Inventory.

In April 2006, the first National Inventory was submitted to the UNFCCC, compiled in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (1997) and the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (2000) and the IPCC Good Practice Guidance for LULUCF (2000 and 2003). The revised and completed volume of the First GHG Inventory was released in August 2006. All data in this chapter are consistent with revised CRF data submitted in January 2007.

Emission estimates are calculated for the years 1990-2004 for carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). The year 2000 is selected for hydrofluorocarbons[4] (HFC) and 1996 for sulphur hexafluoride (SF_6) gases. Emissions from PFCs are not estimated, since these are negligible in their contribution to total emissions in addition to the unavailability of relevant data. The identification of emission sources and the preparation of activity data for PFCs and other emitters classified under HFCs are in progress for forthcoming inventories.

Organisational Structure

GHG Emission Inventory activities were started by the State Institute of Statistics in 1997. During the initial stage of the national inventory preparations, estimates were limited to the sectors of energy, industrial processes, coal mining, agriculture, livestock and solid waste. Supported by various inventory training activities and assistance delivered through international (UNFCCC) experts, the European Environment Agency (EEA) and UNDP-NCSP, successive momentum was achieved in terms of improving institutional capacities and expertise levels of the national GHG inventory system and team.

The Turkish Statistics Institute (TURKSTAT) is the designated body responsible for the compilation and updating of the National GHG Inventory in the country. The institute, formerly named the State Institute of Statistics, was restructured on 10 November 2005 under the Law[5] on Statistics and continued operations as TURKSTAT. Reorganised in line with the European Commission Statistics Office at every level including sub-divisions, TURKSTAT implements GHG Emission Inventory activities under the coordination of the Air Statistics Team that operates as part of the Environmental Statistics Group.

The estimates for the energy sector are primarily based on the data from the Energy Balance Table produced by the Ministry of Energy and Natural Resources. The entire estimates in other sectors are supplied by several agencies as shown in the organisation chart of the GHG emission inventory system given in figure 3.3.

4. Selection of the year 2000 is based on the introduction of HFC 134a to the industry in terms of the replacement program for Ozone Depleting Substances under the Montreal Protocol.
5. Statistics Law No 5429, published in the Official Gazette on 18/11/2005

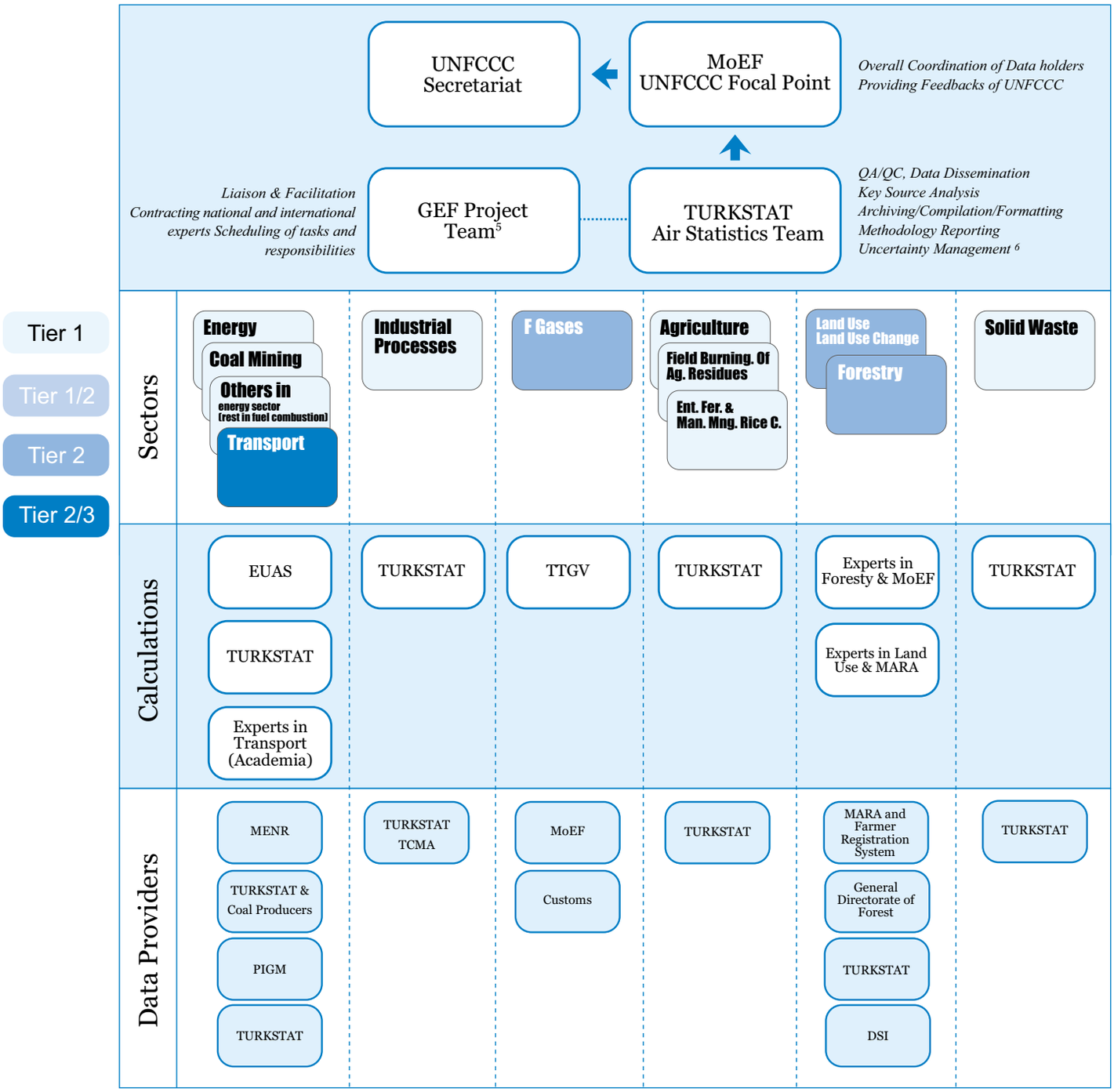

Fig. 3.3 Organization of the GHG Emission Inventory System during the First GHG Emission Inventory Preparation

3.3 Overview of Emissions

3.3.1 Total Emissions

In 2004, CO_2 is the largest proportion of Turkey's total emissions, accounting for 81.6% while CH_4 has a share of 15.6%. The next largest share in total emissions is from N_2O with 1.9 % followed by F gases with 1.0 %.

The summary of aggregated GHG emissions by gas and the net GHG emissions in terms of sector for the period 1990 to 2004 is presented in Table 3.2 and 3.3.

5. Support of the GEF FNC Project team has been provided on a project term basis.
6. Uncertainty estimates were conducted by experts in each sector.

Table 3.2 Total GHG Emissions of Turkey by Gas between 1990 – 2004, CO2 eq (Gg)

Gas	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CO_2	139594	146545	152932	160908	159104	171854	190668	203723	202713	201712	223806	207379	216433	230987	241884
CH4	29207	33173	36664	38979	39187	42539	44985	46445	47706	48826	49269	48703	46875	47757	46290
N_2O	1264	2249	4046	4099	2188	6330	6071	4738	5558	5725	5752	4839	5417	5255	5498
F Gases	0	0	0	0	0	0	374	611	660	517	1141	1180	1896	2286	2922
TOTAL	170065	181967	193642	203986	200479	220722	242098	255517	256637	256779	279969	262101	270620	286286	296605

Source: TURKSTAT, 2006

Table 3.3 Net GHG Emissions of Turkey by Sector between 1990 – 2004, CO2 eq (Gg)

Gas	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Energy	132128	137956	144268	150776	148624	160788	178960	191389	190621	190614	212546	196020	204018	218004	227430
Industrial Processes	13070	15223	17231	18591	16930	21644	59125	81784	87208	72315	52024	46952	67395	63081	87161
Agriculture	18473	19043	18843	18618	18315	17974	17984	16838	16704	16743	16135	15768	14771	14796	15178
Waste	6386	9742	13293	15995	16595	20314	22694	25119	26688	27972	29043	29113	28408	29357	27546
LUCF	-43531	-55233	-59211	-58478	-59522	-60088	-60130	-62594	-63810	-64538	-64521	-70176	-66078	-64822	-74073
NET TOTAL	126527	126731	134424	145502	140941	160631	181961	192919	192824	192238	215435	191923	204540	221460	222529

Source: TURKSTAT, 2006

The contribution to emissions according to sectors and by gases for the year 2004, including removals from sinks, is shown in figure 3.4.

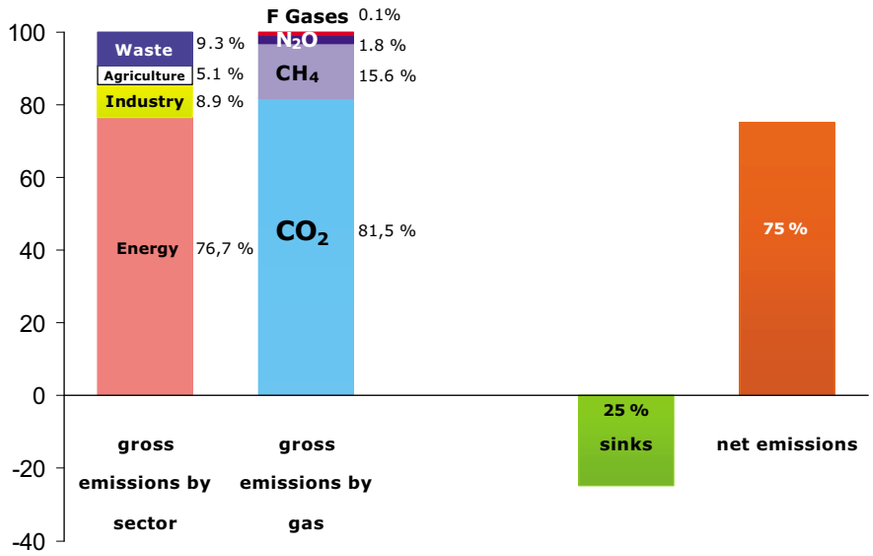

Fig. 3.4 Overview of Turkey's GHG Emissions and Sinks in 2004 (CO2 eq)
Data Source is TURKSTAT, 2006

3.3.2 Carbon Dioxide(CO2) Emissions

In Turkey, CO2 emissions arise largely from the combustion of fossil fuels, reaching 222.3 Tg and having a share of 92% of total CO2 emissions in 2004. The largest single contributor to CO2 emissions was electricity generation Net emissions account for 167.8 Tg since 74.1 Tg emissions removed by sinks.

Energy Sector

Energy sector emissions grew steadily during 1990-2004 except in some years in which fluctuations are observed as shown in figure 3.5. The factors giving rise to these fluctuations include economic crises, climate variations affecting hydraulic power, and the impact of taxes and measures introduced in the sector. Declines in emissions observed during 1994, 1999 and 2001 are the results of economic crises, while the increase in 2000 was due to rising demand for electricity generation by thermal plants as a result of a deficit in hydro power caused by dry climatic conditions.

In Turkey, the energy sector showed the highest emission increase at 124% between 1990 and 2004. It is followed by the manufacturing sector (82%), transport (55.9%) and others (27.9%). The total CO2 increase in 2004 is 75.4% compared to 1990.

With regard to electricity generation, CO2 emissions due to combustion of hard coal, lignite and natural gas showed a remarkable increase during the period in question. However, the replacement of lignite and coal with natural gas resulted in a decrease over the emission trend after 1998. The emission from lignite production in 2004 was 25.4 Tg, accounting for 11.41% of total CO2 emissions, while the share of hard coal was only 4.36%.

Unlike the increasing share of emissions from industry and electricity generation, the share of the transport sector in total energy sector emissions fell from 20% to 18% over the same period. (Figure 3.5)

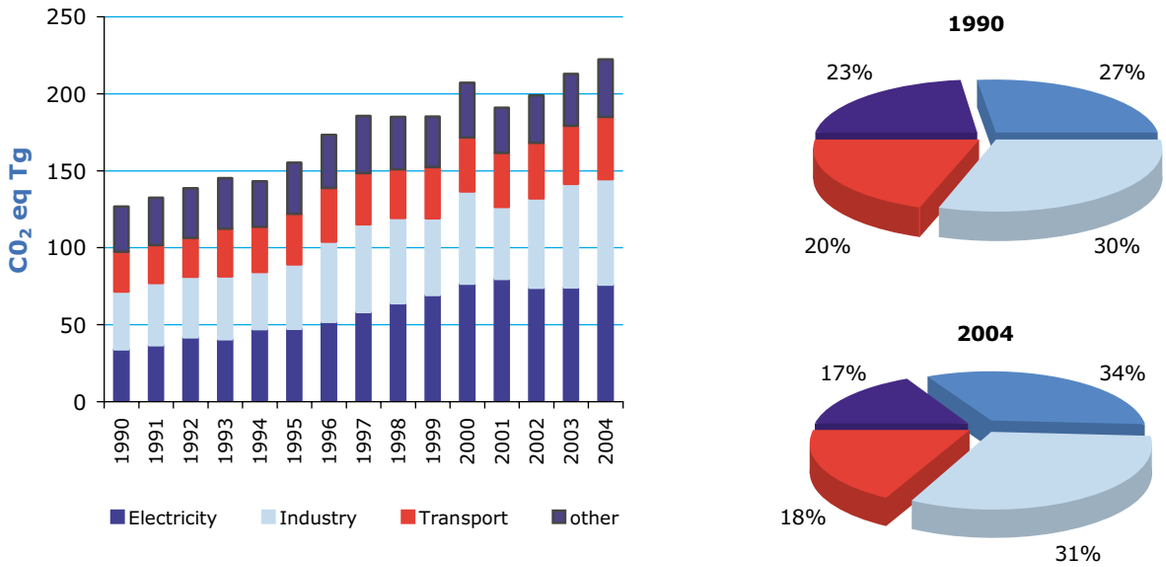

Fig. 3.5 Aggregated CO2 Emissions from Energy Sector
Data Source: TURKSTAT, 2006

Besides, the studies conducted by Can A.(2006) verifies the Co2 emissions generated due to fuel combustion and the prepared map below shows the distribution of those emissions by province match the results of the GHG inventory.(figure 3.6)

Fig.3.6 Provincial CO2 Emissions due to Fuel Combustion in 2000
Source: [7]

Industrial Processes

The CO2 emissions due to industrial processes have risen from 12.9 Tg to 19.6 Tg between 1990 and 2004. 85% of the emissions in 2004 were generated by cement production activities (largely due to clinker production) as classified under mineral products. Figures 3.7 shows an increasing trend since 1990. Emissions from cement production were 16.7 Tg in 2004.

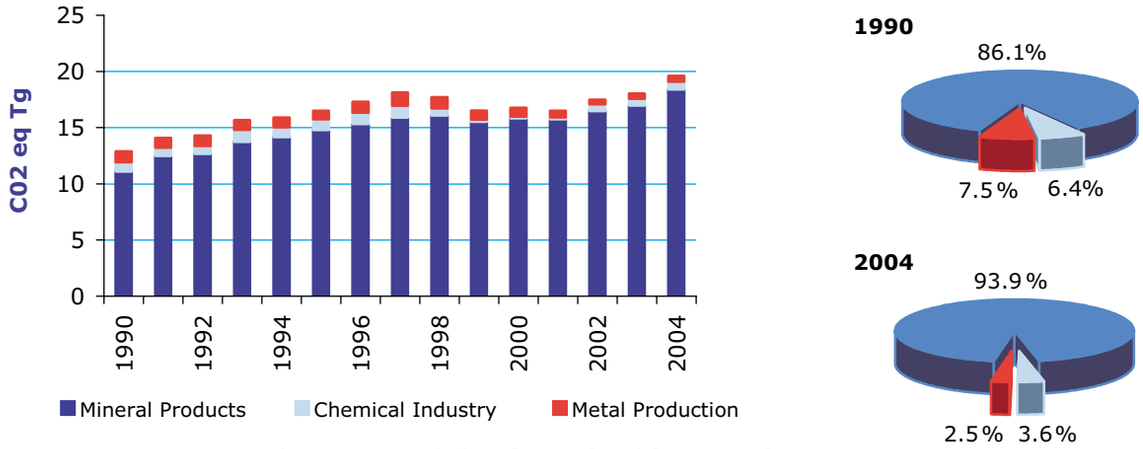

Fig. 3.7 CO2 Emissions from Industrial Processes by Sector
Data Source: TURKSTAT, 2006

Transport Sector

Total Co2 (excluding LUCF) emissions from the transport sector changed from 26 Tg to 40.5 Tg during the years 1990-2004, an increase of 55.8%. (figure 3.8) This corresponds to a change from 0.46 ton CO2 per capita in 1990 to 0.56 ton CO2 per capita in 2004 in terms of CO2 emissions from the transport sector. However, CO2 emissions from this sector have changed from 0.17 kg CO2/$ in 1990 to 0.14 kg CO2/$ in 2004 and its share of total CO2 emissions decreased from 15% to 12% over the period. This decrease indicates a tendency towards more efficient energy consumption in the sector. [3]

The factors underlying this efficiency are explained by alternative fuel usage with low carbon content and by increased use of diesel-fuelled and LPG-fuelled passenger vehicles. Dieselisation is another growing trend in Turkey. Diesel engined cars are more efficient than equivalent gasoline powered passenger cars, bringing CO2 emission levels down per unit distance travelled. Therefore an increase in diesel percentage over the whole passenger car fleet will sustain its role in emission reductions. [3]

In 2004, the share of CO2 emissions from road transport in total CO2 emissions in the transport sector is 84%. This is followed by emissions from civil aviation (12%), shipping (3%) and railways (1%). In the road transport sector, more efficient energy consumption as a result of the shift to new technology in engines and the use of alternative fuel sources led to a decrease in emissions per vehicle km. The total decrease in CO2 emissions per vehicle km throughout the period 1900-2004 is 8.7%.

Furthermore, the reduction of CO2 emissions due to the removal of about 320,000 old vehicles from the road by providing a tax advantage to consumers in 2003 and 2004 resulted in a reduction of 4.9% in CO2 emissions in those two years.[3]

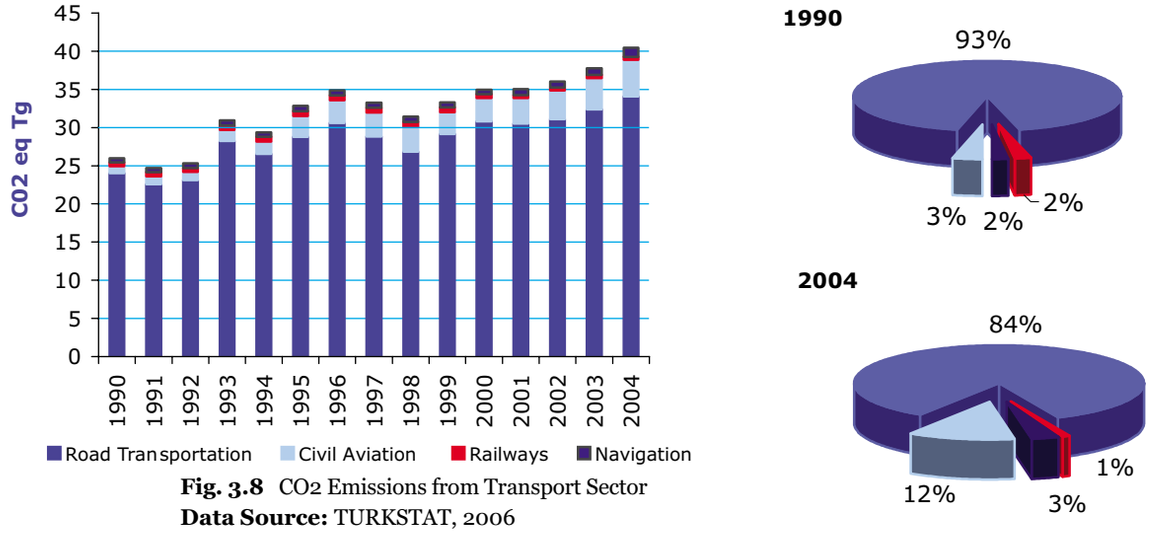

Fig. 3.8 CO2 Emissions from Transport Sector
Data Source: TURKSTAT, 2006

3.3.3 Methane (CH4) Emissions

Increasing from 29.2 Tg to 46.3 Tg CO2 eq between 1990 and 2004, solid waste generation is the largest single source contributing to total CH4 emissions with a ratio of 58.5 % in 2004.(Figure 3.9) However, this emission trend is settling into a stable pattern due to the increasing capacity of controlled landfill sites in densely populated (cities).

In terms of the contribution of CH4 as a fugitive emission, coal from underground and surface mines (mostly from lignite and hard coal mining) showed an overall increase including observed fluctuations until 2001. Declining remarkably after 2001, the lowest emission figure was 58.5 Tg CH4 by the year 2004.

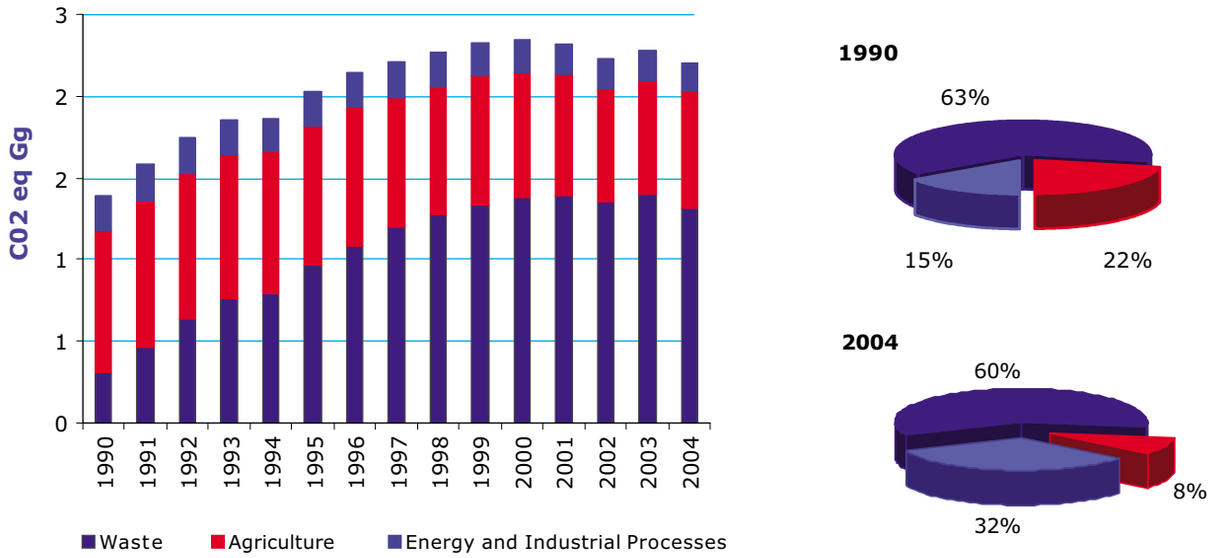

Fig. 3.9 Total CH4 Emissions by Sectors
Data Source: TURKSTAT, 2006

Although there are operational landfill plants recovering CH4, the emission abatement values of these are not included in the National GHG Inventory due to the absence of official data. For instance, in one of the landfill plants in Istanbul, it is estimated that 700-800 kW/h electricity is generated with recovery of 8500 m3 of storage gas. Turkey has a good potential to extend these practices to other large cities since the organic content of municipal waste has an average overall ratio of 45%. [8]

CH4 emissions from the agricultural sector declined during the period 1990-2004 as a result of the decreasing number of livestock. In 2004, the share of CH4 emissions from enteric fermentation within the agricultural sector is 89%. This is followed by emissions from manure management (6%), burning of agricultural residues[7] (3%) and rice cultivation (2%).

3.3.4 Nitrous Oxide (N2O) Emissions

N20 emissions from industrial processes have grown since 1990 while emissions from fuel combustion showed a minor increase. Emissions due to the burning of agricultural residues remained stable over the period. (Figure 3.10)

The share of enteric fermentation emissions within the agricultural sector and the chemical industry has the biggest share of N20 emissions specific to nitric acid production. Between the period 1990 and 2004, N2O emissions showed significant fluctuations as a result of variations in demand for nitric acid.

7. Burning of agricultural residues is prohibited by the mandatory regulation introduced in 2005.

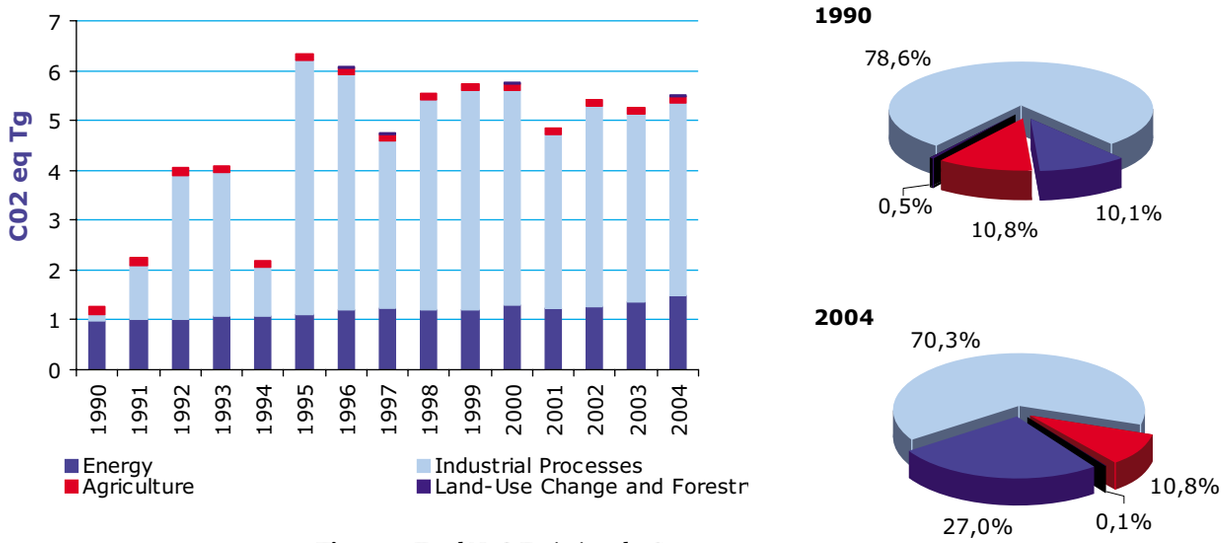

Fig. 3.10 Total N2O Emissions by Sectors
Source: TURKSTAT, 2006

3.3.5 Fluorinated Gases

Total emissions of F gases rose from 374 Gg to 2,933 Gg CO2 eq during the period 1996 to 2004. The emissions of SF_6 and HFC by their use in industry depend only on imported amounts since there is no domestic production within the country.

The SF_6 emissions recorded since 1996 and emissions are generated from the electrical instruments industry.

HFCs were introduced to the industry by 2000 in respect to the programme for the replacement of CFCs controlled under the Montreal Protocol. The emissions of HFCs is only limited to the use of HFC134a by certain industries producing refrigerators and air conditioners. As the entire industry continues using HFC22 for manufacturing purposes, the use of HFCs holds a share of 76% in overall F gases in 2004. The emission of HFCs rose from 818 Gg to 2.229 Gg during the years 2000 to 2004. (Figure 3.11)

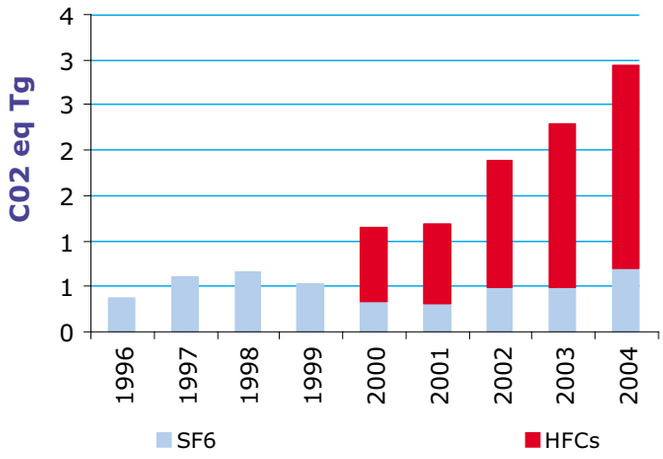

Fig. 3.11 Total F Gas Emissions between 1996 and 2004
Data Source: the Customs; Estimations by TTGV, 2007

3.3.6 Emissions and Removals from Land Use Change and Forestry

Forestry

As already mentioned in chapter 2, Turkey has forests of approximately 21.2 millions ha. The state owns 99% of forests in the country. Half of the forest areas in Turkey (10.567 mil. ha of 21.2 mil.) consists of degraded (non-productive) woodland formations. On the other hand, one third of productive forests have a low density.

As shown in figure 3.11, CO2 removals in Forest and Other Wooded Biomass Stock demonstrated a steady increase. Overall, forest areas showed an increase of 5% while growing stock volume[6] had increased by 35% with an annual volume growth of 29% during the 32 years between 1972 and 2004. (Unal, 2006)

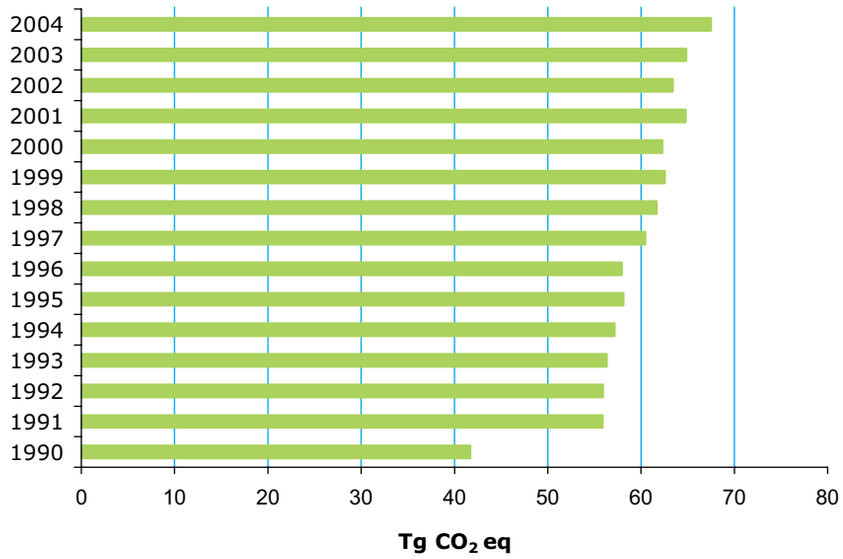

Fig. 3.12 CO2 Removals in Forest and Other Woody Biomass Stock between 1990 and 2004
Data source: Forest Planning and Management Department; Estimations by Unal A. (2006)

The increasing trend has various explanations: migration from rural areas to cities resulting in reduced pressure on forests; reduction in traditional methods of goat breeding and cattle grazing in forests and meadows adjacent to forests; abandonment of some forests occupying steep slopes which have non-economic management conditions; conceptual changes in forestry applications towards the multi-functional use of forest resources in the framework of sustainable forest management; conversion of coppices into high forests; forestation of barren aforestation of bare lands and degraded forests accomplished by the Forestry Service.[4]

Other LULUCF Categories

This section includes the estimates of emissions and removals from croplands, grasslands, wetlands and settlement areas. The estimates were made using data related to land use, crop type, cultivated area and soil from TURKSTAT and MARA. CORINE Land Cover 2000 were also used for settlements areas. The removals by other land use activities were about 21 Tg CO2 eq in 2004. [5]

3.3.7 Factors Underlying GHG Emissions Trends

Figure 3.13 shows the factors underlying GHG emissions trends in Turkey. Economic development in terms of GDP and primary energy source consumption are the main drivers of GHG emissions in parallel to population growth, as those factors follow the same pattern proven with the significant fluctuations occurred during the years that economic crisis and climatic variations encountered which directly effected the total energy consumption over the period.

6. Since all wooded areas greater than 3 hectares in size are treated as forest status disregarding their crown closure, this figure differs from the FAO figures (10,175 Mill. ha. for the year 2005) as the figures presented by FAO cover only the wooded areas having more than 40% crown closure.

Fig. 3.13 Factors Underlying GHG Emissions Trends between 1990-2004
Data Source: GDP, Population and Emission Data are from TURKSTAT(2006), Energy Consumption Data is from MENR(2006)

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CHAPTER 4

POLICIES AND MEASURES TO REDUCE GHG EMISSIONS

4. POLICIES AND MEASURES TO REDUCE GHG EMISSIONS

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4.1 Introduction

When the UNFCCC was adopted in 1992, Turkey, as a Member of the OECD, was included among the countries of the Convention's Annexes I and II. Therefore, Turkey did not sign the Convention, because of the obligations stipulated in the Convention to reduce emissions to the level of 1990, and to provide technological and financial support to non-Annex I countries. On the basis of its main economic indicators, Turkey's degree of industrialisation is not yet comparable with that of most other OECD countries.

An important decision, which was taken at the 7th Conference of Parties (COP7) in Marrakech in 2001, have had an impact on Turkey. This was the deletion of the name of Turkey from the list in Annex II to the Convention and the Invitation of parties to recognize the special circumstances of Turkey, which place Turkey, after becoming a Party, in a situation different from that of other Parties included in Annex I to the Convention on the basis of the "common but differentiated responsibilities" principle of the Convention. After these, The Law No: 4990 concerning the accession of Turkey to the UNFCCC was promulgated in the Official Gazette No: 16 October 2003. The United Nations Framework Convention on Climate Change (UNFCCC) came into force for Turkey on 24 May 2004.

Turkey is ready to undertake its commitments and comply with responsibilities embodied in the Annex I countries to the Convention according to its special circumstances. Because Turkey believes in equity and in accordance with common but differentiated responsibilities and respective capabilities, it shall implement the policies and measures to protect the climate system and shall promote sustainable development. These measures mainly focus on increasing energy efficiency in end-use sectors, fuel switching and increasing the use of renewable energy sources, particularly hydro resources.

The specific national conditions of Turkey in this respect have to be considered. Turkey possesses the lowest per capita fossil-fuel-based CO_2 emissions amongst OECD countries; 3.3 tons per capita (TURKSTAT 2006). The OECD average is 11.1, the world average is 4.0 and the EU 25 average 9.0 [2003] (see Chapter 3 Table 3.1). Optimum use of domestic resources constitutes one of the main components of the national energy policy. Turkey assigns the utmost importance to optimum use of its domestic coal resources and pays due consideration to the use of clean coal technologies, the transfer and use of which requires substantial financial resources.

4.1.1 Policy-making process

The Ministry of Environment and Forestry (MoEF) is mainly responsible for environmental legislation and policy development, while other ministries are responsible for integrating environmental policy targets. The main task of the MoEF is to ensure legal arrangements with regard to related matters by drafting laws and supervising their implementation, as well as supporting research activities in this field (See details in Chapter 2).

The State Planning Organisation (SPO), working under the authority of the Prime Ministry, develops seven-year development plans. (See details in Chapter 2).

Turkey's Seventh Five-Year Development Plan (1996-2000) recognised this inadequacy and called for the development of a national environmental strategy. The National Environmental Action Plan (NEAP), which is the most comprehensive policy document in Turkey, was formed to supplement the existing Development Plan with concrete action for integrating environment and development, has identified the degradation of the environment (air quality, water resources, soils, marine and coastal resources, forests and biological diversity), insufficient waste management, loss of cultural heritage and vulnerability to environmental hazards as Turkey's major environmental problems.

The 9th Development Plan, preparatory work on which has just been finalised under the coordination of SPO, will cover the 2007–2013 periods.

The 9th development plan, prepared to attain sustainable development, contains the phrase "Turkey is aware of the United Nations Climate Change Operation Plan by preparing a National Operation Plan in agreement with the conditions of Turkey, presenting the policies and precautions for reduction of the greenhouse gasses". This phrase clearly highlights the importance that our country attaches to climate change policies within the scope of development.

Turkey is at the planning stage of developing a National Climate Action Plan. Primarily, the MoEF is responsible for environmental legislation and policy development, while other ministries are responsible for integrating environmental policy targets with the National Environmental Action Plan (NEAP) within their respective fields.

The objectives of the Action Plan for Abatement of CO2 and other Greenhouse Gas Emissions will be targeting to reduce the rate of increase in the emission of three GHGs (CO2, N2O and CH4) from all sources in comparison with projected baseline case scenario levels by attaining the courtiers sustainable development in line with NEAP and the draft National Energy Efficiency Law and National on Renewables.

In the 9th National Development Plan (2007-2013), with Clause 461, it has been decided that a" Climate Change National Action Plan Strategy" shall be prepared as national policy and in relation to this, a preparatory workshop was arranged by the MoEF and the National Communication Project team on 8-9th June 2006 for involved stakeholders and academia, results of which are given in Table 4.15. These results constitute a road map for the Climate Change National Action Plan for the mitigation of national climate change and fulfilment of adaptation actions in order to facilitate means and approaches.

The basic approach shall involve all economic sectors such as energy, mining, transport, tourism, industry and agriculture (Use and Management of Soil and Water Resources, Forestry, Fishing, Food Safety, Plant and Food Health, Settlement and Urbanisation, Regional Development, Rural Development, Good Public Governance Special Expertise Commissions, etc.) with a direct impact on the environment.

A list of "Environment Related Institutions and Organisations in Turkey" is given in Annex 1.

TUBITAK, the National Technology Research Foundation of Turkey, is responsible for creating national science and technology policies and conducting activities focused on identifying and recommending tools that aim at accomplishing existing policies through the use of various policymaking methods and related research (see Chapter 7 and 8). The Turkish Development Plan links science and research policies with other sectoral policies.

A European Spatial Data Infrastructure is under way to make available relevant harmonised spatial information to European institutions, national, regional and local administrations and to citizens. The expected entry into force of the directive is 2007; gradual implementation will be between 2007 and 2013.

Greenhouse gas emissions are referred to either directly or indirectly in a large number of national laws, decrees and regulations[1]. These have been discussed in Chapter 2 and will be further elaborated on in this chapter.

4.1.2 Obligations under International Laws

Turkey's obligations under international law stem from multi-lateral conventions and protocols that it has been a party to, along with global and/or regional arrangements such as declarations or action plans that it has joined or agreed to. Many of the conventions are in the form of "framework conventions".

The binding nature of resolutions and recommendations is specified again in these legal dispositions. Turkey has ratified over 50 international legal dispositions in the area of the environment [12].
International environmental declarations and agreements mainly relate to climate change, which Turkey became a party to, include:

- UNECE Convention on Long-range Trans-boundary Air Pollution (1979)
- Convention for the Protection of the Ozone Layer (1985)
- Montreal Protocol on Substances that Deplete the Ozone Layer (1987)
- Rio Declaration on the Environment and Development and Agenda 21 (1992)
- Statement of Principles for the Sustainable Management of Forests (1992)
- Convention on Biological Diversity (1994)
- Convention to Combat Desertification (1995)

1. Regulation used hereby and hereunder represents "By-law".

The other environment-related multilateral conventions that Turkey is a party to, and the protocols thereof, are listed in Annex1. Besides, Turkey is a member of the International Energy Agency (IEA) and participates in the work of the International Civil Aviation Organization (ICAO), the International Maritime Organization (IMO) and International Union of Railway Companies (UIC) with an aim to prepare mechanisms to reduce GHG emissions from international aviation and shipping.

Turkey participates in both multilateral and bilateral development cooperation that often makes direct reference to climate change mitigation, and finances climate change mitigation through the Global Environment Facility (GEF). Further information on Turkey's development cooperation is given in Chapter 7.

In December 2004, the European Council (EC) decided to start accession negotiations with Turkey as of 3 October 2005, and set out the framework and the requirements for starting accession negotiations. Approximation to the EU Acquis is perceived to be of help when addressing climate change issues too. The Environmental Acquis of the EU contains laws that are relevant to climate change.

4.1.3 National Strategy for Climate Change Action

The Ministry of Environment and Forestry (MoEF), is mainly responsible for environmental legislation and policy development for EU Harmonization on Environmental Issues Integrated National Environmental Strategy for EU Accession (UCES) within their respective fields is fulfilled by the MoEF in consultation with other responsible ministries for integrating environmental policy targets.

Turkey, in the process of joining the EU, attaches importance to the work it performs on the environment and in this context, on reduction of greenhouse gasses causing climate change. Within this context, Law No.2872 on the Environment, as amended by Law No. 5491, contains provisions on efficient use of energy, recycling of waste and employment of environmentally friendly technologies.

The MoEF has the primary intention of paralleling all their policies and applications, and especially the Environment Law, with general environmental policies of the EU. This is based on the concepts of "pollution prevention" rather than "pollution control", prevention of pollution at source, minimisation of waste, utilisation of best available techniques , efficient use of energy, effective application of the inspection system and application of the "polluter pays" principle.

The by-law "Air Pollution Caused by Heating" published in 2005 and related legislation revised in 2006, deals with the use of high quality fuels and environmentally compatible combustion systems.

Additionally, the by law, "Air Pollution caused by Industry" published in 2004, stipulates the necessity of industrial plants, and especially power plants, to obtain an "emission permit". The same by-law also specifies the limited and controlled use of the application of F gases.

The cost of investments aimed at environmental protection is the biggest share of Turkey's harmonisation period expenses. The cost, within the scope of harmonisation with the EU is necessary for the improvement of the environment and covering industry, agriculture and urban infrastructure.

The Ministry of Energy and Natural Resources, the Ministry of Agriculture and Rural Affairs, the Ministry of Industry and Trade and the Ministry of Transport and are responsible for environmental issues in their administrative sectors. In addition, the Ministry for Foreign Affairs and the Ministry of Finance are important parties in environmental mitigation.

An inter-ministerial Coordination Board on Climate Change (CBCC) was established in 2004. It includes selected NGOs and TOBB for the preparation of national communications and developing climate change policies. Under the CBCC there are eight thematic Working Groups (WG) entitled with their scopes. The MoEF is fully responsible for preparing Climate Change National policies together with the CBCC. (See Chapter 2)

Improving Air Quality

In Turkey, especially during winter, air pollution makes itself felt due to intensive urbanisation, rapid population increase, industrialisation, and the poor location of cities according to topographic and meteorological conditions. The main reasons for pollution in winter that originates from heating is the utilisation of low grade fuel that is not subject to improvement processing, the application of inappropriate burning techniques and the lack of maintenance of furnaces that are used.

However, with the use of natural gas and other higher grade fuels in heating, there has been some reduction in air pollution in big cities compared to the 1990s. The legislative work related to air quality for the first time was carried out within the scope of the By-law on Air Quality Control promulgated on 2.11.1986 and 19269 numbered Official Gazette.

In addition to this, the following By-laws have been issued by the Ministry of Environment and Forestry. By-laws on Control of Air Pollution Arising from Heating published on 13.01.2005 dated and 25699 numbered Official Gazette, By-law on Industrial Air Pollution Control published on 07.10.2004 dated and 25606 numbered Official Gazette, By-law on The Control of Air Pollution Arising from Motor Vehicles In Traffic published on 08.07.2005 dated and 25869 numbered Official Gazette, By-Law on the Quality of Petrol and Diesel Fuels published on 11 June 2004 dated and 25489 numbered Official Gazette, By-Law on Control of Air Pollution from Industrial Plants 22 July 2006 dated and 26236 numbered Official Gazette; and furthermore the air quality related provisions of By-law on Air Quality Control are still effective. [19][20][21]

The main subjects where responsibilities lie with respect to air pollution are the Air Quality Framework Directive and its related directives, the Fuel Quality Directive and Climate Change and Directive for Consumer Awareness. With the purpose of harmonising EC legislation on air quality to a framework legislation, a Project named "Support to Turkey in the field of Air Quality, Chemicals and Waste Management" was started in 2004 and revised 2006, with the first component of this Project, which is Air Quality, it is aimed at reflecting the contents of the EC Framework Air Quality Directive on our National Air Quality Act and to the activities for measuring air quality, along with the reflection of the provisions of The Directive of Large Combustion Plants on our domestic legislation. New draft regulations were prepared for limiting emissions arising from The Large Combustion Plants and to ensure air quality and these were submitted for the approval of related institutions.

The Draft By-law on Air Quality Assessment and Management was prepared so that it covers four related directives (99/30/EC, 2000/69/EC, 2002/3/EC and 2004/107/EC) other than 96/62/EC numbered Air Quality Framework Directive. The new draft by-law sets the implementation calendar for implementation and harmonisation for 13 pollutants that are defined under the framework directive and in the related directives. The by-law also aims to strengthen the monitoring, sanctioning and institutionalisation in the area of controlling pollution and air quality.

The Integrated Pollution Prevention and Control Directive (IPPC 96/61/EC), Large Combustion Plants Directive (LCP-2001/80/EC), Council Directive on the Limitation of Emissions of Volatile Organic Compounds Due To the Use of Organic Solvents in Certain Activities and Installations (1999/13/EC), the Petrol Vapour Recovery Directive (1994/63/EC), the Directive on The Control of Major Accident Hazards Involving Dangerous Substances (SEVESO II-96/82/EC), the Eco Labelling by-law (1980/2000), and the By-law on EU Eco-Management and Audit Scheme (EMAS) (761/2001), are included in the scope of Industrial Pollution Control. Among these, studies related to the Integrated Pollution Prevention and Control Directive (IPPC 96/61/EC) and Large Combustion Plants Directive (LCP-2001/80/EC) have been started.

The Large Combustion Facilities Directive (LCP-2001/80/EC), imposes limits on dust, sulphur dioxide and nitric oxide emissions from combustion facilities with a thermal input of 50 MW or greater, without any regard to the type of fuel (solid, liquid or gas) being used. A draft by-law has been prepared oriented towards the harmonisation of this directive with internal legislation and this has been submitted to related establishments and institutions to gauge their opinions. The formation of an implementation strategy together with the draft by-law is envisaged by the end of 2006.
The project, "Strengthening the Implementation of Council Decision 97/101/EC on Ambient Air Quality Assessment, Management and Mutual Exchange of Information" (as part of Air Quality Directive 96/62/EC) at the Refik Saydam Hygiene Centre, of the Ministry of Health, was launched in 2003 in bilateral cooperation with the government of the Netherlands's MATRA Program.

In addition, the Chemicals and Waste Management Project, which was submitted to the 2003 Financial Cooperation Program for strengthening administrative capacity as well as adjusting to and implementing the Air Quality Directive 96/62/EC, will be studied within the scope of the Support to Turkey in the Field of Air Quality.

Regarding Fluorine Containing Gasses (HFC's, PFC's and SF6's), which are one of the GHGs, a control mechanism shall be prepared to eliminate uncertainties in emission inventories, necessary precautions shall be taken to stop leaks of these substances in industries using them, research shall be conducted for economic substitutes for these materials, and economic ones shall be applied and a necessary substructure shall be formed to avid their use in new plants.

On making amendments to 09.08.1983 dated and 2872 numbered Environment Law at 26.04.2006 dated and 5491 numbered Law, methods about the determination, monitoring and measurement of air quality and air quality limit values and measures taken to prevent limit exceeding, to boost public awareness and access to information and related jobs are realised by the MoEF.

Table 4.1 Environmental Policies and Measures on GHG Abatement

Policy / Measure	Objective	Type	GHG	Implementation status	Implementing entity
Air Quality Control	Emission control	By- Law	CO_2 NOx	1986	MoEF
Control of Air Pollution Arising from Heating	Emission reduction	By-Law	CO_2	13.01.2005	MoEF
Industrial Air Pollution Control Revised (Control of Air Pollution from Industrial Plant)	Emission reduction	By-Law	CO_2	07.10.2004 22.07 2006	MoEF
Large Combustion Plants Directive (LCP-2001/80/EC)	Emission reduction	Directive	CO_2	Under preparation	MoEF, MENR
Air Quality Framework Directive 96/62/EC	Health and Emission control	Directive		Under preparation	MoEF
Integrated Pollution Prevention and Control Directive (IPPC 96/61/EC)	Emission control	Directive	CO_2	Under preparation	MoEF
Council Directive 1999/31/EC on the landfill of waste		By Law	CH_4	Under preparation	MoEF
Control of Air Pollution Arising from Motor Vehicles	Emission reduction	By-Law	CO_2	08.07.2005	MoEF
Quality of Petrol and Diesel Fuels Directive	Emission reduction	By-Law	CO_2	11.06 2004	MoEF, EMRA
Directive 1999/94/EC Labelling on fuel economy and CO_2 emissions in respect of the marketing of new passenger cars	Emission reduction	New Legislation	CO_2 NOx	2007-2008	MoIT
HFC's, PFC's and SF6's	Emission control	Keeping under control			MoEF, Undersecretary of the Customs
Capacity Development for Air Quality, Chemicals and Waste Management	Capacity building	Policy		2004-2006	MoEF MoH

Waste Management

Waste is controlled under regulations on Control of Solid Wastes, Control of Medical Wastes, and Hazardous Waste Control Management. The responsible authorities for solid waste management in Turkey are the MoEF, MoIT, Interior Affairs, Public Works and Settlement, municipalities, chambers of trade and industry and the Turkish Standards Institute.

Although current Turkish legislation is, to a large extent, harmonised with relevant EU legislation, studies have been initiated to prepare draft regulations and proposals for amendments in order to fully complete alignment with EU directives. Turkey's major problems related to waste management are the elimination of hazardous waste from industry, and the combination of industrial and domestic waste, specific waste and construction waste without separate collection. However, within the framework of regulations prepared by the MoEF, urban areas in particular, have initiated integrated solid waste collection systems. [20][21]

In Turkey, the most common method of disposing of solid waste is to store them in an uncontrolled manner wherever suitable. Only 30% of domestic waste is being stored under controlled conditions. Systems of controlled storage, composting, incineration and recycling are not common. Lack of awareness on the part of the public and local administrations regarding recycling of industrial and domestic waste, results in the loss of an economically important resource of substantial value.

Nature Protection

As for nature protection, an amendment to the implementing regulation on the implementation of the CITES Convention has been adopted. Although revisions are being made to the Law on Environment, Law on National Parks and Law on Land Hunting in order to eliminate gaps and weaknesses in the current legislation, it is considered necessary bring in a new law adopting the Habitat and Birds Directives for the purpose of enhancing protection of nature and biodiversity. A strategy has been prepared to protect biodiversity with a project financed by the Global Environmental Facility (GEF) Funds.

The Ministry of Culture and Tourism monitors the protection and management of natural preservation sites designated as such in accordance with the Act Governing Preservation of Cultural and Natural Resources. For example, 750 different Natural Preservation Sites have been hitherto registered and are under the protection of the Ministry of Culture and Tourism.

Fauna and Flora

Turkey ratified the Biosecurity (Cartagena) Protocol of the Convention of Biological Diversity and planned to establish a National Biosecurity Board by 2005.

Using GEF aid for the project on "in situ Conservation of Genetic Biodiversity", an Action Plan has been prepared for in-situ Conservation of Plant Genetic Diversity and "Protected Areas and Sustainable Resource Management in Turkey".

To solve the drought and/or desertification problem through international efforts and get an international boost for forestation, Turkey acceded the Convention to Combat Desertification in 1998.

Turkey is listed in the Appendix on Regional Implementation of the Northern Mediterranean, and in line with this Convention, the Pastures Law was enacted in 1998.

The National Plan of Action of Turkey to Combat Desertification and Drought was approved on 9 th March 2005 and promulgated in the official gazette number 25750. In addition, Turkey participated in the Pan-European Process on Protection of Forests and ensured national coordination of the Strasbourg, Helsinki, and Lisbon decisions.

Regional Seas

Turkey is a peninsula surrounded by three seas; namely, the Black Sea, Mediterranean and the Aegean Sea. Due to land-based pollution and international maritime transport, pollution of regional seas is a major concern.

21 coastal countries and the European Union, currently implement the Action Plan for the Protection of the Marine Environment and Sustainable Development of the Coastal Region of the Mediterranean. Turkey has been an active participant in this Plan since its inception.

The first international treaty ratified by Turkey dealing with marine pollution through transportation is the OECD Convention. Subsequently, in 1990, Turkey ratified the International Convention for the Prevention of Pollution from Ships (MARPOL).

Municipal Level

The political decision-making system was not widely decentralised, local authorities have been making some decisions on matters that affect GHG emissions, such as traffic and land use planning and waste management until recent legislation. With recent legislation, a larger environmental role is assigned to municipal councils and metropolitan municipal councils acting within municipal boundaries.

One of the main missions of local governments is to reduce CO_2 emissions by promoting public transport and buildings with adequate insulation.

Role of NGOs, Industry and Other Interest Groups

Environmental protection activities having been intensified over the last decade and have led to the establishment of many national and regional environmental non-governmental organisations (NGOs) in Turkey. Environmental NGOs, especially the Society for the Protection of Nature (DHKD), The Turkish Foundation for Combating Soil Erosion for Reforestation and Protection of Natural Habitats (TEMA), Greenpeace, the World Wide Fund for Nature (WWF) and The Turkish Marine Environment Protection Association (TURMEPA) are actively involved in climate-related issues. TOBB participates and cooperates actively in climate change programmes.

4.2 Energy Policies and Measures in Turkey

The main objective of Turkey's energy policy is to ensure a sufficient and reliable energy supply at competitive prices, taking into account environmental concerns in order to support economic and social development as in the other developed countries, with a special focus on promoting steady, sustainable development in the country. In parallel to this objective, Turkish energy policy is focused on the following issues: [2][11]

- Ensuring energy supply security and reliability.
- Keeping the supply of energy resources high flexible to enable expedient, continuous and effective exploration, development and appraisal of Turkey's petroleum resources in accordance with national interests.
- Reducing supply risks caused by increasing imports. (Encouraging the use of domestic energy resources is a high priority on the government's agenda.)
- Giving priority to diversification in import sources both in terms of type of energy and its origin.
- Prioritising energy security activities to cope with increasing demand and import dependency.
- Reforming and liberalising the energy sector to increase productivity and efficiency and to enhance transparency.
- Taking into account the level of investment and environmental concerns in all stages of the energy chain within the framework of sustainable development, increasing energy efficiency and decreasing energy intensity.
- Promoting R&D activities on energy technologies for optimum utilisation of indigenous resources, energy sources and encouraging domestic production.
- Pursuing the functional role of an "Energy Corridor" at every stage of transmitting rich energy resources of petroleum, natural gas and liquid natural gas (LNG) from the East to European and world markets. Facilitating projects for transportation of hydrocarbons from East to Western Europe in the context of the "East-West Energy Corridor" concept.
- Assigning due consideration to preventing environmental damage and pollution in the national environmental policy for pursuing sustainable development.

In achieving these objectives, the fundamental strategy is to encourage private/foreign investment, regional business partnerships and integration.

In addition to these policies, objectives in the electricity sector areas are as follows:

- Diversification of primary energy resources.
- Use of domestic energy resources by increasing the share of renewable energy resources in electricity generation.
- Creating a liberal and competitive electricity market in line with EU directives.

- Creating a good investment environment for new generation capacity as well as transmission and distribution networks.
- Creating an environmentally friendly power system
- Developing regional interconnections and participating in regional markets.
- Increasing efficiency in electricity generation and consumption.
- Decreasing the cost and end-user price of electricity.

4.2.1 Market Reform

The government has launched a market liberalisation and privatisation process to generate the following benefits:

- Reducing costs by efficient operation of electricity generation and distribution systems.
- Increasing supply quality and reliability and ensuring security of supply.
- Reducing technical and non-technical losses in the distribution sub-sector to the same level in OECD member countries.
- Ensuring that rehabilitation and expansion investments are performed by the private sector without creating liabilities on the public institutions.
- Transferring to consumers the benefits obtained through increased competition, cost reductions and regulation of service quality.

4.3 Implemented - Adopted - Planned measures

4.3.1 Energy Sector

Turkey has been attempting to minimise energy-related greenhouse gas emissions through measures aimed at:

- Improving energy efficiency and encouraging conservation measures.
- Increasing the share of renewable energy sources in its energy supply.
- Allowing for fuel switching from high carbon to low carbon fuels and implementing measures for emission reductions.

The government has focused its efforts on improvements in domestic production by utilising public, private and foreign sources to initiate new investment on reasonable accounts. In order to expand the potential in a cost effective way, studies are being conducted on a periodic basis to assess the potential of hydropower, one of the largest domestic resources of the country together with domestic lignite.

Turkey is currently consuming 22 bcm of natural gas. Forecasts [1] to the year 2020 point out that the average growth rate of gas consumption will be around 6% annually. The natural gas transmission and distribution infrastructure in Turkey is being extended rapidly and its transmission network is composed of 6,000 km of high-pressure transmission lines. The total length of the transmission network is expected to reach about 10,000 km by the time the pipelines are completed in a few years time. It is predicted that 80% of the population will have access to natural gas by the end of 2006, underlining the necessity of infrastructural investment. The widespread use of natural gas has significantly contributed to the reduction in air pollution generated by residential heating and increased public awareness of the issue of clean air.

The nuclear option has been considered within future alternative energy resources to reduce risks relating to security of supply due to the dominance of imported fuels and to ensure diversity in power generation. According to the WOM scenario, the total installed capacity of nuclear power plants is expected to be 4,500-5,000 MW by the end of the 2020. Turkey has interconnections with most of neighbouring countries and she has been actively pursuing synchronisation of its network with the European Union's grid for the Co-ordination of Transmission of Electricity (UCTE). The main challenges are improving frequency control and operation and maintenance performance. TEIAS is planning to invest 275 million YTL in 2006 for improvement of transmission efficiency. This investment includes 369 projects.

The new Electricity Market Law No. 4628, which is in full compliance with EU Electricity Directives, lays down provisions for the establishment of competitive, stable and transparent markets in the electricity sector. For securing the energy supply and diversifying energy resources, optimum use of domestic resources (coal and hydro) and expanded use of alternative and renewable energy sources have been given due priority. The Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electricity ('Law on RES'), No: 5346 has been published in the Official Gazette: 18 May 2005, no. 25819 [2][11].

Petroleum Market Law No 5015 states that, refineries and distributors operating in the petroleum market, could blend bio-fuel, which are provided from bio-fuel producers using domestic agricultural products with diesel, at a proportion of 2%. Blending ratio and 'Special Consumption Tax' of blended product shall be determined by the Ministry of Finance. Bio-fuel producers may get distribution and sale licenses to sell and distribute bio-diesel, which is produced by using domestic agricultural products, with the commitment of selling a projected 30,000 tons minimum of bio-diesel annually.

The Draft Energy Efficiency Law is envisaged to be enacted in the fourth quarter of 2006. Adoption and enactment of (energy) legislation shall be performed by the parliament.

Improvements in Conventional Power Generation Systems

In lignite power plants, due to the high sulphur content of domestic lignite, SO2 emissions exceed the limit specified in Turkish legislation and so construction of Flue Gas Desulphurization (FGD) Plants is required. Within this framework, retrofitted FGD plants have been constructed in existing power plants (Cayirhan I-II, Kemerköy, Orhaneli, Yatagan, Yenikoy). However, it has not been possible to retrofit all the old thermal power stations in a short period, due to the high cost of FGD plants. On the other hand, for new lignite power plants planned after the promulgation of related Regulation (1986), the installation of FGD plants has been considered during the planning phase and contracted together with the power plant (Afsin-Elbistan B, Cayirhan III-IV, Kangal III).

Due to the high ash content of domestic lignite, the control of particulate emissions is also very important. Concerning particulate emissions, almost all of coal-fired power plants are equipped with electrostatic precipitators (ESP) operating at high efficiency. For recently constructed or planned power plants, efficiencies are reaching over 99.9%. In some old power stations the efficiencies of ESPs are not satisfactory. Therefore, rehabilitation studies have been carried out in such power plants to improve efficiency (Catalagzi, Kangal I-II, Orhaneli, Seyitomer, Soma I-IV).

Afsin-Elbistan-A Power Plant (1,355 MWe) utilising domestic lignite, plays an important role in power generation in Turkey. However, there has been a loss/decrease in capacity and reliability of the plant due to wear and tear and some big failures have occurred and as a result, the plant's efficiency is lower than the design efficiency. Therefore, the project on the "Rehabilitation of Afşin-Elbistan Thermal Power Plant" will be carried out for the prevention of generation losses and improvement of plant efficiency and reliability by modernisation of some parts and replacement of worn or non-functional parts. The rehabilitation of the electrostatic precipitators (ESPs) of the plant will also be included in the project to achieve the limit value of PM (100 mg/Nm^3), as stipulated in Turkish legislation. The project will be financed by credit provided by the World Bank (280 million euros). The credit agreement was signed on 12.09.2006.

The subject Rehabilitation Project will lead to an improvement in the environmental performance of the plant, since emissions, including CO2 emissions and other discharges per unit of electricity generated, will decrease as a consequence of the increase in the plant.

The main action on power generation includes the reduction of distribution losses by replacement of the normal loss distribution transformers and by making efficiency improvements in the existing lignite-fired power stations through technical enhancement of boilers, turbines, lignite mills and cooling towers.

Combined Heat and Power (CHP)

Electricity Market Law No 4628 regulates the electricity market, including the auto-producers and auto-producer groups, most of which are cogeneration plants. Auto-producer and auto-producer groups generate electricity for their own needs and operate in parallel to the transmission and/or distribution system. Auto-producer groups supply electricity to their shareholders.

Auto-producers can sell up to 20% of the electricity generated. EMRA has the right to determine and to increase this ratio by 50%.

There is a considerable amount of auto-producer capacity in the Turkish Power System. Some auto-producer plants are cogeneration. Cogeneration plants produce heat and electricity at the same time. Due to the large industrial share in total electricity consumption, these cogeneration plants have an important role in the power sector.

According to statistics, total cogeneration installed capacity was 3,608 MW at the end of 2005 which corresponds to 9.8%

of total installed capacity of the Turkish power system Fig.4.1 At present, 61.4% of all cogeneration units are natural gas-fired, and it is therefore assumed that all new cogeneration units will be based on natural gas-fired combustion turbines. According to MENR's estimates, it is expected that new cogeneration facilities will be added to the power system and this new addition will be 8.2% of total electricity generated until the end of the year 2020. So the share of cogeneration will reach 12.2% of total electricity generated, and all new cogeneration capacity will be natural gas fired. [1]

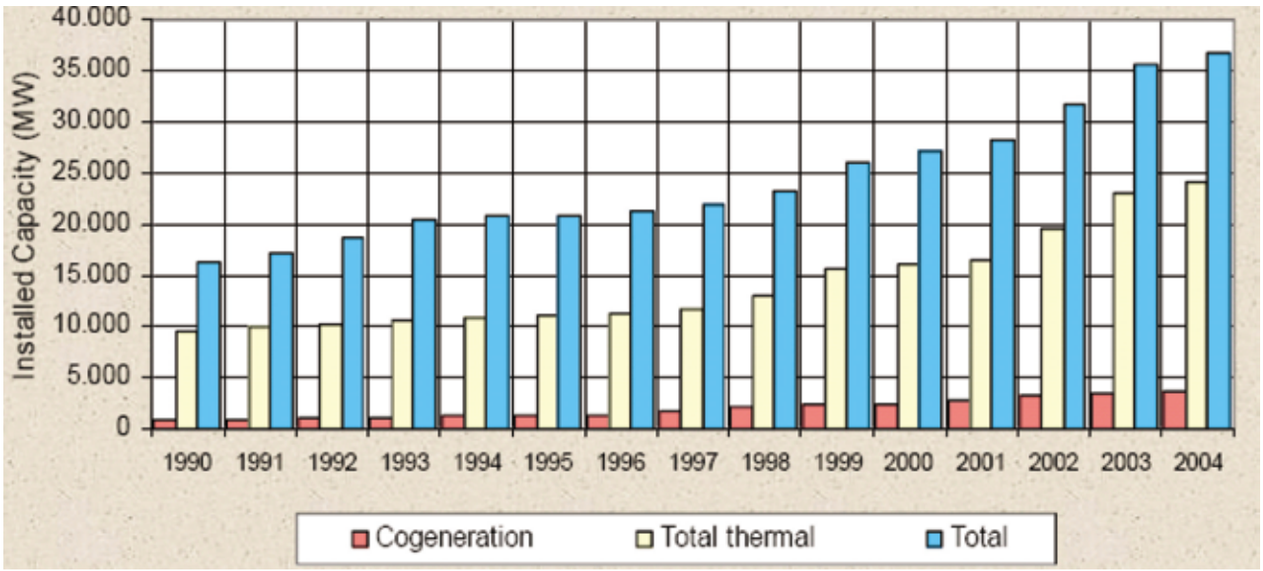

Fig 4.1 Development Of Cogeneration Installed Capacity
Source: TEIAS

Promotion of Renewable Energy Sources

MENR considers the exploitation of renewable energy sources among its energy policy priorities. Electricity generated from renewable energy sources, were the main policy instruments for the promotion of RES.

- Renewable energy production is 12.3% of Total Primary Energy Supply 10.8 Mtoe in 2004.
- Electricity generation from renewables was 31% in 2004.
- Renewables are the second largest contributor to domestic production after coal.
- Renewable energy in Turkey is dominated by hydropower and biomass.
- The contribution of wind and solar is limited but is expected to increase.

The Main Support Mechanism of RES Implementation

- The price for RES certified electricity within each calendar year shall be the average wholesale electricity price of the previous year, as determined by EMRA.
- This price is valid for electricity produced from Renewable Power Plants that start up before 2011 and for the first seven years of operation.
- The Council of Ministers may raise this price by up to 20% at the beginning of each year.
- Renewable Power Plants which start before 2011 shall benefit from this price in the first seven years.
- After the first seven years, the price shall be determined through bilateral agreements in the market, and the purchase obligation of retail sale companies will continue.
- Support is given by 50% reduction for land use permission.
- The regulation provides incentives for RES generation facilities, which are:
- Paying only 1% of the total licensing fee.
- Exemption from annual license fees for the first eight years following the facility completion date.
- Permission to purchase electricity from private sector wholesale companies on the condition not to exceed the annual average generation amounts.

Hydropower

Economically usable hydropower potential is given in Table 4.2, and is estimated at 130,000 GWh per annum, 35% of which has been exploited and 3,197 MW is under construction. It is projected that 36,698 MW will be reached in hydropower utilisation in the future.

Table 4.2 Hydro Electric Power Generation Present and Potential

Hydro Power Electric Generation Status	Number Of Power Stations	Total Installed Capacity MW	Proven Production	Total Annual Production
Present Hydro Power Plants		**MW**	**(GWh/Year)**	**(GWh/Year)**
In Production> 10 MW	74	193	287	722
In Production 10 < MW	68	12,595	33,273	45,208
Under construction > 10 MW	8	45	151	228
Under construction 10 < MW	32	3,152	6,207	10,290
Present Total	**182**	**15,985**	**39,918**	**56,448**
Future Possible Potential				
>5MW	164	366	571	1,848
5 -10 MW	82	610	897	2,587
10 - 50 MW	187	4,727	9,234	18,959
50-100MW	51	3,692	7,734	13,001
100 - 250 MW	37	5,815	11,824	19,308
250 - 500 MW	10	3,250	5,620	10,688
500 - 1000 MW	2	1,053	2,054	3,173
1000 < MW	1	1,200	2,459	3,833
Future Total	**534**	**20,713**	**40,393**	**73,398**
TOTAL	**716**	**36,698**	**80,311**	**129,846**

Source: DSI, 2006

The General Directorate of State Hydraulic Works (DSI) has been assigned as reference centre by EEA for rivers, lakes, ground water qualities and water capacies and is actively participating in the following EU projects:

Project Title: Strengthening the Capacity for Sustainable Groundwater Management (PPAO5TR/7/8)
Financed: MATRA
Project Partners: DSI, MoEF.
Project Status: Started 01.01.2006

Project Title: Capacity Strengthening and Support of Implementation in order to Meet Quality Criteria of Surface Water Intended for the Abstraction of Drinking Water
Financed: MATRA
Project Partners: DSI, MoEF.
Project Status: Under evaluation.

Project Title: Harmonisation of EU Directive 91/676/EC, To Prevent and Reduce Agricultural Originated Nitrate Pollution in Soil and Water.
Financed: MATRA
Project Partners: DSI, MARA.
Project Status: Started in 2004

During EU accession studies, the DSI has also actively participated in the "Agriculture and rural development "and "Environment and Energy" projects.

Geothermal Energy

Turkey, being located on the Alpine-Himalayan geothermal belt, one of the most important geothermal belts in the world, is among the countries rich in geothermal potential.

According to a resource assessment undertaken by the Mineral Research and Exploration Directorate (MTA) (Erisen et al., 1996), geothermal resources in Turkey are mostly of moderate and low temperature. The main uses of geothermal energy in Turkey are direct use applications such as space heating, domestic hot water supply, greenhouse heating, swimming pools and balneology, industrial processes, heat pumps and electricity generation. Out of 171 geothermal areas in Turkey with surface temperatures exceeding 35°C, 161 areas are suitable for central and greenhouse heating whereas the remaining 10 are suitable for electric power production. Areas suitable for electric power production are given in Table 4.3.

A study of the present geothermal fields reveals that as many as 42% of these fields are suitable for domestic heating. In Turkey, 90 fields with temperatures over 50°C have been discovered. 56 of these fields have been bored. Table 4.4 below shows the areas in Turkey heated by geothermal energy. The MoEF has also financially supported some of the projects.

A project for heating 3700 residents by geothermal energy has financially supported by MoEF.

Geothermal energy also offers technically feasible possibilities for the development of different agricultural production sectors in Turkey. Private investors and government institutions are evaluating the extent to which geothermal energy resources can be expanded in a cost effective manner.

Table 4.3 Geothermal Sites and Potentials in Turkey.

Geothermal Site	Temperature °C	Potential MW
Denizli-Kızıldere	240	34,00
Aydın-Germencik	230	51,00
Manisa-Gobeklii	182	0.6
anakkale-Tuzla	174	1,10
Aydın-Salavatlı	171	7,20
Kutahya-Simav	162	3,50
Izmir-Seferihisar	153	0.2
Manisa-Caferbey	150	0.04
Aydın-Yılmazkoy	142	0.5
Izmir-Dikili	130	0.01
Total		98.2

Source: MTA, 2006

Table 4.4 Geothermal Community Heating Applications

Location	Number of Housing Heated	Implementation	Water Temp. °C
9 Eylül Uni. Campus-Izmir	2500	1983	115-60
Gonen	3400	1987	80
Simav	4500	1991	137
Kırsehir	1800	1994	57
Kızılcahamam	2500	1995	80
Balcova	15000	1996	137
Afyon	4500	1996	95
Kozakli	1200	1996	90
Narlıdere	1500	1998	125
Sandıkl	3200/5000	1998	70
Diyadin	400	1999	70
Salihli	3000/24000	2002	94
Saraykoy	1500/5000	2002	140
Edremit	1300/7500	2003	60
Bigadic	500/3000	2005	96

Source: MTA, 2006

Wind

A wind atlas was prepared to outline wind potential throughout the country. Studies are in progress in evaluating the extent to which wind power resources can be expanded in a cost effective manner. Due to the high cost of investment and connection to the grid, wind power utilisation is limited.

Technically and economically viable wind potential is approximately 88,000 MW and more than 10,000 MW respectively. Total installed capacity has reached 50.1 MW, about 1,500 MW is licensed and applications of 2,500 MW have been made to get a licence.

Solar

Solar energy also could provide significant amount of power for Turkey, given the country's suitability in terms of solar radiation. Currently, solar power is used mainly for domestic hot water production.

4.3.2 Energy Efficiency

Turkey attaches great importance to energy efficiency potential in meeting its goal of satisfying demands without hampering economic growth and with a special focus on protecting the environment. An Energy Efficiency Strategy was developed and adopted in 2004 [11]. An assessment of the needs for improving energy efficiency has been a basic condition for developing a national energy efficiency strategy. The main purpose of this strategy is to improve energy efficiency in the final energy consumption sectors in Turkey. In order to achieve this objective, it is envisaged in the strategy to support the government, administrations and municipalities, to provide technical/financial assistance to final consumers and industrial establishments as well as enhancing the existing institutional structure and legislative environment. Following the adaptation of this strategy, it has been decided to start a Twining Project in cooperation with the EIE, ADEME from France and SENTERNOVEM from Netherlands. The studies under the Twinning Project on Improving Energy Efficiency of Turkey have been performing since 2005 in order to strength the current legislative and institutional structure and to assess the energy conservation potential and modelling of Turkey.

The main responsible organisations for energy efficiency policies and activities are the MENR and the General Directorate of Electrical Power Resources Survey and Development Administration (EIE). The MENR is responsible for the formulation of policies and supervision of their implementation within the context of national energy policies, while EIE is responsible for the implementation and coordination of energy efficiency programmes. The EIE has been carrying out training, energy auditing, drafting of legislation and public awareness (see chapter 9) and promotional activities for enhancing energy efficiency in all end-use sectors. Moreover, the EIE has been conducting energy efficiency projects in Turkey in cooperation with international organisations such as the WB, EU and JICA. [4]

Two sub-committees have been established, namely "EE in the Electricity Sector" and "EE in the National Energy Sector", under the administration of the "General Energy Ad-Hoc Committee" to prepare the Eighth Five-Year Development Plan. Policy formulation, coordination and supervision of activities on energy conservation and efficiency are pursued by the MENR within the framework of national energy policies and strategies. The Energy Conservation Coordination Board (ECCB), under the auspices of EIE, is responsible for encouraging public awareness. Energy conservation and efficiency studies in end-use sectors, which indirectly contribute to environmental protection via efficient use of energy resources, are carried out by the EIE.

Improving energy efficiency in the main end-use sectors, promoting rational use of energy and optimum utilisation of domestic resources, constitute the central components of the national energy policy. Accordingly, the main mission of the EIE is to promote the rational use of energy and to improve energy efficiency on the demand side, in the context of concerted/integrated collaboration mechanisms with related institutions. The Department of Energy Resources under the administration of the EIE is involved in developing renewable energy resources [4].

The General Directorate of Electrical Power Resources Survey and Development Administration (EIE) is responsible not only for energy efficiency and development of alternative and renewable energy sources, but also for such activities as the preparation of survey projects for national water resources, determination of water resources suitable for electricity generation, and preparation of technical and feasibility reports and related projects for dams and hydroelectric power plants.

With the collaboration of the empowered institutions, the General Directorate of Electrical Power Resources Survey and Development Administration (EİE) is to prepare and publicise an inventory that depicts the development of energy efficiency in industrial enterprises and buildings on a regional and sectoral basis countrywide and future projections of such data, as well as annual reports based on its own findings and evaluations concerning the public sector, according to the Draft EE Law. In this manner, an Energy Efficiency Portal establishing studies is being continued.

Purpose of an energy efficiency strategy

- Generating guidelines for stakeholders in the government for implementing an energy efficiency strategy in an integrated manner through concerted and targeted activities.
- Ensuring effective participation of relevant governmental institutions for integrated/concerted cooperation in the implementation of the strategy.
- Analysis and recommendation of measures as basic tools for the design of targeted/integrated energy efficiency projects and national energy efficiency programmes, as well as for motivating interested donors.
- Defining the time schedule and financial resources for the implementation of proposed action.

Expected Results of EE

The measures are expected to generate the following results:

- Ensuring that EE targets and concerted actions are included in national energy plans by determining the energy saving potential in end-use sectors.
- Providing technical and financial support on harmonisation with EU acquis.
- Establishing a platform for exchange of views and decisions on energy efficiency aspects at legislative and executive levels.
- Adopting the energy efficiency strategy to motivate donors from international institutions and the IFI, while demonstrating political willingness in project implementation.
- Based on the strategy, establishing integrated and concerted cooperation among related institutions as well as public-private cooperation for developing innovative energy efficient projects, which can receive financing or co-financing from related EU instruments/programmes.
- Providing with this strategy, the analysis and basis in developing targeted and integrated projects in line with the overall energy efficiency policy.

Further development and implementation of the strategy shall be managed by related institutions of the Turkish government. The main driving force shall be the EIE under the administration of MENR for the six main areas of focus of the energy efficiency strategy for Turkey.

- Assistance in the development and implementation of the government's energy efficiency strategy
- Assistance in setting up institutional arrangements for implementation of the strategy.
- Promoting energy efficiency in buildings.
- Promoting energy efficiency in industrial sector
- Promoting energy efficiency in municipalities
- Promoting energy efficiency in transport

The essential tool for achieving these objectives is to strengthen existing government institutions, particularly the EIE, and empowering administrative arrangements by providing effective know-how/financial assistance from relevant EU institutions and other international donors.

The MENR shall be responsible for the approval and implementation of legislation/regulations on EE matters within its own functional responsibility, rather than for the entire EE legislation in all end use sectors. The same approach shall also prevail for other related ministries and/or government organisations (MoIT, MRR, MOT, SIS, TSI, etc.). The Draft Energy Efficiency Law should be passed in the fourth quarter of 2006. Adoption and enactment of (energy) legislation shall be performed by the Parliament subsequent to its approval by the Council of Ministers.

Fig. 4.4 Provides an overview of the development and implementation of the Energy Efficiency Strategy in Turkey over time with an indication of interim tasks, projects and milestones.

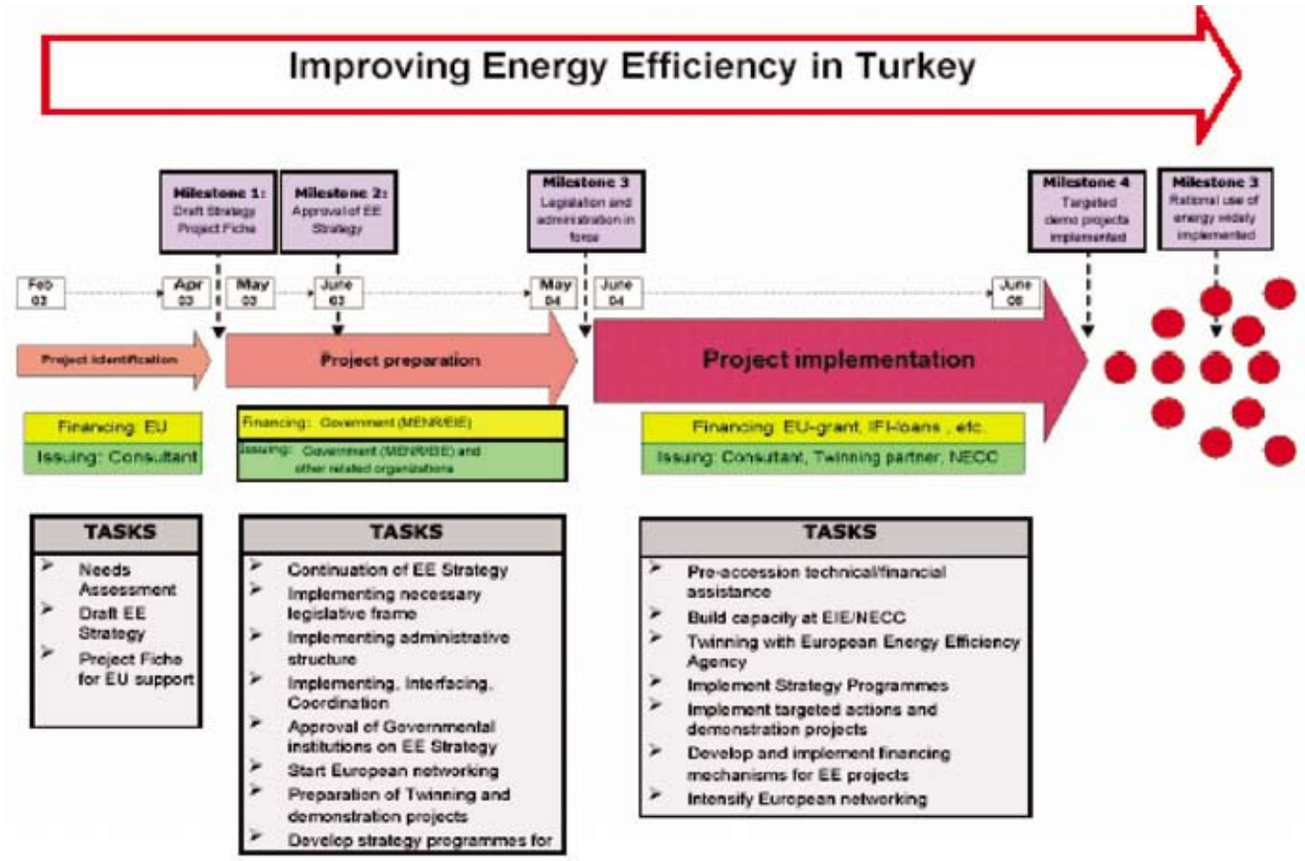

Fig. 4.4 Energy Efficiency Strategy in Turkey (EE strategy paper 2004)[11]

The National Program, which constitutes the official road map of the government in assuming its short, and medium term obligations and responsibilities within the framework of Accession Partnership has been prepared and approved by Parliament. The major policies and measures effecting GHG Abatement in the energy sector are listed in Table 4.5.

Table 4.5 Major Policies and Measures Affecting GHG Emissions in the Energy Sector

Policy or Measure	Objective	GHG	Type of instrument	Status	Implementing entity
Promotion of Wide Use of Natural gas	Emission reduction	CO_2	Policy	2001	MENR
Natural Gas Substitution Policy in Industry	Emission Reduction	CO_2	Policy	2001	MENR
Rehabilitation of Existing Coal Fired Power Plants	Emission Reduction	CO_2	Policy	1998	MENR
Construction of a New Nuclear Power Unit	To overcome the Increased demand of electricity and to decrease import dependence on fossil fuels	CO_2	Regulatory, economic	2015	MENR
Energy Conservation Programme	Reduced energy consumption	CO_2	Technical, regulatory, economic,	1992	MoIT, MENR
Labelling Household Appliances	Energy efficiency	CO^2	Regulatory, economic	2002	MoIIT, MENR
Labelling Project-GEF	Project Proposal	CO^2	Efficiency	2006	EIE-UNDP
Building Insulation Regulations	EIE is in charge	CO^2	Regulatory, economic	2000	MENR
Building Cod Project-GEF	Project Proposal	CO_2	Efficiency	2006	EIE-UNDP

Energy Audits	Energy efficiency	CO_2	Efficiency	1998	EIE
Building Insulation Regulations	Energy efficiency	CO_2	Regulatory	2000	EIE
SME Strategy and Action Plan (Decree No. 2000/1822)	Productivity	CO_2	Policy	2004	MoIT, MENR
Market Liberalization Privatisation Law No: 4046 (Amended by Law 5496)	Efficient production, emission reduction	CO_2	Economy	2002 2004	EMRA
Natural Gas Market Law. 4646 Privatisation of gas	Better Service	CO_2	Economy	2001,	EMRA
Law on RES No: 5346 Promoting Renewable Energy Sources	Reduced GHG emissions	CO_2	Policy	2005	MoIT, MENR

Labelling of Appliances

MoIT has recently issued a number of regulations on energy efficiency labelling standards for refrigerators (March 2002), electric ovens (February 2003), washing machines, dryers, dishwashers and electric lamps (August 2002). The GEF Project Proposal is prepared and is being submitted for labelling by the EIE and UNDP. The Turkish Standards Institute (TSE) has functional responsibility for the certification of products and processes in compliance with international norms. Energy efficiency aspects are handled in the Standard Preparation Group on Mechanical and Electrical Equipment.

Industrial Sector

The MENR issued a regulation in November 1995 on "the measures to be taken to increase energy efficiency in industrial establishments", which requires industrial establishments with annual energy consumption of 2,000 tons of oil equivalent or more to set up an energy management system in their plants. The EIE is authorised to supervise implementation of this regulation [4][11].

MoIT is responsible for supervising implementation of the regulation on thermal performance of boilers, which was issued by MoIT in 1990. The MoIT is also responsible for preparing and issuing energy labelling standards.

The Under Secretariat of the Treasury, in cooperation with the MoIT, has been implementing a financial incentive programme for the enhancement of small and medium-sized enterprises (SME). Soft loan credits are provided for investments to increase production efficiency in SME's. Conceptually, energy-saving investments are also eligible under this facility. It is aimed to develop defence, aviation and machine manufacturing as well as chemicals and electronics industries, by giving priority to the use of high technology in industry and increasing the competitiveness of traditional industries. In production industry, R&D shall be supported, particularly in the fields of information and communication, development of new products and technologies, environmental protection, development of small and medium sized industries, and investments in the reduction of inter-regional differences in development.

New policies and strategies shall be developed to promote clustering of industries in Organized Industrial areas, Industrial Zones and Industry Sites.

In deciding on industrial policies, priority shall be given to environmentally friendly technologies and local producers shall be informed and encouraged. Preparations shall be made to make environmental impact assessments more effective.

Most parts of the EU acquis in the area of energy efficiency have already been transposed into national legislation (EU directives on energy labelling of refrigerators, lighting sources, washing machines, dishwashers, driers and their combinations, ovens as well as displaying the noise indicators associated with these appliances) or have been scheduled for implementation in Turkey within the framework of short and medium term objectives of the National Program.

Energy Conservation Promotion Studies

In order to increase energy efficiency in industrial sectors, an Energy Conservation Regulation was issued in 1995. Accordingly, factories consuming energy over 2000 toe are obliged to appoint an Energy Manager in their plants.

Under the Energy Bus Program, the EIE has been carrying out energy conservation audits in industrial sectors since 1990. On the basis of the results achieved from audits, it would be fair to say that approximately 40% of existing energy conservation potential could be exploited in Turkish industry through basic operating and low investment measures.

The ECCB primarily coordinates the government's energy conservation awareness campaigns that include an annual Energy Week in the second week of January, publicity material, contests for school children, TV spot films etc. During Energy Efficiency Week, activities are organised in cooperation with the EIE and a two-day conference on energy conservation of the sectors is held. Additionally, a contest of energy conservation projects implemented in their plants has been organised among industrial establishments since 2002.

Building Sector

The Obligatory Standard Notice on Rules of Heating Insulation at Buildings - TS 825 is promulgated in the Official Journal (numbered 2375, dated June 14, 1999). The harmonization activities of Directive for Energy Performance in Buildings and Rules of Heating Insulation at Buildings - TSE 825 has been under implementation In June 2000, implementation of these standards became mandatory. This regulation was revised by the MRR in June 2000 by introducing new insulation conditions for new buildings in conformity with the TS 825 standard.

According to the "Thermal Insulation Regulation" for new buildings, location of the building and architectural details, heating insulation records prepared according to regional values are evaluated and the maximum energy amount needed for the building is limited in order to control the convenient insulation system. On the basis of preliminary assessments, heat loss is expected to be reduced to 100-150 kWh/m2, and effective implementation of this regulation could yield nearly a 50% reduction in the current level of heat loss from buildings. The new law regulates the procedure and functional responsibilities of municipalities in supervising the application of existing insulation standards.

Action that shall be taken is as follows: The Ministry Of Public Works and Housing is working in collaboration with the EIE in enforcing Commission Directive 2002/91/EC of the Council of Europe regarding energy performance of buildings issued on 16th December 2002; establishing service companies for energy efficiency; formulating a mechanism for promoting energy efficiency; increasing the impact of municipalities in enforcing standards for existing buildings and constructions; organising Work Groups and projects to discuss the benefits of energy management in public buildings and developing public financing mechanisms with the aim of constructing energy management systems. Natural gas is preferred for heating system of public buildings, wherever a natural gas supply is available and the distribution system of the settlement is convenient. Coal is the second preference, and fuel oil is only used if the air pollution rate is high. Another important activity of The Ministry Of Public Works and Housing is ongoing revised draft version of Turkish Coastal Law (law no 3621).

Within the German-Turkish Technical Cooperation Program, a project entitled "Support to Improving Energy Efficiency in Buildings in Erzurum" was initiated by GTZ and the EIE in November 2002. The project comprises the following main components:

- Development of an energy management facility in Erzurum Municipality.
- Improvement of secondary legislation in the building sector for increasing energy efficiency

Capacity building in technical, legal and methodological issues to implement energy management in Erzurum Municipality and the EIE.

It is planned to initiate two new projects. The "EU Increasing Public Awareness on Energy Efficiency in Buildings" project will be launched in 2007. The "UNDP/GEF S&L-EUCC Project-Capacity-Building Program for the Removal of Barriers to the Cost-Effective Development and Implementation of Energy Efficiency Standards and Labelling in EU Candidate Countries Project" will be launched in 2007 by the GEF Local point of Candidate Countries (Romania, Turkey, Croatia and Bulgaria). The EIE has also launched the "Certified Energy Managers Program" in 2006, to establish energy management concepts in buildings.

In addition, various seminars addressing targeted groups (students, candidate teachers and government staff etc.) are organised at this building.

Moreover, the Ministry Of Public Works and Housing is working on the revision of Coastal Settlement Law 3194.

Environment sector

Within the MoEF there are departments related to the energy sector responsible for emission controls and environmental impact assessment. The respective General Directorates (DG) undertakes environmental protection and control of air pollution and carry out environmental impact assessments and planning.

Harmonising existing environmental legislation with the EU acquis lies within the activities of the MoEF. At present, the screening process has been completed in more than 60% of Turkish environmental legislation for the purpose of harmonising with the EU. The Environmental Impact Assessment Regulation (EIA), which was put into effect on February 7, 1993, has been successfully implemented. The EIA was subject to revision in June 2002 for complying with EU legislation. The provisions of the EIA Regulation have been implemented since 1993 in the planning stage of the MoEF, within the framework of the Regulation on Air Quality. Since 1992, the MoEF has been carrying out, through its provincial directorates, measurement of emissions from vehicles at appropriate measuring stations in cooperation provincial governors. The General Directorate for Highways, in consultation with the Ministry of Industry and Trade, has recently made adjustments on emission limits from vehicles so as to determine that emission limits are in compliance with EU standards.

Emission control from stationary energy conversion systems (ovens, boilers, power plants) is coordinated by the respective DG in cooperation with the concerned authorities, which are municipalities - concerning the emission control of boilers in residential areas and administrative buildings, the Ministry of Industry and Trade - concerning emission control from industrial plants, the Ministry of Energy and Natural Resources - concerning emission control in power plants, the Ministry of Education - concerning emission control from buildings within the education sector and Ministry of Health - concerning emission control from buildings within the health sector (hospitals, etc.).

The MoEF is represented in the Energy Conservation Coordination Board (ECCB) and is also giving support to TUBITAK-funded climate change R&D projects aimed at emission reduction.

International Assistance and Donations to the Turkish Energy Sector

All international aid to Turkey is co-ordinated through the SPO. In the case of loan agreements, contracts between donors and the SPO are counter-signed by the Under Secretariat of Treasury. Requests for external donor assistance by Turkish applicants have to be made to the SPO in line with specified procedures. Technical assistance projects supported by EU in the energy efficiency sectors are given in Table 4.6 and technical assistance projects in the energy efficiency sector are given in Table 4.7

Table 4.6 EU Supported Technical Assistance Projects in the Energy Efficiency Sector

Donor / country	Implementation agency	Project and activities	Type of assistance/ elements	Implementation period/ completion
EU	5th Framework Program on RTD (5 FP RTD)	SOL-MED Project:	Widening the Use of European Solar Thermal Technologies in Mediterranean Countries Following the Successful Model of Greece. PART B: Italy, France, Bulgaria, Romania Turkey	2002
EU	5 FP RTD	SME-TC Project	BIO- Promotion of EU Biomass Technology in Agro-industry of High-potential Third Countries	2001

EU	EMRA	Assistance to Energy Market Regulatory Authority	Proposals and design of a program for EU funding aiming at strengthening the administrative capacity of the EMRA and any other relevant public institutions / entities in the sector, which would ultimately support the creation of a properly functioning internal energy market in Turkey	2002
EU	Thermie-Program action	BOO/BOT Options for the Turkish Energy Sector	Technical assistance, consultancy,	1997/98
EU	Thermie-Program action	Energy Technology Cooperation EU-Turkey Coordination Centre for Turkey	Making available information on THERMIE Projects to target groups and disseminating information, in order to analyse the Turkish market for European energy technologies	1996-98

Table 4.7 Technical Assistance Projects in the Energy Efficiency Sector

Donor/ country	Implementation agency	Project and activities	Type of assistance	Implementation period/ Status
Germany	GTZ	Support to energy efficiency in buildings in the Erzurum Municipality	Capacity building at EIE, energy managers training, demonstration projects	2002 - 2005,
Germany	KfW	Environmental improvement investments in small and medium sized enterprises (SME)	Loan facility, can also be used for RUE investments in SMEs	2003,
Japan	JICA	Energy conservation in industry	Capacity building at EIE, analysis, Energy managers training, Policy making and promotional activities, demonstration projects; providing donations for establishing of the energy conservation demonstration factory	2000 - 2005,
World-Bank	EIE, MENR, State Hydraulic Works (DSI)	Increase utilisation of renewable energy sources and preparation of renewable energy legislation	Loan facility with a series of small projects; PIU at EIE	2003, ongoing
EU6	TAIEX	Aligning the Turkish legislation with EU acquis	Capacity building, services, analysis	2002, ongoing
EU	Administrative Cooperation Program	EE Strategy, needs assessment, project fiche for twinning of energy agencies	Consultancy services (present project)	2003-2004
EU	MENR, EIE	Harmonisation of Turkish legislation with the EU acquis	Capacity building, twinning	2004

EU	MENR MEDA program action	Technical assistance within the framework of the MEDA regulation program -Reform of the legal and institutional energy sector framework Network	Diagnostic studies of the legal, regulatory and institutional framework, environmental aspects and reform needs in the energy sector (electricity, oil and gas) Organisation of regional training events, workshops and conferences	2001 - 2004
EU	Financing Memorandum 2005	Increase public awareness of energy efficiency in buildings	Technical assistance, supply, consultancy, co- financing	2007-2008
UNDP/GEF	EIE, MoIT,	Capacity-Building Programme for the Removal of Barriers to the Cost-Effective Development and Implementation of Energy Efficiency Standards and Labelling (Increase public awareness, support verification and enforcement, capacity building of actors in the household appliances sector)	Co-financing	2007-2010

4.3.3 R&D Studies and Related Projects

Turkish science and technology shall be given momentum by taking steps including the construction of the national information infrastructure needed for the 21st Century and the telematic services network, promoting R&D activities, especially in flexible manufacturing and flexible automation technologies for innovation in the Turkish manufacturing industry, upgrading the existing railway system on the basis of "High-Speed Train Technologies", developing the aviation industry, and R&D on the basis of selected aviation products, as well as in areas which reflect climate change awareness and environmental protection such as environmentally sound technologies, for effective use of energy and environmentally friendly "Renewable Energy Technologies" in nationwide applications and in Advanced Materials and related industries.

The "National Energy Technologies Research Program" started jointly by the MENR, MoEF, EIE, TTGV and TUBITAK was completed in 2002. The resulting report contains a 10-year National Operation Program.

There are a number of studies, which may play an important role in renewable energy sources in Turkey. Some of these studies are the World Bank Report on Energy, Environmental Issues and Alternatives, the Report of the Work Group for the Energy Technologies Policy (TUBITAK/TTGV, 1998), the National Environmental Operation Plan activities of the "New and Renewable Energies Research Unit" of the Kocaeli University and the Energy Department of Marmara University, the work of the EIE General Management on Solar and Wind Energy and the Joint Work of the EIE and SAS for the Construction of the Wind Atlas of Turkey. [4] [10]

Within the scope of the World Bank-supported "Energy and Environment Project of Turkey", a scenario study has been made by the Turkish Electricity Corporation (TEAS), under MENR.

There are several research projects at university level. One of these studies is that of Kocaeli and Marmara Universities on Renewable Energy resources.

NGOs are supporting the national solar cell project, particularly the Sarigerme Solar cell project (Uyar 2001), which was initiated in 2000 and will be supplying information to set up the national strategy.

The TUBITAK-financed "Project on Monitoring of Parameters Effecting the Power Quality and Power Transmission, Evaluation and Realization of Counter Measures" is an important ongoing GHG mitigation project (see Chapter 7).

The “Eastern Anatolian Water Basin Rehabilitation Project” is an example of a projects not related to energy. The World Bank-supported project, which ended in 2001, was aimed at promoting pasture and forest formation in small basins by mitigating soil erosion and increasing fertility.

New Technology and Mitigation Projects of TUBITAK MAM Energy Institute

It is the TUBITAK-MAM Research Centre (Research Institutes: Information Technologies, Energy, Chemistry and Food, Environment, Materials, Earth and Marine Science) that is in charge of implementing the Technology Foresight Project in coordination with related institutions and establishments. The following list of projects in Table 4.8 have been completed by the Energy Institute of TUBITAK MAM [17].

Table 4.8 New Technology and Mitigation Projects of Tubitak Marmara Research Centre Energy Institute Executed In the Last Six Years

Title of project	Description of project	Amount	Date(s)	Client
CEPA 16.11 MOLTEN CARBONATE FUEL CELLS NAVAL GENERATOR	The RTP 16.11 project has started in the year 2000 with contribution of 2 countries under CEPA, and 16 West European Armaments Group (WEAG). The aim of the project is to construct a 0.5 MW-powered electricity generation system prototype and to do a feasibility study on a 3-5 MW powered generation system, based on molten carbonate fuel cell technology, using NATO F76 diesel fuel, having sulphur removal and fuel processing systems and also to do a feasibility study on a 3-5 MW powered MCFC system.	1,000,000 €	2002-2006	Turkish Ministry of Defence
DESIRE-CEPARTP 16.08diesel fuel processing for fuel CELL	The aim of the project is to develop diesel fuel processing systems and to apply a fuel cell application for surface and submerged platforms in future. Fuel cells are the systems that convert chemical energy in fuel to electrical energy with high efficiency, low emissions, low noise-vibration, low IR signature, modularity, low maintenance and easy operating conditions. It is expected that these technologies will be part of future technologies.	575,000 €	2001-2004	Turkish Ministry of Defence
IRMATECH- Integrated Research on Materials, TECHnologies and processes to enhance mcfc in a sustainable development	IRMATECH is a European Union 5. Framework Programme Energy, Environment and Sustainable Development Thematic Area project. The main aim of the project is to solve the problems and limitations of MCFC technology, which is at the stage of commercialisation.	0	2002-2006	EC 5. FP
MOCAMI	The main objective of this project is to develop and demonstrate a small-sized hybrid system with a combination of Molten Carbonate Fuel Cells (MCFC) technology and Micro Gas Turbines (MT). The development of such a small-sized system will lower production costs through the implementation of new and simpler processes (innovative on-site stack conditioning) with better quality control (development of a remote control system) and a higher yield for the different components.	0	2002-2005	EC 5. FP
Innovative Cost-Effective Hybrid System Based on Integration of a MCFC and a Gas Turbine for High Efficiency Dispersed CHP Generator				

HYDEPARK	The main goal of this project, number 5042130 and named "HyDePark" for short, is to research hydrogen technologies and renewable energy applications, which take place in work packages. The management of all work packages is carried out by the leadership of TUBiTAK MRC and with the support of collaborating organisations.	800,000 €	2005-2008	SPO (State Planning Organization)
	It is planned to design and assemble reactor systems with the required sub-units for hydrogen production, to provide PV, wind turbine and electrolyser with the required sub-units for hydrogen production by using renewable energy sources and then to integrate these systems with PEM fuel cell systems, which will be provided, to obtain energy by using hydrogen as a fuel, which is generated.			
HY-PROSTORE	The strategic objective of the proposed project is to improve the research capacity of the Centre on Hydrogen Technologies [herein referred to as the "Centre" at TUBITAK MRC Energy Institute (El)]. Specifically, the centre aspires to improve its research capacity in the areas of hydrogen production, purification, and storage.	650,000 €	2005-2008	EC 6. FP
BIGPOWER	Improving of the S&T research capacity of TUBITAK MRC El in the fields of "Integrated Biomass Gasification with Power Technologies" has successfully evaluated and just passed the negotiation process with the EC in 2005. The main goal is to improve the scientific research capacity of the national research centre (here it is TUBITAK MRC) and to create an Excellency Centre.	670,000 €	2005-2008	EC 6. FP
MC-WAP	The MC-WAP Research Project is aimed at the application of Molten Carbonate Fuel Cells technology onboard large vessels, such as Ro-Pax, Ro-Ro and Cruise ships for auxiliary power generation purposes. In order to fulfil its main targets, the project will be constituted by intensive research and experimental activities, in order to improve the performance of these energy generation systems to allow efficient application of them on board. The improvement in the performance of MC Fuel Cells and of their components, to allow an efficient, reliable and safe use of them onboard ships	1,000,000 €	2005-2010	EC 6. FP
EU-DEEP	A group of eight leading European energy utilities have joined forces to remove, in five years from January 2004, most of the technical and non-technical barriers which prevent a massive deployment of distributed energy resources (DER) in Europe.	15,000,000 €	2004-2009	EC 6. FP
NATURALHY, Preparing for the hydrogen economy by using the existing natural gas system as a catalyst	The NaturalHy Project is one of eighteen projects funded by EU at the first call of 6.1.2 Thematic Priority Area under the Sixth Framework Programme. The aim of NaturalHy is to test all the critical components of a hydrogen system by adding hydrogen to natural gas in existing networks.	250,000 €	2004-2009	EC 6. FP

Development of Fuel Cell Technologies for Clean Energy Production	The main objective of the project is to bring the knowledge of fuel cell technology to Turkey and to develop innovative products for transport and stationary applications, to increase energy efficiency.	300,000 €		Private Industrial Consortium
Surface run-off treatment for Mogan Lake in Turkey	Surface run-off generated from the watershed of lake Mogan are being treated by constructed wetlands within the content of this ongoing project. The effluent of the constructed wetlands designed will be used to feed Mogan lake.	30,000 US$		Turkish Ministry of Environment and Forestry

Source: TUBITAK 2006

International Centre for Hydrogen Energy Technologies (UNIDO ICHET)

As of October 2003, an agreement has been signed between UNIDO and the MENR to establish the "International Centre for Hydrogen Energy Technologies" (ICHET) in Istanbul. The immediate objective of the ICHET is to respond to demands from developing countries for energy services by promoting hydrogen energy technologies, which are economically, technically and environmentally appropriate. The ICHET will become an applied technology bridge between the demonstration and commercialisation of hydrogen technologies in spanning the gap between research and development organisations, innovative enterprises and the market place to stimulate appropriate applications of hydrogen energy technologies and hydrogen energy-related industrial development throughout the world, and in developing countries in particular.

A hydrogen road map of Turkey has been prepared by UNIDO-ICHET together with other interested parties such as the Turkish Ministry of Energy, universities and other research institutes. When preparing the hydrogen road map of a specific country it is necessary to take into account the facts and resources of that specific country and refer to the ideas of various organisations working in the energy field. (See chapters 7 and 8)

The hydrogen road map for Turkey has been prepared for a period from 2010 to 2035. Figs 4.2-4.3.

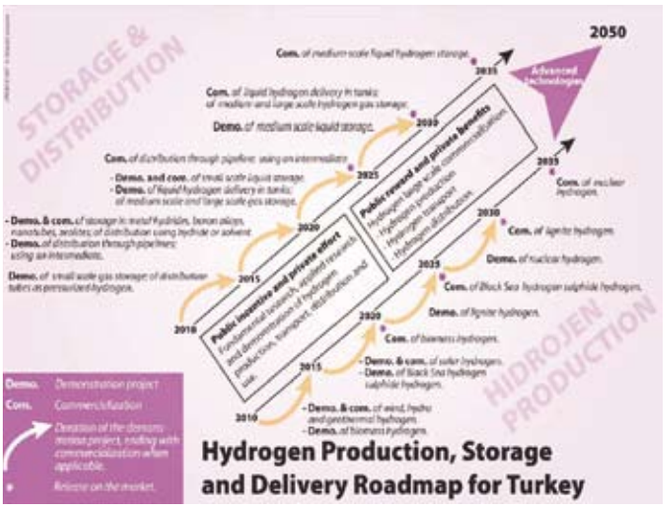

Fig 4.2 Hydrogen Road Map for Turkey

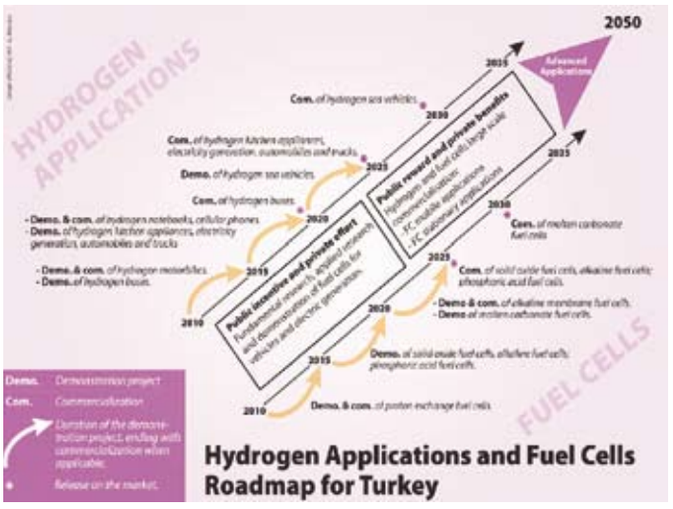

Fig 4.3 Hydrogen Production and Storage Road Map for Turkey

4.3.4 Transport Policies

As far as restraining the growth of transport and reducing its negative environmental impacts are concerned, climate change policy becomes an integral part of transport policy. However, many transport policy decisions aimed at the reduction of greenhouse gas emissions are taken primarily for reasons other than climate change policy. Such reasons are things like improving traffic safety (limiting traffic speeds), developing vehicle and fuel taxation (fiscal targets), or EU and other international standards for vehicle emissions (reduction of exhaust emissions and improving air quality).

MoIT has published "labelling on fuel economy and CO2 emmissions in respect to the consumer information and marketing of new passenger cars" directive in Dec. 2003.

In 2003 the Ministry of Transport initiated a 2-year project aimed at developing a general master plan for the national transport sector. By realising this project, the Strategic Plan of Ministry of Transport for the Transportation Sector was also prepared in this context.

Law number 4925, covering Highway Transport was passed on 19.07.2003, and by a decision of the cabinet, the General Directorate of Land Transport was founded in 2004. The object of this directorate is to set standards for goods and people being transported and the vehicles used.

On 30.11.2005, Law number5434, which accepted Turkey's participation in the European Agreement on the land transport of dangerous materials, was passed and work on by-laws based on this law is in progress. With the reinforcement of the by-laws, rules regarding VOC emissions caused during transport and storage of land-transported petroleum shall be in force.

The General Management of Civil Aviation, which is the authority of the aviation sector, regarding important arrangements on climate, was restructured under Law 5431, dated 10. 11.2005. With this restructuring:

- Macroeconomic political guidelines for the transport sector will be developed.
- Future modes of transport will be assessed and methods for their achievement will be recommended.
- Regulations, laws and standards for energy use and emissions will be developed.
- Inter-ministerial cooperation and coordination will be improved.

Motivating alternative modes of transport for passenger and freight transportation, i.e. for decreasing the dominant share of road transport for intra-city transport, has been assigned as a priority area in the 8th Five Year Development Plan and annual implementation programmes prepared by the State Planning Organization. The present taxation regime favours less cylinder volume/lower fuel consuming passenger cars.

A considerable amount of tax reduction (nearly 25%) is applied on the rate of Special Consumption Tax for the purpose of replacing old (20 years or more) cars with new ones. Within this context, modifications to the urban infrastructure have started and work has begun in cities such as Ankara, Istanbul, Bursa, Konya, Denizli, Gaziantep, Trabzon, Mersin, Kayseri, Eskisehir and Samsun for building environmentally friendly rail transport systems.

As regards road transport, Turkey became a contracting party to the European agreement on the work of personnel of vehicles engaged in international road haulage (AETR). In 2001, Turkey signed the INTERBUS Agreement on the International Occasional Carriage of Passengers by Coach and Bus. It is recommended to adopt an action plan, within a clear time frame, for transposing the road transport acquis into Turkish legislation. The road transport law adopted in 2003 provides a general framework for both national and international road transport market activities.

One of the primary objectives of Turkish transport policy is to restructure the railways. An ambitious Rail Transport Action Plan has been adopted for the restructuring the railway sector by 2008, setting out a road map for legislative alignment with the revised railways acquis. Particular attention will also be given to rapid modernisation of the railway infrastructure to be realised in harmony with the structural, technical norms and policies of the EU. In order to ensure the utmost use of the present railway network, the emphasis will be on investments for improving and modernising the infrastructure. In this context, within the planning period, rehabilitation of existing tracks of 1,800 km, and completing signalling works of 180 km and electrification works of 160 km are envisaged.

DLH Mitigation Involvement

Development of the Bosphorous Tunnel Railway Passage (Marmaray) Fig 4.5 of 76 km is of crucial importance for improving passenger transport traffic within Istanbul, as well as ensuring uninterrupted railway transport between Europe and Asia. This rail route will be the most important part of the shortest rail connection between Europe and Asia starting from Bulgaria to Georgia, which will enable an uninterrupted passage through the Bosphorus for this East-West railway corridor. The Marmaray Project is planned by DLH and construction work started in 2004. An agreement has been concluded with the Japanese Credit Institute for financing and the project has been started.

The Marmaray Rail Tube Tunnel will also be a challenge for Istanbul traffic. This will ease the ever increasing problems related to car traffic congestion and air pollution. The expected Project Cost is $2.913 billion. The capacity of system will be 10-12 times higher than the capacity of one of the existing bridges.

Fig. 4.5 Marmaray project http://www.marmaray.com.tr/

Total passenger km saved, daily saved vehicle traffic expressed as km-vehicle, km-passenger and passenger are given in tables 4.9 through 4.11

Table 4.9 Total Passenger Km. Saved [23]

Year	Passengers	Passenger-km
Total	39,816,683	596,697,765
Annual average	**1,592,667**	**23,867,911**
2009	1,079,560	15,005,884
2014	1,428,285	21,351,192
2030	1,862,390	28,12,091

Table 4.10 Daily Saved Vehicle Traffic Expressed as km-vehicle, km-passenger and passenger [23]

Year	Number of Passengers	Passenger-km	Vehicle-km
2009	97,777	1,759,986	977,770
2014	99,317	1,787,700	993,167
2030	131,079	2,424,966	1,347,203
Total	2,733,857	50,280,710	23,014,084
Average	**109,354**	**2,011,228**	**920,563**

Table 4.11 Total Decrease of Emissions, Caused by Decrease of Car, Autobus, Minibus, Bus and Ferryboat Traffic.

Emission	Total		
	Daily average (Tons/day)	Yearly average (Tons/day)	25 Year Total (Tons)
NMHC	8.5	2,740	68,504
CO	49	15,815	395,372
NO_x	18	5,897	147,430
1	2.2	705	17,614
PM	1.7	550	13,760
CO_2	327.0	104,628	2,615,701

It is estimated that the reduction of green houses gases in the form of NOx, NMHC, CO and CO2 as a consequence of the Marmaray Project will be 130,335 tons/year [23].

In view of these, work has been started towards transportation systems with links to other inter-modal transportation and aims to reduce energy consumption to that which is required for land transport and consequently project preparation for the international transportation line, the East-West railway corridor has been begun.

Bearing in mind the fact that Turkey is a transit country with regard to regional/international transportation on the East-West and North-South axes, within the 8th planning period, it is aimed to improve, modernise and increase the capacity of national ports within the framework of the Nationwide Port Development Master Plan which is prepared by the DLH with the collaboration of the JICA in August 2000. In this context, ports are planned to be restructured using such criteria as dimension, administration style and service approach so as to constitute a focal point within the world transportation network. Maritime legislation will be harmonised with international legislation. Importance is assigned to signing bilateral agreements with EU countries as well as with other countries in order to reduce operational costs of the Turkish Maritime Merchant Fleet and to create new working areas.

In order to strengthen Maritime Transportation Safety, an ambitious five-year plan, namely the Maritime Transport Action Plan was adopted in December 2003. One of the primary objectives of Turkish transport policy is to promote maritime transport. In the context of free market structure in Turkey, the maritime sector is one of the most liberalised sectors, with limitations only from the perspective of national security.

The law defining the structure and duties of the Turkish Civil Aviation Directorate was restructured in 2005 to develop Turkish Civil Aviation and under Law number 5431, the Turkish Civil Aviation Directorate was given autonomy. The Turkish aviation sector is undergoing privatisation. In the medium-term, secondary legislation regarding air transport, prepared to align fully with EU legislation, will be completed to a great extent.

In Turkey, inter-modal transport plays an insignificant role in the domestic transport system. Provided that the rail infrastructure and services are sufficiently developed, Turkey seems ideally suited for the development of inter-modal transport. Turkey does not have any special legislation related to combined transport systems.

Turkey is also participating in the TRACECA (Transport Corridor Europe-Caucasus-Asia) project, and the route of the corridor through Turkey has been defined.

In accordance with the above mentioned country policies, project preparation is planned to start in 2005-2006 by the DLH for the Halkalı-Bulgaria, Ankara-Sivas, Sivas-Erzurum, Erzurum-Kars and Kars-Tibilisi railway lines, which are other important links in the East-West corridor. Within this context, construction of the Ankara-Istanbul fast train line has been started by Turkish Railways'. General Management. (TCDD) In Turkey, the building of a trans-European network is fully consistent with the transport policy of the EU White Paper, since Turkey is strategically positioned as a bridge between continents, and between geographical, economic and political regions and countries. Connecting the Black Sea countries to the Mediterranean, linking Europe to the Middle East and landlocked Central Asian and Caucasian nations, Turkey is likely to become a very important transit country in the future. In fact, development of the Turkish transport sector will be crucial for the economic development of the entire region.

In particular, development of Euro-Asian links is important to Turkey and the EU. The Pan-European Transport Corridors IV and X already extend to Istanbul. Accession to the EU will strengthen ties with Europe and lead to a substantial increase in the flow of passengers and goods. As regards the Trans-European Transport Networks, preparations for a Transport Infrastructure Needs Assessment (TINA) study for Turkey are currently being undertaken using TEN–T guidelines. Turkey is participating in the EUROMED Transport Project, which will establish transport infrastructure needs between the EU and Mediterranean countries. The study aims at improving the quality of transport services and increasing the efficiency of transport systems in the region.

In Turkey, urban transportation has long been formed by a road-based policy focusing on providing more road capacity to accommodate the rapidly increasing number of motor vehicles, especially in large conurbations.

Several ministries and agencies are responsible for transport infrastructure matters and there is a great need for improved co-ordination. The Ministry of Transport plays a key role in the road transport sector. However, responsibilities relating to

implementation of road transport and traffic legislation are scattered over more than 10 other ministries and authorities having a role in implementation of the road transport acquis. This makes proper planning and coordination of activities difficult. Mechanisms for establishing more effective coordination among the ministries and streamlined decision making should be developed.

Municipalities- Activities in Urban Transport

i) Istanbul Metropolitan Municipality,

The total number of vehicles within the boundaries of the Istanbul Metropolitan Municipality is 1,000,000, out of which 2,377 are public transport vehicles from the Istanbul Electricity Streetcar Trolleybus General Directorate (IETT). IETT has taken the following measures to reduce exhaust emissions.

The "Green Bus Project" was initiated in 1993 for fuelling 100% of buses with natural gas. In this context, the number of buses with natural gas engines has reached 100. Efforts continue to increase this number to 236.
Privatisation and decreasing dead miles save fuel by shifting parking lots to central positions. EURO 2 and EURO 3 standards are accepted as basic criteria when purchasing new buses. Currently there are 550 buses complying with EURO 2 and EURO 3 standards.

The "Smart Station Project" and the "Bus Surveillance Project" both have the objective of providing passengers with detailed information about time schedules and routes of IETT buses in order to promote the use of public transport. By coordination, passenger intensity will be evenly distributed and real time traffic circulation reports will be registered. Currently there is a 42 km railway system (underground, light rail train and tram), 8km of which is the subway with a total daily capacity of 120,000 passengers. In the next decade, 250km of additional railway will be integrated into the current system, increasing passenger capacity to 2.5 million per day. Istanbul Ulasim A. S. estimated that 30,000 passenger cars/day would be removed from traffic by introducing an efficient subway system. Istanbul municipality began a public awareness campaign in March 2006 to promote mass transport. The slogan: "World is your home, take care of it ".

In Istanbul, ITS, or "Intelligent Transportation Systems" are operational. By manipulating traffic lights at junctions, traffic congestion and emissions are reduced.

Since 2001, Istanbul Municipality has converted its traffic signal system to LED (Light Emitting Diodes). To date, 4,000 signals have been converted in this way.

ii) Ankara Metropolitan Municipality

The 8,725-metre long Ankaray Light Rail Train Project (Ankaray) of the Electricity Gas Bus General Directorate (EGO) of Ankara Metropolitan Municipality was initiated in 1996 to raise awareness in public transport and to achieve fuel conservation. The total capacity is 340,000 passengers per day, with an achieved capacity of 175,000 passengers per day in 2002. An additional 9km line was completed in 2005.

The entire length of the subway is 14.6km with a daily capacity of 500,000 passengers. Efforts are under way to add a further 15km of lines to the current capacity. There are 1,240 buses operated by the municipality, 267 of which fulfil the EURO 2 standard.

iii) Izmir Metropolitan Municipality

Bus-boat-subway systems are being integrated. The subway system is 11.6km long, with a capacity of 90,000 passengers per day. A 79km national railway will be upgraded with improvement of infrastructure so that it will become suitable for high standard passenger transport. Tracks will be transferred from the Railway Company to the Metropolitan Municipality.

Izmir Metropolitan Municipality owns 1,400 buses. The total capacity of the fleet together with buses operated by the private sector is 1,000,000 passengers per day. 345 buses meet the EURO 2 standard.
Transport Abatement Measures and Research for Mitigation are outlined in Table 4.12.

Table 4.12 Major Transport Abatement Measures and Research for Mitigation in Turkey

Policy Name	Type	Energy used	GHG	Status
Transportation Master Plan is prepared	Policy Processes			2005
Vehicles using unleaded gasoline equipped with Catalytic converters	Policy Processes	Fossil Fuels	CO_2	2001
Taxicabs using LPG (liquid petroleum gas) Law No 5307	Fiscal	Fossil Fuels	CO_2	2005
Dieselisation is rising trend in Turkey Law no 5015	Fiscal	Fossil Fuels	CO_2	2005
New regulations regarding the quality of fuels used for heating and transportation	Regulatory Instruments	Fossil Fuels	CO_2	2005
Promotion of natural gas in public buses	Fiscal	Fossil Fuels	CO_2	Municipalities
The expansion of the urban rail transit network	Policy Processes	Fossil Fuels	CO_2	Law no 3348 Article 9-DLH
Hydrogen Bus Pilot Project	R&D	Hydrogen	CO_2	2006
Hydrogen Fuel Cell Vehicle.	R&D	Hydrogen	CO_2	2006
Fuel Cell Powered Unmanned Airplane Project.	R&D	Hydrogen	CO_2	2006
Hybrid Buses	R&D	Fossil Fuels	CO_2	2005
Solar cars	R&D	Renewables	CO_2	2005
Fuel Cell Technology in motor vehicles	R&D	Renewables	CO_2	2002-2006
Hybrid Electric Vehicle	R&D	Electricity	CO_2	2002-2006
A road transport Law adopted in 2003	Regulatory Instruments			2003
Motor Vehicle Technical Regulations of the EU.	Regulatory Instruments			1998
Turkey signed the INTERBUS Agreement on the	Regulatory Instruments			2003
Railway Organization Action Plan	Policy Processes			2003-2008
Transport Infrastructure Needs Assessment (TINA)	Policy Processes			2005
Vehicle labelling directive (1994/94/EC) shall come into force.	Regulatory Instruments	Fossil Fuels	CO_2	2008
Maritime Transport Action Plan	Policy Processes	Fossil Fuels	CO_2	2003
The Turkish aviation sector privatisation	Policy Processes			2005
Participating in the EUROMED Transport Project	Policy Processes			2001
Participating in the TRACECA	Policy Processes			2001
Road Improvement and Traffic Safety Project	R&D Project	Fossil Fuels	CO_2	1996
High gasoline taxes (compared to the world average)	Regulatory Instruments	Fossil Fuels	CO_2	Regulated by MoF
Heavy taxation of passenger cars (compared to the world average)	Regulatory Instruments	Fossil Fuels	CO_2	Regulated by MoF

Implementing Regulation on the Control and Management of End-of-Life Vehicles	Emission reduction	Legislation	CO_2 NOx	2005
Gasoline vehicles of Euro III and Euro IV levels.	Policy Processes	Fossil Fuels	CO_2	2004-2005
EURO I emission regulations are put into action	Regulatory Instruments			1994
Removing old cars from the registers 325 481	Regulatory Instruments			2003-2004
Promotion of Biofuel	Fiscal	Renewables	CO_2	2004
Ankara, İstanbul, Bursa, Eskişehir, İzmir Metro Project	Fiscal	Electricity	CO_2	1997-2006
Marmaray Railway Project (Construction Stages)	Fiscal	Electricity	CO_2	2005-2009
Ankara-İzmir Railway Project (Feasibility Study Stages)		Electricity		2005
Ankara-Sivas Railway Project (Feasibility Study Stages)		Electricity		2005
Tekirdağ-Muratli-Büyükkariştiran Railway Project (Feasibility Study Stages)		Electricity		2005-2006
Halkalı-Bulgaristan Railway Project (Feasibility Study Stages)		Electricity		2006
Sivas-Erzurum Railway Project (Feasibility Study Stages)		Electricity		2006
Kars-Tiflis Railway Project (Feasibility Study Stages)		Electricity		2006
Ankara-İstanbul Railway Project (Consruction Stages)		Electricity		2003-2007
Ankara-Konya Railway Project (Consruction Stages)		Electricity		2005-2007

Transport Mitigation Measures

LPG-fuelled passenger cars show a reduction in GHG emissions due to higher efficiency obtained and convenient fuel specifications. The contribution of vehicle categories to CO2 emissions is given in Fig. 4.6. Almost 75% of CO2 emissions are from passenger cars, trucks and buses. The clear increase in the contribution of light duty vehicles (LDV) and trucks can be seen in figure 4.7 [23].

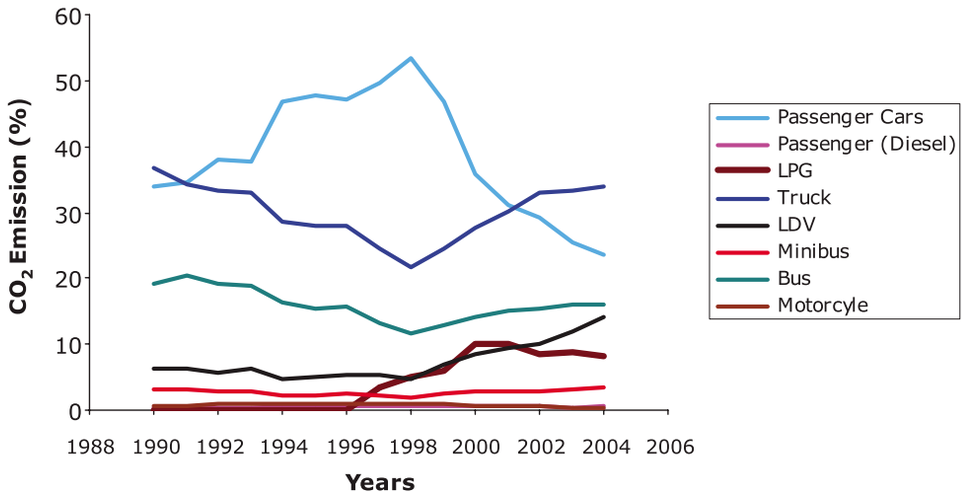

Fig. 4.6 Contribution of vehicle classes to CO2 emission

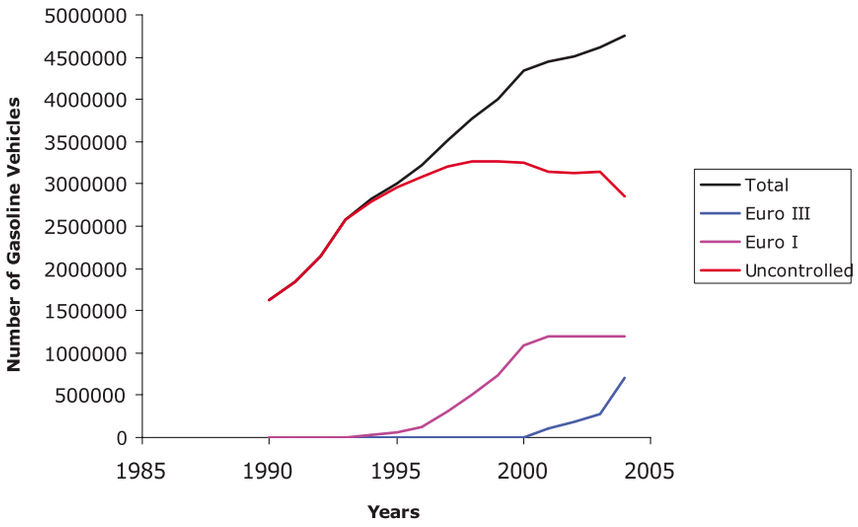

Fig.4.7 Number of gasoline vehicles in each emission class

The technological development in engines and vehicles is one of the major factors that influence GHG emissions resulting from transportation. In recent years, starting from 1994, EURO I emission regulations came into force in Turkey in order to reduce CO2, unburned HC and NOx emissions. The advanced technologies used in these vehicles also reduced fuel consumption and therefore CO2 emissions.

The increased consumption of unleaded gasoline within the total gasoline consumed in the year 2000 (38%) partly reflects the increase in the number of cars fitted with catalytic converters. In 2001, the consumption of unleaded gasoline amounted to nearly 46% of total gasoline consumption. It is forecast that inheritable amount of cars will be fitted with catalytic converters as of 2012. [5]

- As of January 2002, no regular gasoline has been sold on the market.
- As of 2000, all imported and domestically produced new cars are equipped with catalytic converters and Euro/95 standards are in place.
- Standards for maximum sulphur content in diesel oil are being tightened so as to comply with EU Regulations by the year 2007.

So it is expected that nearly 87% of Nox, 75% of CO2, 80% of CH4, 95% of NMVOC and 95% of CO emissions from gasoline vehicles be from this category. Fig. 4.8.

Removing old cars from registers will also bring a significant improvement to emissions. The number of passenger cars with uncontrolled emission technology provides a potential for gain by removal of some 2,500,000 cars still in service. Considering only vehicles that are older than 15 years, this number adds up to 1,500,000. It is therefore possible to decrease emissions by a further 20-25% by removing these vehicles from registers. Research results from the project “Abatement of Greenhouse Gases Emissions Resulted From Transport” Figs. 4.9 and 4.10 shows the change in emissions due to old car removal from the road.

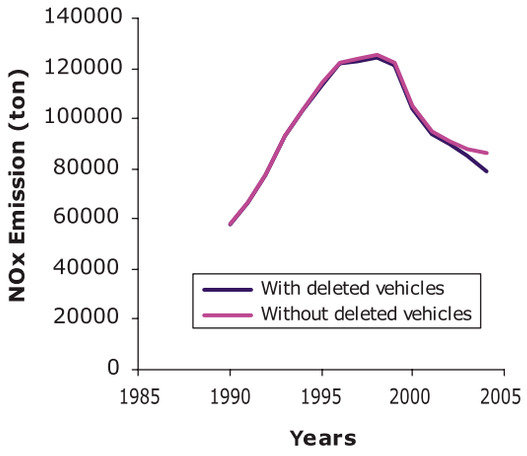

Fig. 4.8 Effect of new technology on NOx

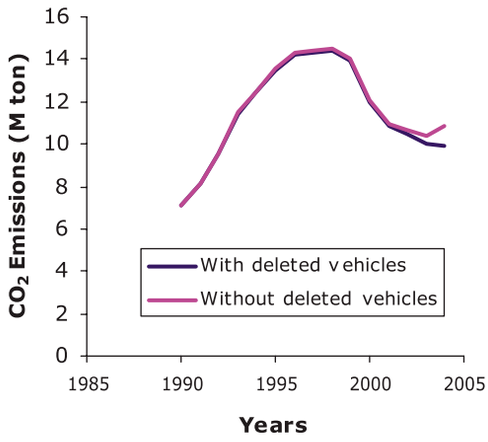

Fig.4.9 Effect of new technology on CO2

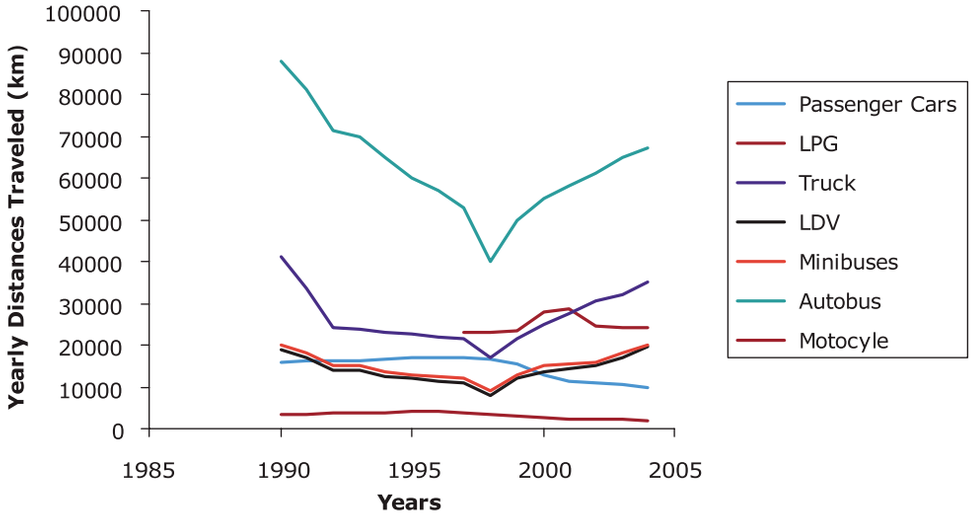

Fig. 4.10 Yearly travel distance of vehicle classes

From Fig.4.10 it can be seen that there is a rapid increase in annual distances travelled in passenger cars in recent years. Yearly travel distances in LPG cars and minibuses also increased, since the use of LPG is promoted in taxies and more minibuses are used for mass transport.

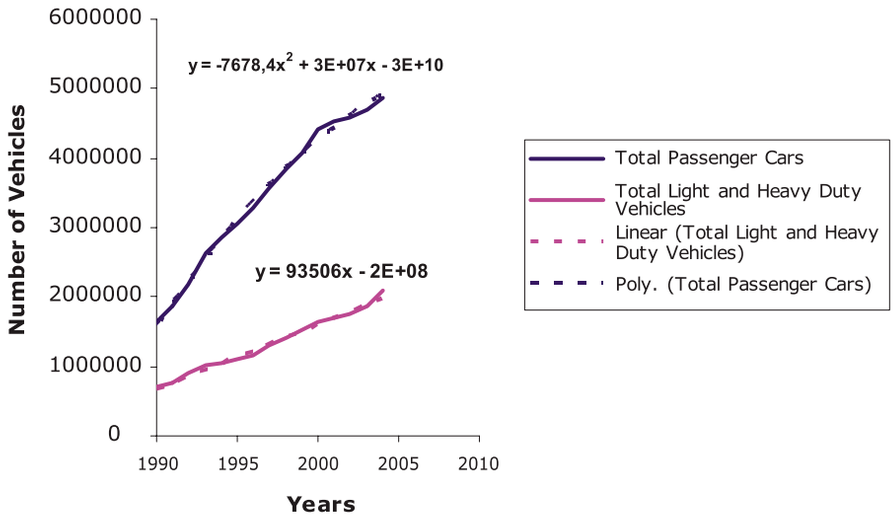

Fig. 4.11 Projection of the number of vehicles up to 2010

The projection indicates that the number of total light and heavy duty commercial vehicles will reach 2,550,000 units by the year 2010. Fig 4.11 corresponds to a 21.5% increase relative to 2004 values. This means that to maintain present CO2 emission levels, those vehicles must have 21.5% less fuel consumption on average. But an improvement in fuel consumption to that level is not expected. The number of passenger cars, including diesel vehicles will also reach 5,700,000 by the year 2010 with an increase of 17%, based on 2004 figures. It seems possible to compensate for this increase in vehicle fleet size by an improvement in fuel consumption technology.

Use of natural gas in road vehicles is still limited in Turkey. The only application is in a fleet of city buses in certain districts of Istanbul and Ankara. Short-term reduction of GHG emissions would benefit from an increase in natural gas-fuelled vehicles due to any legislative actions by the authorities in terms of taxation advantages provided.

4.3.5 Agricultural Policy

The basic objective in agricultural policy (2006-2010 Agricultural Strategy Paper) is to ensure balanced and adequate nutrition to an increasing population and create an agricultural structure which is economic, socially and economically sustainable, well organised and highly competitive by taking food security principles into account. Harmonisation studies on food security and control, organic agriculture, Integrated Administration and Control System (IACS) / Land Parcel Identification System (LPIS) and efforts for the preparation of the Rural Development Plan to ensure harmony with the Common Agricultural Policy and to meet the commitments in agriculture in the National Program are being supported by programming within the framework of Turkey-EU Financial Cooperation in 2004. [5] [13] [14]

2006-2010 Agricultural Strategy Paper

Objectives and Priorities (in line with the EU Accession and WTO-AA) are to ensure [4]:

- Sustainable development, product quality
- Sustainable use of natural resources
- Food security and safety
- Competitiveness in agricultural holdings
- Agricultural markets and marketing
- Rural development
- Producers' organisations

Support Schemes in the Strategy

Direct income support, deficiency payments, livestock support, rural development support, alternative crop support, crop insurance premium support, environmentally based agricultural land protection support (CATAK), and other support. The Agricultural Reform Implementation Project (ARIP) established the farmer registration system and the related land registration-cadastral system, to ensure a change over from crops which are in excess supply to alternative crops, to restructure agricultural sales cooperatives and unions and to pay severance benefits during this process. The project is financed to the tune of $600 million from the World Bank, with $200 million being the programme loan. The project was extended to 2007 to enable the establishment of the farmer registration system and accelerating supportive cadastral works, land massing, agricultural investment support, preserving agricultural land for environmental purposes and licensed storage. The Organic Agriculture Law number. 5262 on this matter was promulgated in the Official Gazette on December 3, 2004. The Regulation on Principles and Practices Regarding Organic Agriculture prepared as per this Law was promulgated in the Official Gazette on June 10, 2005. Organic agriculture maintains its importance as an interesting form of production because of low pollution in our country's soils and climatic conditions.

The objectives are to decrease nutrient load on the environment, particularly on surface and ground waters, and to maintain the biodiversity of animal and plant species and the rural landscape. The measures also aim at maintaining or improving the productive capacity of agricultural lands.

Livestock Sector

Efforts are effectively made to improve animal species, increase production of concentrated feed and fodder crops of high quality, eradicate animal diseases and pests, organise animal breeders, and improve publication services in order to make the livestock sector competitive.

Decree number 2000/467 on Supports on Livestock, which expired in 2005 was renewed and the Supports on Livestock Decree number 2005/8503 of the Council of Ministers was put into effect for 2005-2010. In addition, works on alignment of national livestock legislation with related EU regulations are under way. In this context, almost all of cattle were included in the animal identification system. Work was carried out by including newborns in the system starting from 2005 and removing those who died or were slaughtered out of the system. Work commenced to identify the sheep and goat populations.

Fisheries

The Project for Institutional Strengthening and Development of Fishery Sector with a total cost of 6.6 million euros was implemented 2004-2006 for harmonisation with the Common Fisheries Policy of the EU.

Watershed

Rural Development projects include basin management and small scale agricultural development projects. They cover activities like the development of agriculture and livestock, irrigation, rehabilitation of flooded areas, construction of village roads, construction of forest roads, creation of drinking water ponds, providing drinking water, increasing agricultural and livestock production and forestation.

On the other hand, The "Eastern Anatolia Watershed Rehabilitation Project", supported by a World Bank loan, was carried out in 11 provinces in the Eastern and South-Eastern of Turkey and completed in 2001.

Anatolian Watershed Rehabilitation Project supported by WB and GEF fund was prepared and started to be implemented between 2005-2011 under the coordination of the General Directorate of Afforestation and Erosion Control. The project comprises various activities in rural parts of six provinces located in central Turkey and 28 micro-basins where poverty is widespread, came into force. This project includes soil protection, rehabilitation of forestry lands, agricultural land and activities for rehabilitation of natural resources such as pasture improvement, as well as revenue increasing activities such as improvement of livestock and greenhouses, small scale irrigation infrastructure and product diversification. The project aims to contribute to capacity building activities in compliance with EU standards and similar activities. The total project budget is $45 million. (WB $27 million, GEF $7 million, government $8.65, local government $ 0.9 million, villagers' contribution $8.45 million). Partnership cooperation between the government and NGOs such as the Turkish Foundation for Combating Erosion, Forestation and Conservation of Natural Habitats (TEMA), the Chamber of Forest Engineers (OMO), the Association of Turkish Foresters (TOD), the Turkish Development Foundation (TKV), the Association for Protection of Natural Resources (DHKV), the Union of the Forest Village Cooperatives of Turkey (OR-KOOP) etc. have also gained momentum recently. They have implemented and/or participated in a number of projects in the field of land management, environment and forestry activities in Turkey. They often play an important role in awareness and fund raising, public education, increasing of stakeholders' interest and transfer of technology in forestry.[5][25]. Policies and measures in the agricultural sector are given in Table 4.13

Table. 4.13 Policies and Measures in Agriculture Sector

Policy or Measure	Objective	GHG	Type of instrument	Status	Implementing ntity
Agricultural Strategy Paper **2006-2010, Sustainable agricultural measures**	To promote environmentally sound agricultural production and to improve production efficiency, food safety, environment, rural development	CO_2, CH_4, N_2O	Economic	Implementation started	MARA
The Agricultural Reform Implementation Project (ARIP)	Farmer registration and Land registration		Regulatory	In implementation	MARA
Integrated Administration and Control System (IACS)			Regulatory	In implementation	MARA
Food security and control	Food safety		Economic	In implementation	
The Organic Agriculture Law No. 5262	To reduce N2O	N_2O	Regulatory	2004	MARA
Farm Accounting Data Network			Regulatory	Underway	MARA
Livestock Decree No. 2005/8503	Improving animal species	CH_4	Regulatory	2005-2010	MARA
Institutional Strengthening and Development of Fishery Sector	Protection, control and resource management		Economic	2004-2006	MARA
Eastern Anatolian Watersheds Rehabilitation Project, 11 micro-basins	Soil protection, rehabilitation of forestry land and agricultural land and activities for rehabilitation of natural resources		Economic	1993-2001	MARA MoEF
Anatolian Watersheds Rehabilitation Project, 28 micro-basins	improvement of natural resources and supporting the revenue increasing activities		Economic	2005-2011	MoEF MARA

4.3.6 Land use, land-use change and forestry

In Turkey, land use and planning is done by various bodies within the framework that they are responsible of. But by establishing the necessary coordination between all organisations and parties concerned, it is necessary to decide on a National Land Use Plan based on an interdisciplinary approach with precise and up-to-date data and to base all decisions on these policies on this plan. Moreover, land use plans and policies have to be updated in view of the changing conditions in the country [3]. In order to resolve the identified obstacles in the field of land use and use of authorities, draft Building Code Law has been prepared by MPWS.

This sector affects the mitigation of climate change in three different ways:

- By protecting and increasing existing carbon storages and sinks
- By creating new carbon storages and sinks
- By replacing fossil-based energy, raw materials and products with biomass

In 1990-2004, CO2 removals by LULUCF have varied between 43 Mt to 74 Mt. In spite of covering 27% of the country's area, almost half of total forests are unfortunately unproductive and need to be rehabilitated and protected. Furthermore, forested areas in the country are not evenly distributed. About 15% of Turkey's population (about 9.5 million) lives in forest or forest-neighbouring villages, where forest resources make a vital contribution to the livelihood of local communities whose living standards are considerably lower than the national average.

As of 2004, traditional agricultural techniques such as excessive fertilizer use, stubble incineration and heavy forestillage are being widely used on the 26.5 million ha (all fields, vegetable fields, fruit gardens and olive plantations) agriculture land. In addition to this, plot distribution of agricultural lands in the country is not suitable for machine operation and irrigation.

Water for irrigation is scarce. Farming with irrigation is insufficient and irrigation is inefficient. Average field size is very small, with more than one field (average of 6) per farmer and field shapes are unsuitable for farming. These unsuitable conditions cause 50% of farming energy to be wasted. The main source of energy in the agricultural sector is fossil based [3]

With an area of 13.5 million ha (in 2004) of meadows and pastures which have an important position as CO2 sink, Turkey has a rich potential. But the concept of management of these fields is poor both at administrative level as well as among villagers [3].Wetland development requires major investments in capital, manpower, technology, and input (such as fertilizers), as well as substantial annual investments in maintenance. The limitations of wetland reclamation are becoming obvious, especially as negative consequences can be felt immediately by local people and the economy of the region is affected. Wetland development projects concentrate on goods produced by wetlands (agricultural, forestry or fishery yields) without taking into consideration their full value as environmental regulators of land, water and nutrient flows. Consequently, where conservation is attempted, the ability of natural wetlands to sustain alternative development is low.

National Forest Policies

The Ministry of Environment and Forestry (MoEF) and its associated branches are primarily responsible for forestry activities throughout the country.

Basic forestry policies in the 8th Five Year Development Plan, which is still operational, are; (i) Conservation of forest lands and unity. (ii) Conservation of biodiversity and enlargement of protected areas. (iii) Improvement and updating of forest resources management plans according to principles of sustainability and multi- purpose utilisation, present conditions and capacities of forests and demands and expectations of the community. (iv) Giving due importance to environmental effects. (v) Carrying out environmental, economic and social forestation and forest improvement activities, and giving priority to local communities to benefit from these activities. (vi) Strengthening institutional capacity and giving importance to biological control to fight with biotic and abiotic harm agents. (vii) Training of forest workers and improvement of ergonomic studies and study conditions. (viii) Strengthening research studies on socio-economic and environmental issues. (ix) Strengthening cooperation with non-governmental organisations and forestry institutions. (x) Strengthening studies on adaptation to European Union. (xi) Improvement of the forest law and regulations by taking into consideration environmental conservation, public benefit, ecosystem unity and wild life protection. [18] [19]

Turkey has a Forestry Master Plan (FMP) prepared firstly for the period of 1973-1993 and subsequently for the 20 year period, 1990-2009. However its scope needed to be enlarged to cover all economic, social, ecological and cultural perspectives. To address emerging issues in the forestry sector, a Forestry Sector Review has been undertaken with the assistance of the World Bank. This review that was concluded in 2001 identified a long term vision for Turkish Forestry. The preparation of the Turkish "National Forest Program" (NFP) was initiated in 2001 and finalised in 2004. The programme has been developed with the involvement of all interested parties including forest villagers, non-governmental organisations (NGOs), academicians, forestry sector, forestry professionals and other government agencies with the assistance of the FAO.

Contents of the National Forestry Programme

The mission of Turkish forestry is defined as "Sustainable management of forest resources of our country and ensuring its optimal contribution to people's welfare and sustainable development of the country".

The main policy to improve the sustainable management of the forests is "Multiple use and management of forests through ecosystem management approach, integrated planning and implementation of forestry activities at watershed base in active participation and collaboration with forest organisations and other stake holders".

National Forestry Objectives in the NFP

Conservation of the integrity, biological diversity and natural structures of the forests, protection against harmful biotic and a biotic agencies.
Improvement of existing forests, rehabilitation of degraded forests, expansion of forest areas by establishment of forest cover on suitable lands outside forests.

Provision of multi-purpose (ecological, social, economic, cultural) benefits (e.g. wood and non-wood forest products, socio-cultural services, protective and environmental functions) from the forests on a sustainable basis, at local, national and global levels, and their equitable distribution and utilisation in the overall interest of society.

In the Action Plan under the National Forestry Programme, in the framework of the changes that occurred in the community and in the demand for and expectations from forest resources, higher values of forestry, changed and improved roles in forestry, special importance has been given to gain and evaluate the needed information and experiences by common studies in order to achieve needed reforms and improvements in Turkish forestry.

Since approximately half of the forests in the country are degraded, rehabilitation of these areas by forestation and other improvement activities has been of special importance for improvement of forests in Turkey. Activities of forestation, erosion control and range-grazing land improvement are implemented by the General Directorate of Afforestation and Erosion Control Up to now, some 1.9 million ha of forestation, 710,000 ha of artificial regeneration, 53,000 ha of private forestation, 622,000 ha of energy forest establishment, 104,000 ha of range rehabilitation, 8,000 ha of green belt construction, 594,000 ha of erosion control and 142,000 ha of degraded forest rehabilitation activities have been completed by the forest organisation. According to survey and evaluation studies carried out by the General Directorate of Afforestation and Erosion Control of the MoEF in 1999-2000, it has been determined that the size of potential areas for forestation, erosion control and range improvement activities are 2.3 million ha, 1.3 million ha and 0.8 million ha (total 4.4 million ha), respectively.

Government-NGOs partnerships on reforestation have also gained momentum recently. One of the most renowned NGOs, namely the Turkish Foundation for Combating Erosion, Forestation and Conservation of Natural Habitats (TEMA) aims at contributing to forestry and environmental activities across the country. Among them, a protocol has been signed for financial contributions for oak plantation activities in suitable regions of Turkey. TEMA has been playing an important role in awareness raising programmes.

The Union of Forest Village Cooperatives of Turkey (OR-KOOP) is another important player as a central unit of the forest village co-operatives that organise relationships between state forestry administration and cooperatives.

During the development of the national forestry policy, strategy and programmes, it is an important necessity to adopt national strategy-action plans, regional development plans and national programmes, which are operational. These are the 8th Five Year Development Plan, the Forestry Master Plan (FMP), the National Environment Action Plan (NEAP), the National Biodiversity Strategy-Action Plan, and the National Plan for in-situ Conservation of Plant Genetic Resources, the Combating

Desertification National Action Plan, the South Eastern Anatolia Development Plan (GAP), the Eastern Anatolia Development Plan (DAD), the Eastern Black Sea Development Plan (DOKAP), and the National Programme for the Adoption of the Acquis.

Global Responsibilities, International Treaties and Processes

During the development of the National Forestry Policy, Strategy and Programs, appropriate measures have been taken into account to meet global responsibilities towards taking care of national conditions and interests. Also it must be taken into consideration that Turkey is a party to the following international treaties, decisions and processes.

- United Nations, Environment and Development Conference (RIO) Decisions related to Forestry, Forest Principles, Agenda 21, Unit 11 "Combating Deforestation"
- UN Biodiversity Convention
- UN Combating Desertification convention
- Framework Convention of Climate Change
- Internationally important Wetlands Convention (RAMSAR)
- World Cultural and Natural Heritage Conservation Convention (PARIS)
- Natural Landscape Conservation Convention
- Convention on international Trade for Endangered Wild Flora and Fauna Species (CITES)
- Intergovernmental Forestry Panel (IPF), intergovernmental Forestry Forum (IFF), United Nations Forestry Forum (UNFF) Process
- Conservation and Sustainable Management of European Forests Process
- Near East Process for the Development of Sustainable Forest Management

Forestry Legislation

Forestry Legislation in Turkey consists of the related articles of the Constitution, legislation directly related to forestry (Forest Law, Law on Support for the Development of Forest Villagers, Afforestation, National Solidarity Law, National Parks Law, Hunting Law, Establishment Laws for the Ministry of Forestry and General Directorate of Forestry and Regulations for the implementation of these laws) and other related legislation (Environment Law, Range Law, Specially Protected Areas Law, Tourism Encouragement Law, Law on Protection of Cultural and Natural Values, Land Cadastre Law, and Regulations for the implementation of these laws). In addition to these, international forestry treaties signed by Turkey have also legal status, therefore, these treaties are also accepted and taken into consideration in forestry legislation.

Scientific Forest Research, Training and Awareness Activities

A Master Plan For Forestry Research, which ensures the policy, strategy, priority and principles for forestry research studies was prepared in 2001, The plan says that the studies shall be strengthened and improved by adaptation to the changing roles and needs of forestry, coordination and cooperation among various research institutions and activities, dialogue among researchers implementation units and other stakeholders, dissemination and availability of research results to implementers and obtaining benefits from these studies, and strengthening the capacities of research institutions.

Forestry research is currently undertaken by eight regional and three topic-orientated research institutes. The new vision of forestry research contains social, economic and environmental issues. It includes, inter alia, conservation of biodiversity, participatory forest management systems with involvement of all interested parties, in particular forest villagers, plantation with fast growing forest tree species, non-wood forest products and services, land use, and development of sustainable forest management policies at national level.

4.3.7 Waste

Preparatory work is under way for emission control by controlled waste disposal in compliance with Council Directive 1999/31/EC on the landfill of waste. In the meantime, work on organic wastes (Biowaste Directive-3rd Draft) are also under way. As regards organic waste recovery, mechanical and biological treatment is being considered for composting. In parallel to the current by-laws on Control of Solid Wastes, by-laws on landfill shall also include rules to reduce greenhouse gasses. By-laws governing the re-use and recycling of waste and incentives for re-use of recycled waste gives some responsibilities to regional local governments.

Turkey attaches great importance to building controlled storage areas, rehabilitation of existing controlled storage areas and increasing the insufficient number of wastewater treatment plants, within the framework of sustainable development principles and in the direction of ensuring compliance of Turkish legislation with that of the EU in the process of accession to the EU. The "Integrated Adaptation Strategy Project in Environment Field for the Republic of Turkey and European Union" gives the total cost of adaptation in the mentioned sectors, and argues that it would be 289% more expensive than for the other candidate countries. Turkey is experiencing the difficulty of not being able to find funds to conduct the improvement operations in this sector with an estimated cost of €59 billion.

As per the principle of "the cost of restoring the polluted environment is higher than that of pollution prevention", priority must be given to treatment plants and controlled storage areas.

Recycling of waste, use of less polluting technologies and making environment friendly designs must be promoted. In line with the National Programme for Adoption of EU Acquis, directives of relevance require investment with an estimated budget given [19] in Table 4.14. The related costs include decommissioning old dumpsites, installation of new landfill sites (for disposal of hazardous and household solid wastes), creation of collection systems for dual collection and recyclable wastes, installation of composting facilities and incineration facilities, recycling of construction wastes and debris, recycling of mixed wastes and separately collected wastes, and hazardous waste conveying centres and handling systems.

Table 4.14 Investment Requirement as per the Waste Sector Directive

	TOTAL - *million Euros*
Landfill	7 574
Packaging	655
Incineration	1 257
Hazardous Waste	74
TOTAL	9 560

Source: MoEF, 2006

Statistics

TURKSTAT, under the administration of the Prime Ministry, by law has the sole responsibility for collecting and processing all statistical data for the country. Since 1995, energy statistics have been compiled annually according to EUROSTAT standards. At TURKSTAT there is a specific department working in the energy statistics field.

The prepared statistics are provided to relevant ministries for further use. Various statistical data, including the energy sector, are regularly transmitted to EUROSTAT. The Project on the Compilation and Assessment of Energy Statistics of MEDSTAT Countries has been funded by the EC in cooperation with EUROSTAT.

TURKSTAT is represented on the Energy Conservation Coordination Board. The functional role of the TUIK on the board centralises on the necessary interpretation of energy statistics with respect to energy efficiency.

State Budget Support Aspects

There exits a decree, encouraging general investment by means of a tax benefit programme with some credit possibilities in the form of aid to small and medium sized enterprises. These instruments of investment support, which are addressed by the respective legislative acts, have an indirect impact on energy efficiency and GHG reduction.

4.4 Additional Policies and Measures

Ratification of Draft Energy Efficiency Law

Through the Energy Efficiency Law, it is targeted to have efficient administrative co-ordination integrated programmes to reach the final energy consumers. This will enable contribution to the national greenhouse gas emission reduction policy by improving the EE. The targets are to promote awareness, to demonstrate effects and viability by hands-on concrete projects, to provide technological information, to implement support and financial incentives, supervision, monitoring and evaluation

of effects and design and to apply appropriate instruments for revenue creation, and to ensure availability of all necessary equipment in the market. For an efficient and sustainable implementation of energy efficiency policy, it is important to aim for an improvement in the involvement of related ministries in the targeted or integrated energy efficiency programmes (sectoral measures) and to provide the administrative framework for the involvement of third parties (mediators and private initiators in consumer sectors).

Harmonisation of Turkish Legislation with the EU acquis

It is of the utmost importance to ensure effective participation of Turkey in relevant EU programmes (SAVE, ALTENER, CARNOT, INTELLIGENT ENERGY & TEN) and to allocate adequate funding through appropriate EU funds.

Participation in International Co-operation Projects

Turkey is at present not yet a member, but is eligible for participating in the energy efficiency support programmes of the EU, such as the "Intelligent Energy for Europe" (IEE) and the 6th Framework Program for Research and Technological Development in “Energy, Environment and Sustainable Development" sectors. International agreements shall be used to establish links with potential project partners for developing common projects. The same process applies to the application for membership to the European Network OPET (Organisation for the Promotion of Energy Technologies). Turkey is giving priority to forestation, clean technologies and CO_2 storage as possible options. Within the “institution building and access to environmental information” component of the Pre-accession Financial Assistance Program, a national database will be created for environmental information and the training of staff will be prioritised for strengthening the administrative capacity.

The following priority areas have been identified:

- Periodic renewal of cost/benefit analyses for emission reduction in critical sectors.
- Ensuring local administrations take a pioneering role in reducing CO_2 emissions by extending public transportation and promoting heat insulation in buildings.
- Biochemical absorption of atmospheric CO_2 by forests, vegetation, soil and natural products or consumption of greenhouse gases in chemical and industrial processes.
- Bringing hydrogen and fuel cells to the point of commercial readiness and viability in terms of performance and cost, as well as substantial effort on research, technological development and validation.

Promoting less polluting cars

In line with the relevant Directive, (that comes into force on 1.1.2008) less polluting cars are promoted using brochures prepared for consumers on fuel economy and CO_2 emissions of new passenger cars with eco-labelling. Seminars and meetings are organised for manufacturers in co-operation with car manufacturers and distribution organisations (e.g. Turkish Automotive Manufacturers Association and Turkish Automotive Distributors Association) according to related legislation (December 2003) enacted by the MoIT. The MoIT has been carrying out market surveillance activities according to national technical legislation by inspectors.

Testing Laboratories

There are two testing laboratories analysing fuel economy and CO_2 emission of new passenger cars. The aim is to increase testing facilities to fulfil the relevant (MARTEK) standards.

National Climate Change Action Plan Strategy:

Under the co-ordination of the MoEF, a stake holder-facilitated meeting was organised and the following draft list of actions are proposed with the expectations. Table 4.15 MoEF will be responsible to merge the CCAP priority areas with UCES in the near future.

Table 4.15 Draft National Climate Change Action Plan (CCAP) Strategy

Name of Proposed Action	Expectations
National Scientific Steering Board for Climate Monitoring Platform for coordination of National Action Plan on Climate Change	• Effective implementation of the National Action Plan • Capacity building in relation to climate • (CCAP) Organisational Infrastructure • Information to decision-makers • Reliable co-ordination, effective control, structural reforms • Through a National Co-ordination Board, inform the related agencies of the activities carried out in various disciplines; appoint to the said Board a representative from the Ministry of Health; the provision of consultancy services by the said Board to the related agencies and organisations • Keep CCAP live and effective monitoring of it • Have a multi-participation implementation of CCAP pursuing a sustainable public and political will; rapid success achieved with CCAP
Observation Systems	• Have an effective data management; the provision of data to all the actions related to this issue • Completion of the existing deficiencies (e.g., emission inventory)
Improving co-operation with in terms of climate change	• Shift activities on climate from local to regional
Raising public awareness on water resources and their relevance to climate change	• Raise public awareness; the inclusion of health impacts
In line with the climate change scenarios, the determination of new criteria for the designing and operation of water reservoirs, taking into account the time frame, area and the situation of project in the basin	• Ensure adaptation to climate change in terms of water structures and the supply of a sufficient amount of water
Ensuring implementation of water management plans in the RAMSAR sites, and devise integrated management plans on the basis of 26 basins	• Make effective and expand the management plans for wetlands; ensure the sustainable use of water
Following water-saving methods for irrigation systems	• Water saving
Monitoring of Carbon Stock Change in Plant Ecosystems (Agriculture, meadows, forests)	• Enhance the reliability of emission inventory; complete the lacking data; contribute to the assessment of action-reaction; provide input to the models • Enhance the reliability and quality of the data used for national communication, generating country-specific data during the computation of emission
Monitoring the effects of climate change on the need of irrigation water for irrigated lands	• Measure the performance of the existing irrigation systems; determine the planning criteria for the irrigation systems to be newly devised
Using wood raw material as a source of bio energy; give support to the use of wood raw material as an alternative source to replace the energy-intensive products in the industry	• Reduce the release of greenhouse gas and enhance the sink capacity; ensure energy gain

Modelling interactions of energy, environment and economy: Environmental modelling for energy and the national action plan	• Analytical capacity building for the devising of the policies of energy, environment and economy • Make rational policies toward energy and the environment; shift to cost-effective measures
Encouraging the use of renewable energy	• Reduce the dependency on the use of fossil fuels; ensure the stability of energy production • Diversify energy resources; reduce the importation of energy; reduce pollution; enhance employment; enhance economic contribution and accelerate local development rate
Increasing sectoral energy efficiency	• Reduce emission without compromising the growth • Reduce emissions • Devise pilot projects beginning from the sectors that have the highest impact on the climate • Complete the statutory infrastructure; identify the potential for saving; develop a house funding model; generate house indicators; enhance employment; increase competitive power
Giving training on the diseases due to climate change	• Manage the effects of climate change in terms of health • Raise public awareness on the issue; identify the areas that are vulnerable to potential risks; warn the related agencies located in those areas; include the personnel in the training system; take the other necessary measures
Risk mapping of the diseases due to climate change	• Reduce and prevent the risk of epidemics in the community; lower the health expenditures
Macro-economic optimisation of emission objectives and cost-benefit analysis in the critical sectors	• Economical and social cost analysis • Make policies of international scale
Create an integrated database; establish reliable and continuous information and monitoring system	• Devise future plans that will be most appropriate for our country collecting healthy data; add health parameters to the said database • Change behaviours of consumption of the public raising their awareness • Have a reliable statistical infrastructure • Provide access to quality and reliable data, allowing policy-making and generating the data needed by the decision-makers • Create a healthy spatial database for a rational and cost-effective modelling and application; achieve public awareness

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CHAPTER 5
PROJECTIONS AND MITIGATION SCENARIOS

5. PROJECTIONS AND MITIGATION SCENARIOS

5. PROJECTIONS AND MITIGATION SCENARIOS

This chapter shows the trend of greenhouse gas emissions between 2010 and2020, with four scenarios. As described in the previous chapter (see Chapter 4), during the past decade, full implementation of several mitigation policies and measures have already been applied up until 2006.As a consequence of these, emission levels in Turkey are significantly below the business as usual expectations. Therefore, the reference points of all these scenarios include the effects of this previous work. In foreshadowing national intervention strategies to mitigate climate change, it is impossible to disregard prospective emission growth in other countries. The emission of greenhouse gases in Turkey account for less than 1% of global emissions. Turkey still is among the least polluting countries in the world.

5.1 Energy sector

5.1.1 Brief Description of the Energy Sector

Over the period 1990-2004, Turkey's demand for general energy and electricity energy has increased at an annual rate of 3.7% and 7.2% respectively. Over the same period, the population grew by 1.7% and GDP 3.6%. As expected, the rapid expansion of energy production and consumption has brought with it a wide range of environmental issues at the local, regional and global levels. With respect to global environmental issues, Turkey's carbon dioxide (CO_2) emissions have grown along with its energy consumption. Emissions in 2004 reached 223 million metric tons.

With GDP projected to grow at over 6% per year over the next 15 years, both the energy sector and the pollution associated with it, are expected to increase substantially.

5.1.2 Description of the Methodology Used

The current study was carried out by a team from the Turkish Ministry of Energy and Natural Resources (MENR), the Electricity Generation Corporation (EUAS) and Turkish Electricity Transmission Corporation (TEIAS) in close collaboration with and with support from Argonne National Laboratory's Centre for Energy Environmental and Economic Systems Analysis (CEEESA). The study was supported by the UNDP within the framework of the PIMS 3367, Turkey's First National Communication Project [1]. The analytical methodology is based on the Energy and Power Evaluation Program (ENPEP), an integrated energy modelling system developed by Argonne National Laboratories. The MAED module of ENPEP was used for projection of energy demand, including electricity. The WASP module was used for electricity generation expansion planning. The BALANCE module projects future fossil and non-fossil energy flows in Turkey from energy extraction through end use across all sectors. It also calculates the environmental burdens, such as emissions from greenhouse gases and other pollutants. In addition, the VALORAGUA model was used to evaluate the operation of the hydro portion of the electricity system. The horizon for all analyses spans the period 2005 - 2020 with 2003 taken as the base year. For details of the projections, please refer to [1]

Macroeconomic Forecasts Main Assumptions and Energy Demand Projections

Population, population growth rate and GDP growth rate are given below Table 5.1. These values were being used in general energy and electricity projections.

Table 5.1 Population, population growth rate and GDP growth rate

	2005	2010	2015	2020
Population (million)	73.101	78.459	83.340	87.759
Population Growth Rate (%)		1.4	1.2	1.0
GDP Growth Rate (%)		5.5	6.4	6.4

Sources: SPO

Main Assumptions of WOM (without measures)(Reference Scenario)

The Reference Scenario reflects the current official outlook with regard to energy prospects. With regard to the energy system structure under the WOM (Reference) Scenario, the following assumptions are made:

- No additional domestic reserves of fossil fuels will be available
- No limits are placed on crude oil, natural gas, or hard coal imports
- No major changes will be made in the country's energy pricing policies
- No additional major energy conservation or renewable resource programs will be implemented

Expansion of the electricity system will be on the basis of cost minimisation over the planning horizon and should observe the following policies: The total domestic lignite generating capacity available for power generation is taken as 18,790 MW (120 TWh). As of the end of 2003, 6,520 MW (42 TWh) of this total is already in operation, and a further 2,200 MW (11 TWh) is currently under construction or in the licensing process. The remaining 10,070 MW (67 TWh) is assumed available for expansion in the planning study. [1]

- Turkey has a limited amount of domestic hard coal potential, just1,755 MW (11 TWh). Out of this, 555 MW (3.1 TWh) was already available as of the end of 2003, and the remaining 1,200 MW is assumed available for expansion in the planning study.
- Under average hydro conditions, total hydro capacity is calculated as 36,355 MW (129 TWh), and the utilised potential by the end of 2003 was 12,578 MW (45 TWh). A capacity of 3,254 MW (11 TWh) is under construction and already licensed. A considerable amount, which corresponds to 20,523 MW (73 TWh), is still to be used in the future and defined as expansion candidates. Due to the large number of hydro candidates, they are grouped by considering water inflow characteristics, cascade situations and possible commissioning years.
- Diversification of both domestic and imported resources is important to ensure supply security at all times.
- According to long-term contracts and policies in place, natural gas consumption is limited to 20 bcm to 30
- Based on infrastructure and transport limitations, it is assumed that the maximum amount of imported
- coal use must be limited to 15 million tonnes per year

Demand Projection

As a result of the reference case scenario, the TPES is expected to increase from 92 Mtoe in 2005 to 223 Mtoe in 2020 with an annual average growth rate of 6.1%, see Table 5.2. The consumption pattern of these sources was: coal 29%, oil 37%, natural gas 22%, hydro 4% and other renewables 8% in 2005. It is expected to evolve as: coal 37%, oil 27%, natural gas 23%, hydro 4%, other renewables 5% and nuclear 4% by 2020. Although the renewables supply increases about 1.5 times during 2003–2020, their share decreases from 8.3% in 2003 to 4.6% in 2020.
Per capita energy consumption was put at 1,284 kgoe in 2005 and expected to be 2,541 kgoe in 2020.

Power demand in the Turkish economy grew by 8-10% in the past and it is expected to grow by 7-8% in the long run. The gross electricity demand, which was 163 TWh in 2005, is expected to be 499 TWh in 2020; growing by three times over the next 15 years.

Connection with this growing demand per capita electricity consumption will increase from 1,994 kWh in 2005 to 5,692 kWh in 2020. Bearing in mind that already by 2003 the world average was 2,429 kWh and the OECD average was 8,044 kWh , it is very clear that Turkey is an energy- and electricity-hungry country.

Table 5.2 WOM (Reference) Case Primary Energy Supply

Fuel	2003	2005	2010	2015	2020
Hard Coal/Coke (ttoe)	12,902	16,153	25,170	31,653	49,477
Lignite/Asphaltite (ttoe)	9,616	11,301	18,509	24,712	32,372
Oil (ttoe)	31,804	34,073	42,212	49,576	60,215
Natural Gas/LNG (ttoe)	19,451	20,331	30,455	41,054	51,570
Hydro (ttoe)	3,038	3,602	4,903	7,060	9,419
Nuclear (ttoe)	0	0	0	8,230	8,230
Renewables (ttoe)	6,964	6,820	7,312	8,243	10,323
Net Electricity Import (ttoe)	48	0	0	0	1.398
TOTAL (ttoe)	83,825	92,281	128,562	170,528	223,003

5.1.3 Final Energy Consumption by Sector and by Fuel Type

Based on demand forecasts, total final energy consumption will grow at an average of 5.8% annually from 67.9 mtoe (2003) to 176.6 mtoe (2020)[1]. Average annual growth rates vary by sector, with industry having the highest rate (6.5%), followed by transportation (6.1%), residential (5.3%), agriculture (4.7%), own use (3.8%), and non-energy sectors (2.6%). Industrial consumption will increase from 26.1 to 76.4 mtoe between 2003 and 2020 while its share of total consumption will increase from 38.5% to 43.3% over the same period. Consumption will also increases in all other sectors but their shares will decline, except for the transport sector, as shown in Table 5.3.

Table 5.3 WOM Case (Reference Case) Final Energy Consumption by Sector

Sector	2003	2005	2010	2015	2020
Industry (ttoe)	26,117	27,003	41,646	55,508	76,408
Residential (ttoe)	19,634	21,648	29,015	38,503	47,542
Transport (ttoe)	12,395	14,298	19,915	26,541	34,037
Agriculture (ttoe)	3,086	3,475	4,368	5,441	6,751
Non-Energy (ttoe)	2,098	2,202	2,514	2,844	3,220
Own-Use (ttoe)	4,558	4,807	5,967	6,997	8,593
TOTAL (ttoe)	67,887	73,433	103,425	135,834	176,551

BALANCE also projects final energy consumption by fuel type. The results are graphically displayed in Fig. 5.1 and 5.2. The model projects that fuel shares will change as follows over the 2003–2020 period:

- Hard coal and coke will have the highest growth rate with 8.1% per annum, and increase from 10.1 to 37.8 mtoe (14.9% to 21.5%).
- Use of lignite and asphaltite will grow by 1.7 % every year from 3.3 to 4.4 mtoe while their share decreases from 4.9% to 2.5%.
- Use of natural gas will increase at an average rate of 6.8% from 8.2 to 25.1 mtoe, and will capture 14.2% of the market by 2020 (up from 12.2% in 2003).
- Oil products consumption will grow at a low rate of 4.6% from 25.1 to 53.8 mtoe and continues its historical decline in market share dropping from 37.0% to 30.5% by 2020.
- Renewables will grow from 6.9 to 9.3 mtoe, representing an annual increase of 1.8%. The share of renewables falls from 10.1% to 5.3%; mostly due to the decline in the use of non-commercial biomass (wood and wood waste) from 5.7 to 3.9 mtoe. Solar and geothermal energy in combination will increase by a factor of five from 1.1 to 5.3 mtoe between 2003 and 2020.

Electricity consumption has the second highest annual growth rate at 7.7% and will increase from 12.1 to 42.9 mtoe (equal to 141.1 to 499.4 TWh) while its share rises to 24.3% by 2020 (up from 17.9% in 2003). Industrial electricity consumption will grow at the rate of 8.7% on average every year, while residential electricity consumption is projected to grow at an average rate of 8.1% between 2003 and 2020.

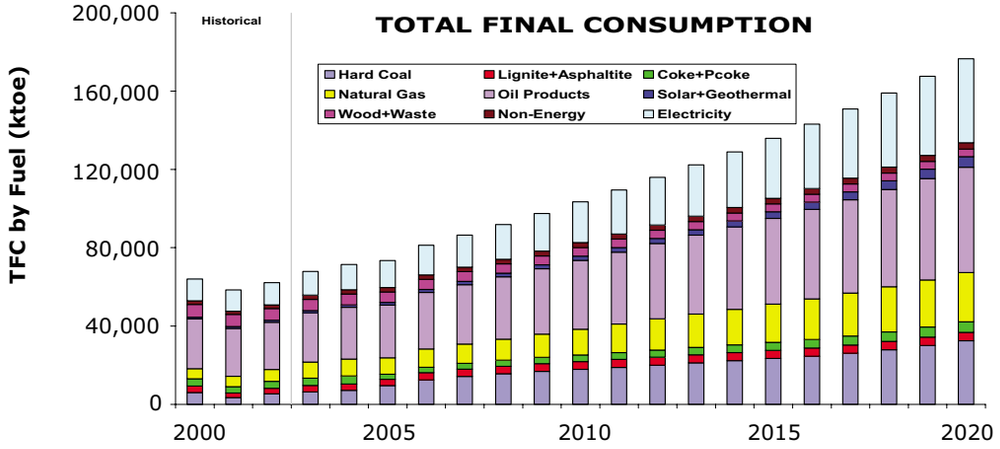


Fig. 5.1 WOM (Reference) Scenario Final Energy Consumption by Fuel.

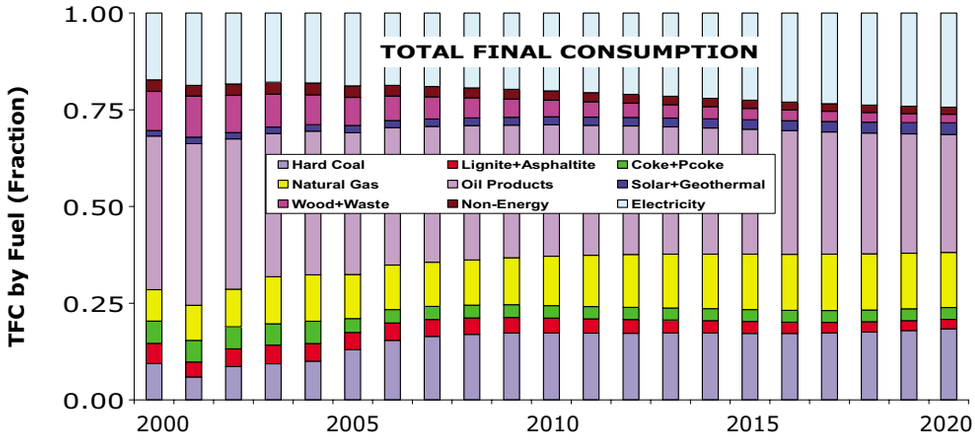


Fig. 5.2 WOM (Reference) Scenario Final Energy Consumption Shares by Fuel.

Electricity Supply

Total system generation capacity is projected to grow to 544 TWh as shown in Fig. 5.3. Fig. 5.4 shows that natural gas-fired units will account for 36.5% (198.8 TWh) of total generation capacity by 2020, dropping from 43.8% (97.3 TWh) in 2000. Hard coal and lignite-fired generation will change from 20.0% (44.6 TWh) in 2005 to 25.0% (135.9 TWh) in 2020. Fuel oil and diesel-fired generation will decline significantly. These are projected to generate only about 3.6% (19.4 TWh) of total electricity. This is down from 8.7% in 2005. All renewables (hydro, geothermal, solar and wind) account for a combined 22.5% (118.3 TWh), up from 21.7% in 2005. When the share of primary resources for electricity generating capacity are observed in Figs. 5.3 and 5.4, there is a small decrease in natural gas, a considerable decrease in oil products, a slight increase in lignite and imported coal, a sharp increase in nuclear and a relatively stable share of hydro and wind.

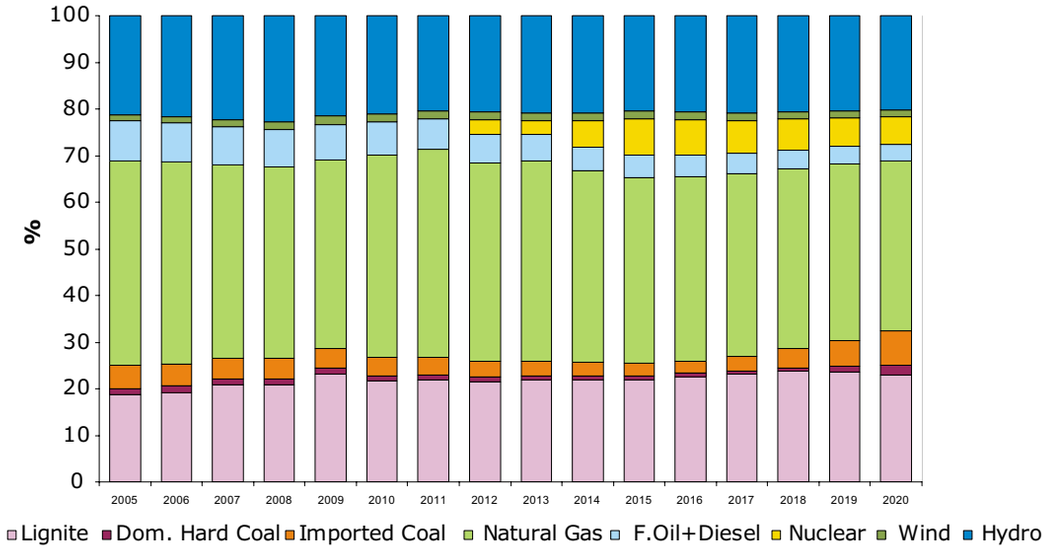
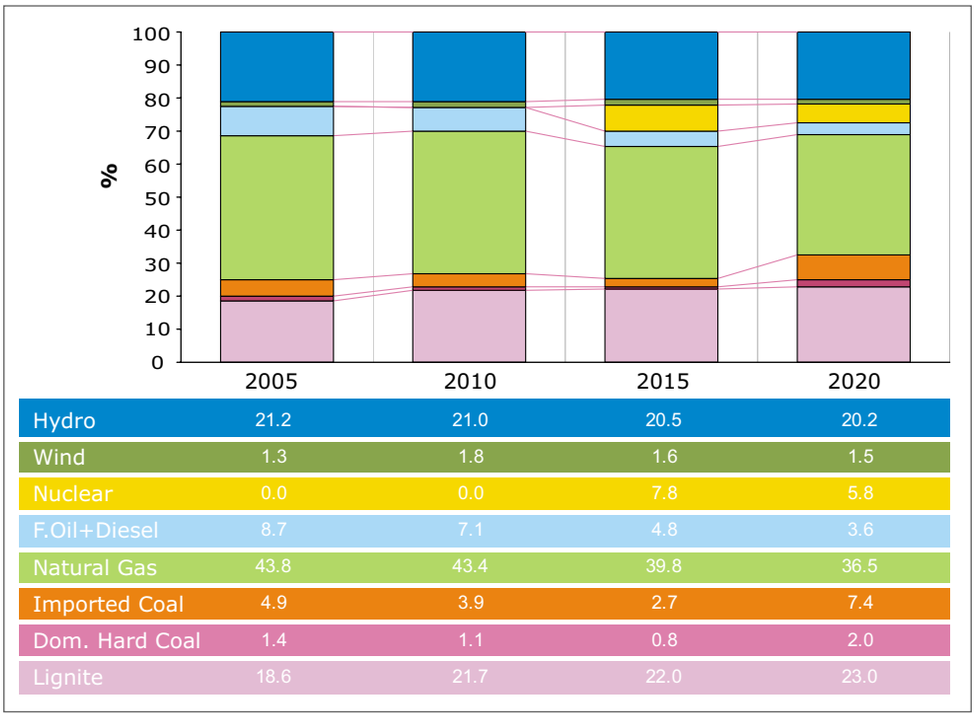


Fig. 5.3 Breakdown of Generating Capacity by Primary Resources.



	2005	2010	2015	2020
Hydro	21.2	21.0	20.5	20.2
Wind	1.3	1.8	1.6	1.5
Nuclear	0.0	0.0	7.8	5.8
F.Oil+Diesel	8.7	7.1	4.8	3.6
Natural Gas	43.8	43.4	39.8	36.5
Imported Coal	4.9	3.9	2.7	7.4
Dom. Hard Coal	1.4	1.1	0.8	2.0
Lignite	18.6	21.7	22.0	23.0

Fig. 5.4 Breakdown of Generating Capacity by Primary Resources.

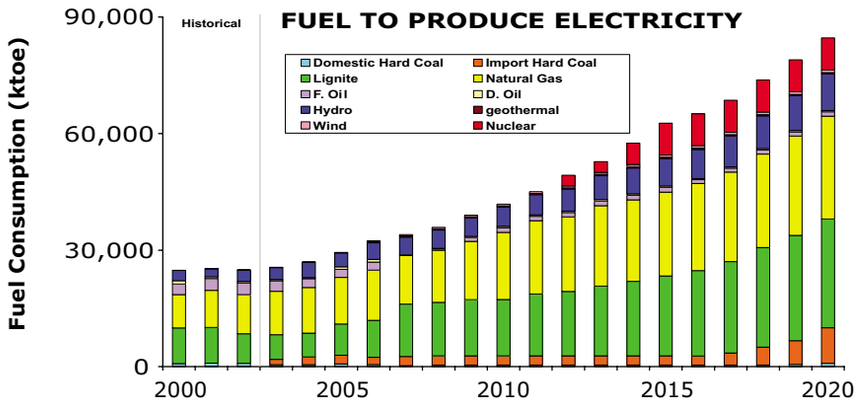


Fig. 5.5 WOM (Reference) Scenario Power Sector Fuel Consumption

5.1.4 Emission of GHGs under the WOM scenario (Reference Scenario)

CO2 Emissions

Total CO2 emissions by sectors under the WOM scenario (Reference Scenario) are shown in Figs. 5.6 and 5.7. Emission will increase at an average rate of 6.3% annually between 2003 and 2020, and reach a total of 604.63 million tons/year by 2020. The most noticeable change in sectoral contribution is in the power sector, where emissions will grow by 7.1% every year and account for 37.0% by 2020 (221.9 mtp.a.), up from 32% in 2003 (68.9 mtp.a.). This is driven by high growth in final electricity demand as well as the continued reliance on solid fuels in this sector, which still account for 36% of power-related fuel consumption by 2020, despite the increased penetration of natural gas, nuclear, and wind energy.

- Industrial CO2 emissions will grow at a below-average rate of 5.9%, mostly due to an increasing reliance on natural gas and electricity. Annual sector emissions will increase from 73.61 to 196.41 million tons but the sectoral contribution stays constant at around 33% throughout the planning period.
- The growth rate in the transportation sector is 6.1% p.a., with sectoral contributions declining slightly from 18% (37.5 mtp.a.) in 2003 to 17% (102.44 mtp.a.) in 2020.

• The share of the residential sector also declines slightly from12% (25.0 mtp.a.) in 2003 to 11% (65.21 mtp.a.) in 2020, with a growth rate of 5.8% p.a.

Finally, in agriculture, the emission share will decline from 4% (8.4 mtp.a.) in 2003 to 3% (18.61 mtp.a.) in 2020, with a growth rate of 4.76% p.a

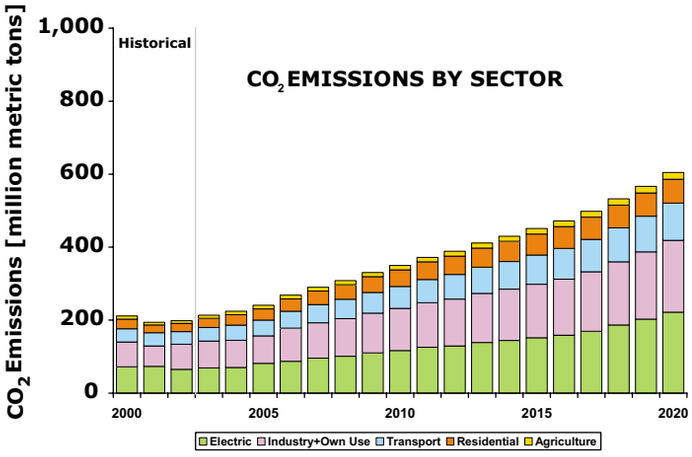


Fig. 5.6 WOM Scenario (Reference Scenario) CO2 Emissions.

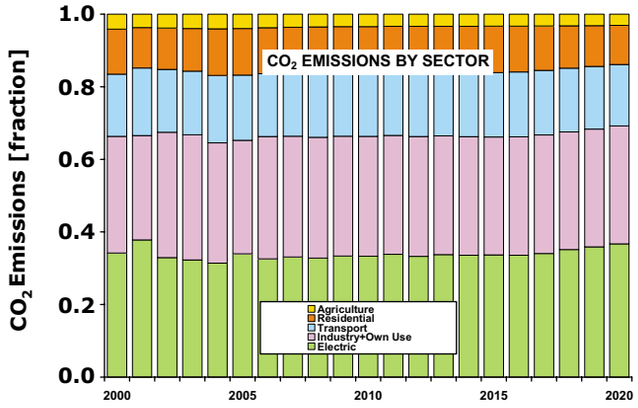


Fig. 5.7 WOM Scenario (Reference Scenario) CO2 Emission Shares.

CH4 emissions

Total CH4 emissions will increase 2.4 times from 175.7-to 421.4 kt p.a. between 2003 and2020 (see Figs. 5.8 and 5.9.). At the beginning of the planning period, CH4 emissions are dominated by residential biomass combustion with 56.7% of total CH4 emissions in 2003 but due to the growth in natural gas and electricity consumption, residential CH4 emissions will increase at a below average rate with the sectoral share declining to 35.7 % in 2020. At the same time, supply sector emissions increase substantially from 63.2 to 234.4 ktp.a. The increasing sectoral share, up to 55.6% (up from 36% in 2003) is a result of the growth in domestic hard coal production. Supply (i.e. coal mining) sector emissions will grow at an annual average rate of 9%. Industrial CH4 emissions will grow at a 6.5% annual rate from 6.2 kt p.a.to 18.2 kt p.a. between 2003–2020. The industrial share will be around 3.5-4% throughout the planning period.

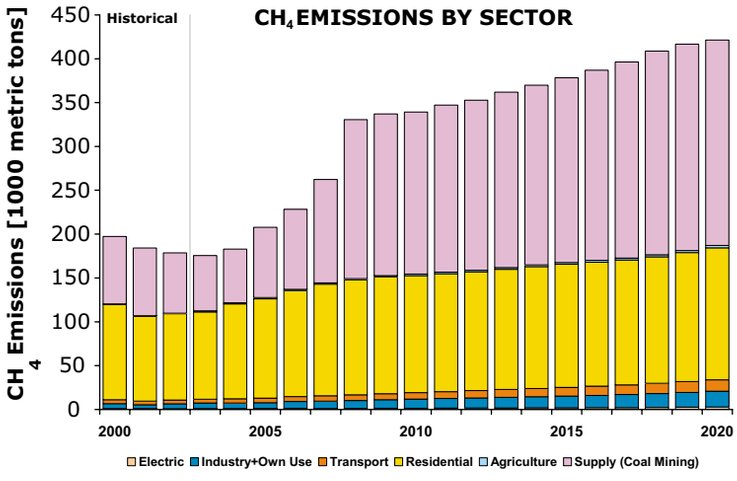


Fig. 5.8 WOM Scenario (Reference Scenario) CH4 Emissions by sector

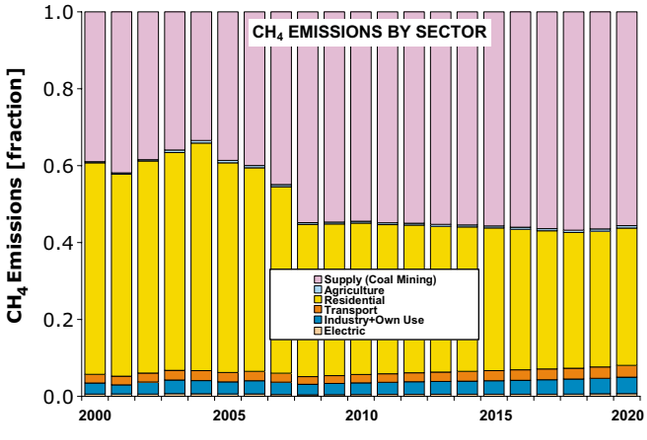


Fig. 5.9 WOM Scenario (Reference Scenario) CH4 Emission Shares

N2O emissions

N2O emissions are initially dominated by residential biomass combustion with 40% of total N2O emissions coming from households in 2000 and 38% in 2003 (see Figs. 5.10, and Fig. 5.11). However, the expected shift from non-commercial biomass results in a drop in its contribution to 17%. At the same time, power sector and industrial emissions increased from 0.60 to 2.38 and 0.84 to 2.32 ktp.a. respectively, increasing the power generation share to 34% (up from 20% in 2003) and the industrial share to 33% (up from 28% in 2003).

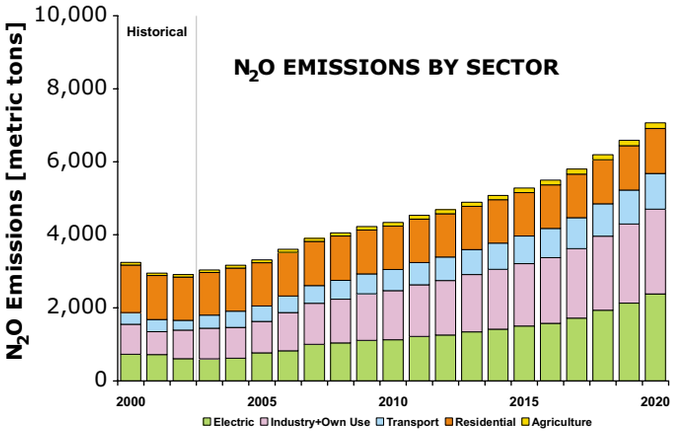


Fig. 5.10 WOM Scenario (Reference Scenario) N2O Emission

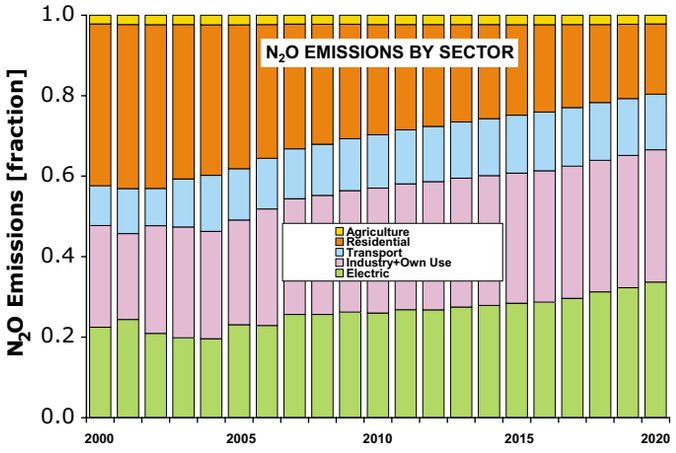


Fig. 5.11 WOM Scenario (Reference Scenario) N2O Emission Shares.

Total carbon equivalent emissions

Total emissions in carbon equivalent are calculated by using standard conversion factors and are recorded in Table 5.4.

Table 5.4 WOM Scenario (Reference Scenario) Carbon Equivalent Emissions by Sector.

WOM SCENARIO (REFERENCE SCENARIO)								
MTCE	1000 Metric Ton							
Emission Source	1990	1995	2000	2003	2005	2010	2015	2020
Electric	9.311,72	12.952,75	21.011,43	20.297,95	22.379,50	31.887,03	41.538,50	60.751,51
Industry	10.291,36	11.508,09	16.423,95	18.471,77	20.644,06	31.661,04	40.183,72	53.867,75
Transport	7.245,33	9.175,43	9.933,63	10.243,63	11.842,94	16.487,33	21.948,30	28.093,68
Residential (Other)	8.872,79	9.918,76	10.404,81	9.857,15	9.182,99	13.331,83	16.624,33	18.749,79
Agriculture					2.614,46	3.287,80	4.106,22	5.103,88
Supply					460,12	1.058,44	1.206,72	1.342,53
TOTAL	35.721,20	43.555,04	57.773,82	58.870,50	67.124,06	97.713,47	125.607,78	167.909,16

Note: The agriculture related emissions are arising from the fuel used in this sector while supply sector emissions from mining activities (mostly methane).

5.1.5 "With measure WM- Demand Side Management (DSM)" scenario and the total effect of policies and measures

Studies carried out by the EIE show that it may be possible to reduce peak and energy demands by using Demand Side Management. A reduction of 15% in the industrial sector and 10% in the residential sector are assumed to assess the combined impact on emissions as well as energy and electricity.
However, increasing efficiency requires some investment in the improvement of appliances and infrastructure. The estimated total cost for this investment is calculated to be approximately 100 million YTL annually, starting from 2008 to 2020. But one limitation is that estimated potential and associated costs by 2003 are not available for the transport sector. The WM (DSM) scenario therefore focuses mainly on industry and residential sectors. One noticeable effect is nuclear power. Although three 1,500 MW capacity nuclear units enter the system by 2012, 2014 and 2015 under the WM (Reference) Case, only two units will come into operation under the DSM Scenario in the years 2015 and 2018. Electricity imports also drop by 1.9 GWh by 2020.

Energy Consumption and Energy Supply

By 2020, total final energy consumption will drop by 16.2 mtoe or 9.2% from 176.6 to 160.3 mtoe (Fig. 5.12 and Table 5.5). Renewables will remain at the same level as under the WOM scenario (Reference Scenario) as they are assumed to be unaffected by the DSM programme. Hence, the largest declines are in hard coal, with a drop of 16.4% (6.2 mtoe), natural gas at 13.4% (3.4 mtoe), and lignite at 12.5% (0.5 mtoe). Electricity consumption will fall by 10.8% (4.6 mtoe or 53.7 TWh) while oil products will only decrease by 2.8% (1.5 mtoe), as the majority of their consumption in the transport sector is not affected by DSM efforts.

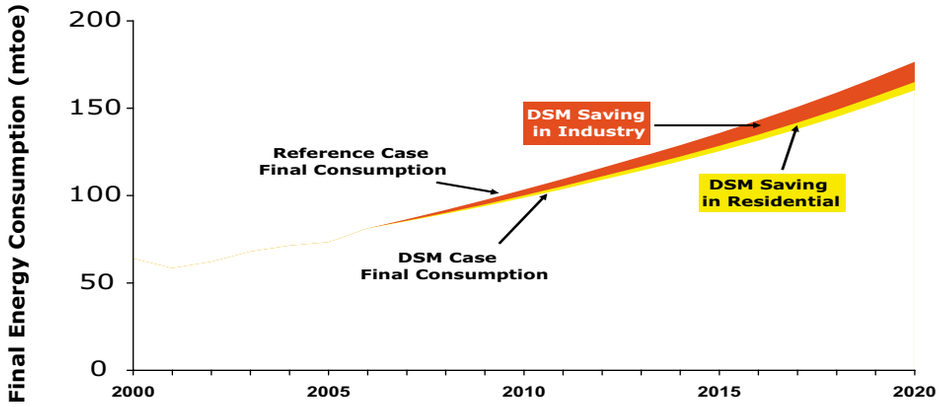


Fig. 5.12 WM (DSM) Scenario Final Energy Consumption.

In accordance with the assumed DSM potential in households, overall residential final consumption will fall by 4.8 mtoe or by 10% (2020). Figure 5.13 shows that a proportionally larger decline can be seen for residential, hard coal and coke (17.4%, 1.1 mtoe), natural gas (13.6%, 1.5 mtoe), lignite (10.6%, 0.1 mtoe), and oil products (10.6%, 0.3 mtoe). Residential electricity demand in 2020 will be 19.6 TWh, or 10% below Reference Scenario levels (a cut from 16.8 to 15.1 mtoe or 195.2 to 175.7 TWh).

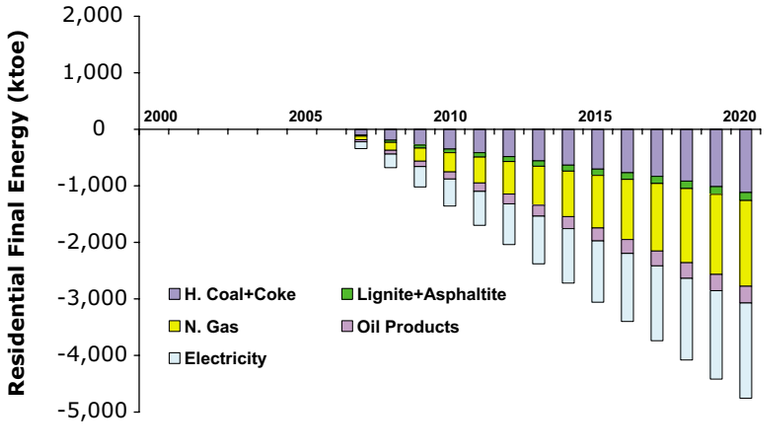


Fig. 5.13 WM Scenario Change in Residential Final Consumption.

In the industrial sector, the overall drop in final consumption will be 15% (11.5 mtoe) by 2020. As Figure 5.14 shows, industrial hard coal and coke consumption in 2020 drops by about 5.1 mtoe (16.3%), oil products by 1.2 mtoe (13.5%), lignite by 0.4 mtoe (14.9%) and natural gas by 1.9 mtoe (13.5%). Industrial electricity demand in 2020 will be 2.9 mtoe or 34.1 TWh (15%) below Reference Scenario levels.

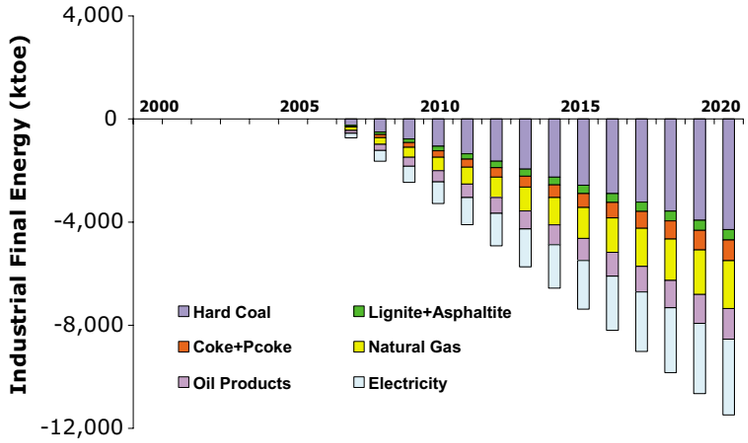


Fig. 5.14 WM Scenario Change in Industrial Final Consumption

The WM (DSM) scenario will result in a drop in total energy supply needs, that is, 23.9 mtoe in 2020 or 10.7% below Reference Scenario levels. The majority, that is 66.2% of this, comes from a reduction in energy imports by 15.8 mtoe, a reduction of 10.0% below the Reference Scenario. The energy import savings consist of 10.9 mtoe of hard coal/coke (24.5%), 3.9 mtoe of gas (7.7%), 1.1 mtoe of oil products (3.2%), and 0.16 mtoe (1.9 GWh) of electricity. In addition, domestic supplies will also fall by 7.9 mtoe, that is a 12% reduction compared to the WOM (Reference)Scenario. Lignite (4.7 mtoe or 14.4%) and nuclear fuel (2.7 mtoe or 33.3%) are dominant in that decrease.

Table 5.5 WM (DSM) Scenario Change in Consumption and Primary Energy Supply

Sector/Fuel	2000	2005	2010	2015	2020
CHANGE IN FINAL ENERGY CONSUMPTION (KTOE)					
Residential	0.0	0.0	-1,359	-3,058	-4,757
Industrial	0.0	0.0	-3,279	-7,378	-11,478
TOTAL	**0.0**	**0.0**	**-4,638**	**-10,436**	**-16,235**
CHANGE IN FINAL ENERGY CONSUMPTION (KTOE)					
Hard Coal + Coke	0.0	0.0	-1,657	-3,818	-6,214
Lignite + Asphaltite	0.0	0.0	-242	-435	-547
Natural Gas	0.0	0.0	-862	-2,130	-3,369
Oil Products	0.0	0.0	-557	-1,083	-1,484
Electricity	0.0	0.0	-1,319	-2,970	-4,620
TOTAL	**0.0**	**0.0**	**-4,638**	**-10,436**	**-16,235**
CHANGE IN TOTAL NATURAL GAS CONSUMPTION (MILLION M^3)					
Residential	0.0	0.0	-360	-987	-1,609
Industrial	0.0	0.0	-557	-1,279	-1,974
Electric	0.0	0.0	-2,489	-149	-698
TOTAL	**0.0**	**0.0**	**-3,407**	**-2,414**	**-4,282**
CHANGE IN PRIMARY ENERGY SUPPLIES (KTOE)					
Hard Coal + Coke	0.0	0.0	-1,927	-4,202	-11,488
Lignite + Asphaltite	0.0	0.0	-630	-2,933	-4,671
Natural Gas	0.0	0.0	-2,936	-2,254	-3,951
Oil Products (Net imports)	0.0	0.0	-316	-1,574	-1,167
Nuclear	0.0	0.0	0	-5,486	-2,743
Net Electricity Import	0.0	0.0	0	0	160
TOTAL	**0.0**	**0.0**	**-5,808**	**-16,449**	**-23,861**

Emissions under the WM (DSM) scenario

Emission reductions in the WM (DSM) scenario will take place in the power, industry and residential sectors. The DSM will reduce national CO_2 emissions in 2020 by 75 million tons per year, or 12% (Fig. 5.15). Sectoral reductions are as follows.

- 37.2 mtp.a or 16.8 % in the power sector
- 28.7 mtp.a. or 14.6 % in industry
- 9.4 mtp.a or 14.4 % in the residential sector

The larger percentage reduction in the power sector is due to the proportionally higher decline of fossil fuels, particularly coal use. The 16.8% reduction in the power sector is close to the reduction in coal consumption for electricity since the DSM essentially reduces lignite and imported coal-fired generation.

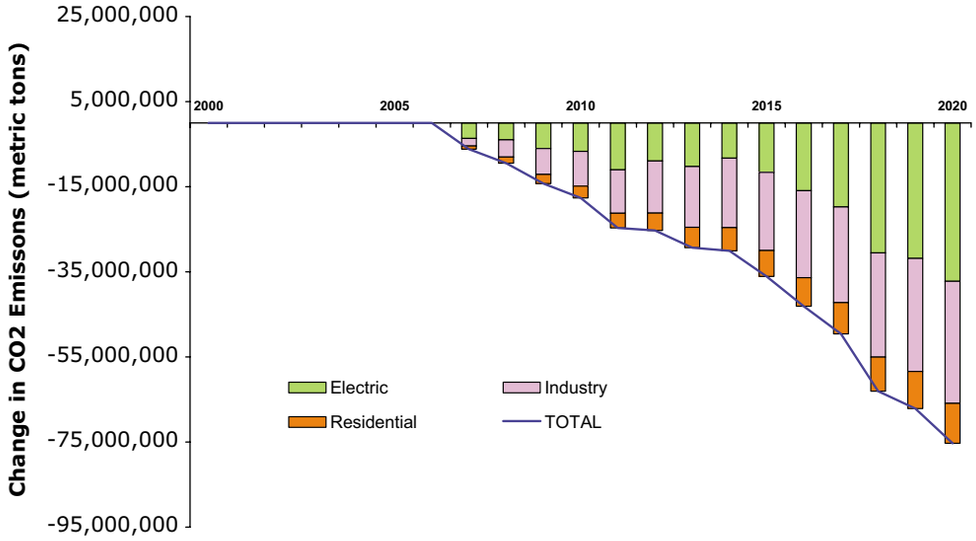


Fig. 5.15 WM Scenario Change in CO_2 Emissions.

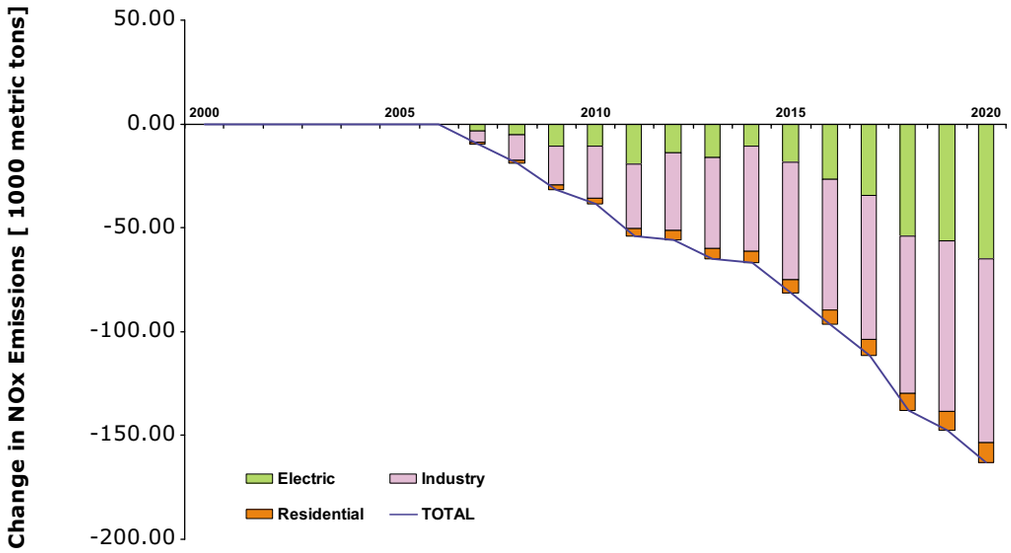


Fig. 5.16 WM Scenario Change in Power Sector NOX Emissions.

National SO_2 emissions will be reduced by 203.2 kt p.a. from 2.36 to 2.15 million kt p.a. or by 8.6%. Industry accounts for the large majority of projected reductions, that is, 133.5 kt p.a.or 66% of total reductions. This will lower industrial emissions in 2020 by 13.5% from 986.0 to 852.6 kt p.a. Total SO_2 emission reductions in the power sector will be 4.1% compared with the WOM (Reference) Scenario. The DSM reduces SO_2 emissions from the residential sector in 2020 by 20.6 kt p.a. (13.1%) from 157.9 to 137.3 kt p.a.

National NOX emissions in 2020 will be reduced by 163.2 kt p.a. (6.4%) from 2.55 to 2.38 million tons per year. Industry accounts for 54% of total reductions, the power sector for 40%, and the household sector for 6%. The DSM will cut industrial emissions by 88.8 kt p.a. (14.8%) from 601.2 to 512.5 kt p.a. Power sector emissions in 2020 will drop by 64.7 kt p.a. (12.5%) from 518.3 to 453.5 kt p.a. due to lower coal and gas combustion (Fig. 5.16). Residential DSM cuts 2020 NOX emissions in that sector from 84.2 to 74.5 kt p.a., a reduction of 9.7 kt p.a. (11.5%).

National CH_4 emissions by 2020 will be down by 49.8 kt p.a. (11.8%) from 421.4 to 371.6 kt p.a. Supply accounts for the large majority of the projected reductions, that is, 30.4 kt p.a. or 61% of the total reduction because of the large decline in hard

coal consumption. It is followed by residential (33% of the total reduction) and industry (6% of the total reduction). Reductions in the power sector are negligible.

National N2O emissions in 2020 will have been reduced by 974.8 kt p.a. (6.4%) from 7.1 to 6.1 kt p.a.
Forecasts for GHG Emissions 2005-2020, WOM (Reference) and WM (DSM) are given in Table 5.6.

Table 5.6 Forecast GHG Emissions 2005-2020, WOM (Reference) and WM (DSM)

	WOM (REFERENCE) SCENARIO				WM (DSM) SCENARIO			
	Million Metric Ton							
CO_2 EMISSIONS								
Emission Source	2005	2010	2015	2020	2005	2010	2015	2020
Electric	81,79	116,53	151,8	221,96	81,79	109,84	140,19	184,75
Industry	75,29	115,46	146,53	196,41	75,29	107,32	128,16	167,72
Transport	43,19	60,12	80,03	102,44	43,19	60,12	80,03	102,44
Residential	30,92	45,71	57,64	65,21	30,92	42,91	51,56	55,82
Agriculture	9,53	11,99	14,97	18,61	9,53	11,99	14,97	18,61
TOTAL	240,73	349,81	450,98	604,63	240,73	332,18	414,92	529,33
	1000 Metric Ton							
SO_2 EMISSIONS								
Emission Source	2005	2010	2015	2020	2005	2010	2015	2020
Electric	818,3	1019,47	1091,33	1196,46	818,3	1023,86	1052,63	1147,44
Industry	489,77	677,93	797,25	986,07	489,77	633,43	705,15	852,56
Transport	122,22	14,03	15,12	16,47	122,22	14,03	15,12	16,47
Residential	125,71	152,22	157,47	157,93	125,71	144,09	142,62	137,29
Agriculture	44,31	0,4	0,5	0,62	44,31	0,4	0,5	0,62
TOTAL	1600,3	1864,1	2061,7	2357,6	1600,3	1815,8	1916,01	2154,39
	1000 Metric Ton							
NO_X EMISSIONS								
Emission Source	2005	2010	2015	2020	2005	2010	2015	2020
Electric	191,03	315,8	384,33	518,27	191,03	305,16	365,97	453,52
Industry	227,62	351,05	446,56	601,22	227,62	326,05	389,94	512,45
Transport	438,13	610,28	812,91	1036,71	438,13	610,28	812,91	1036,71
Residential	56,32	67,61	77,28	84,2	56,32	64,64	70,94	74,49
Agriculture	157,59	198,18	247,51	307,65	157,59	198,18	247,51	307,65
TOTAL	1070,7	1542,9	1968,6	2548	1070,7	1504,3	1887,28	2384,82
	1000 Metric Ton							
CH_4 EMISSIONS								
Emission Source	2005	2010	2015	2020	2005	2010	2015	2020
Electric	1,32	1,65	2,08	2,89	1,32	1,56	1,96	2,51
Industry	6,48	10,26	13,25	18,17	6,48	9,5	11,5	15,4
Transport	5,09	7,34	9,97	12,86	5,09	7,34	9,97	12,86
Residential	113,36	133,59	140,3	150,47	113,36	128,25	129,75	134,19
Agriculture	1,31	1,65	2,06	2,56	1,31	1,65	2,06	2,56
Supply	80,34	184,81	210,7	234,41	80,34	177,94	193,73	204,04
TOTAL	207,9	339,3	378,36	421,37	207,9	326,24	348,97	371,57
	Metric Ton							
N_2O EMISSIONS								
Emission Source	2005	2010	2015	2020	2005	2010	2015	2020
Electric	766,31	1128,9	1501,76	2381,98	766,31	1090,68	1341,38	1849,458
Industry	862,98	1345,76	1709,63	2321,74	862,98	1247,28	1485,25	1967,194
Transport	423,74	576,65	759,19	978,17	423,74	576,65	759,19	978,1705
Residential	1185,93	1189,73	1188,48	1231,32	1185,93	1160,85	1130,91	1143,575
Agriculture	78,8	99,09	123,76	153,82	78,8	99,09	123,76	153,8241
TOTAL	3317,8	4340,1	5282,8	7067	3317,8	4174,6	4840,49	6092,22

The overall effect of the WM (DSM) scenario in terms of equivalent carbon units is given below in Table 5.7.

Table 5.7 Actual Emissions and Forecast Emissions under WM (DSM) Scenario, in MTCE.

WM (DSM) SCENARIO								
MTCE	1000 Metric Ton							
Emission Source	1990	1995	2000	2003	2005	2010	2015	2020
Electric	9.311,72	12.952,75	21.011,43	20.297,95	22.379,50	30.058,73	38.359,17	50.555,91
Industry	10.291,36	11.508,09	16.423,95	18.471,77	20.644,06	29.427,93	35.145,09	45.996,54
Transport	7.245,33	9.175,43	9.933,63	10.243,63	11.842,94	16.487,33	21.948,30	28.093,68
Residential	8.872,79	9.918,76	10.404,81	9.857,15	9.182,99	12.534,30	14.900,77	16.088,09
Agriculture					2614,46	3.287,80	4.106,22	5.103,88
Supply				361,73	460,12	1.019,09	1.109,53	1.168,62
TOTAL	35.721,20	43.555,04	57.773,82	59.232,23	67.124,06	92.815,19	115.569,08	147.006,73

Note: See the note on the agriculture and supply sectors in Table 5.4.

5.1.6 Conclusions

Without Measures Scenario (Reference Case)

The following points may be reiterated from the results of the Reference Case:

- Prices: the future price of coal index does not vary much. After its peak in 2001, it gradually declined to 101. The future price of gas will also decline continuously after it peaked in 2005 (139). The oil price index peaked in 2006 (150) followed by a continuous drop until 2015 (119) and a steady increase, reaching 125, by 2020.
- A total capacity of 4500-5000 MW nuclear units will be added to the power system by 2015.
- Final energy demand will increase from 68 mtoe to 177 mtoe over the study period. Industry will have the highest share, followed by the residential and transport sectors. Oil products, electricity and coal are the most important sectors. Demand for electricity and hard coal will more than triple and the demand for oil products more than double.

Overall energy imports are estimated to increase from 61 mtoe to 157 mtoe between 2003 and 2020.

With Measures (Demand Side Management Scenario)

Table 5.8 summarises the main economic and environmental results for the WM (DSM) Scenario. The incremental change and the percent-based reduction are based on the Reference Case. The net present value of the economic cost of delivered energy for the DSM Scenario is projected to be $334.9 billion (NPV over 2003–2020). The incremental cost is negative, that is, a NPV of -$15.5 billion. This appears to make DSM a very attractive option. The scenario is cost-effective and turns out to be a “win-win” situation.

The overall fuel savings and the lower capital investment requirements in the power sector more than offset the costs involved in implementing the DSM programme. The very high cost savings come with the highest cumulative emission reductions of all scenarios, i.e. 0.5 billion tons of CO2 (7.1% reduction), 1.6 million tons of SO2 (4.6% reduction), 1.1 million tons of NOX (3.6% reduction), and 0.4 million tons of PM (3.8% reduction). Cost effectiveness could be $-113/ton, which means, under this scenario, a 1-ton decrease in MTCE in savings of $113.

Table 5.8 WM (DSM) Scenario Cost and Environmental Summary

	Unit	Absolute Results	Incremental Change	Incremental Change (%)	Cost-Effectiveness ($/ton)
Economic Results					
Total Economic Cost	10^9 US$2003	334,900	-15,5167	-4,43	
Net Energy Import Bill	10^9 US$2003	163,298	-4,5629	-2,72	
GHG Emissions					
Cumulative CO_2 Emissions	1000 tons	6.462.013	-491.047	-7,06	-31,6
Cumulative MTCE Emissions	1000 tons	1.800.728	-136.586	-7,05	-113,6
Ancillary Benefits					
Cumulative SO_2 Emissions Nominal	1000 tons	32.763	-1.574	-4,58	
Cumulative NO_x Emissions Nominal	1000 tons	29.300	-1.079	-3,55	
Cumulative PM Emissions Nominal	1000 tons	10.505	-410	-3,76	

Cumulative emissions are calculated as the sum of emissions over 2003-2020. MTCE is the metric tons of carbon equivalent and includes CO2,CH4 and N2 O.

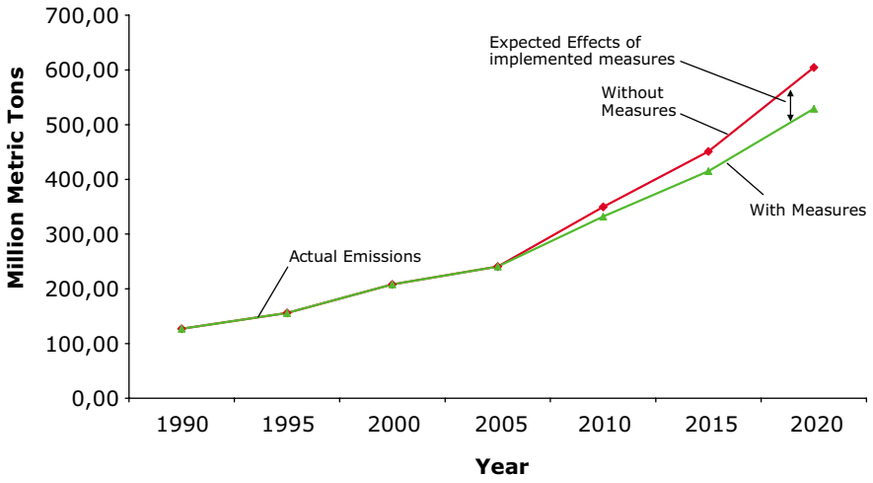


Fig 5.17 National CO2 Emissions WOM (Reference) and WM (DSM) Scenarios

Table 5.9 and Fig. 5.17 bring it all together. They report MTCE emissions under the WOM (Reference) and WM (DSM) scenarios.

Table 5.9 Forecast WOM (Reference) and WM (DSM) Emissions, in MTCE

MTCE emissions	2003	2005	2010	2015	2020
WOM (Reference) Scenario	59.468	67.124	97.713	125.608	167.909
WM (DSM) scenario	59.468	67.124	92.815	115.569	147.007

The following comments may be made based on the discussion in the text and in the light of the above Table 5.9 and its Fig. 5.17:

Under the DSM scenario, the economic cost of energy supply and the cost of energy imports will be lower, as will the emissions of CO2/GHG. In addition, there are substantial ancillary benefits involved in terms of PM, SO2, NOx.

The DSM scenario with more conservative and efficient consumption of energy would help in both lowering demand and supply costs. The reduction in CO2/GHG emissions from DSM is about 7.0% over the period 2003-2020. The potential may be even higher as this analysis concentrated on the residential and industrial sectors only. It could not include the transport sector for lack of specific data.

5.2 Other Projections: Mitigation / Evaluation

In order to give a clear, quantifiable picture of how individual policies and measures result in GHG emission reductions, the input data and the method of calculation are explained in the relevant sections. The origin of input data is diverse, this is due to the different nature of individual policies. Often either the baseline or the method of calculating the emission reduction is different, too. These differences and the applied methodologies are therefore described in each case.

Besides the analytical methodology based on the Energy and Power Evaluation Program (ENPEP), hybrid approaches are also used for combinations of econometric and structural approaches. They typically involve separate models for each end use, like structural approaches, but also include econometric analysis in an effort to better incorporate behavioural responses. These models are typically used for transport demand forecasting and mitigate alternative measure forecasting in energy intensive industries such as steel and cement.

The following studies include a series of different approach trend scenarios of greenhouse gas emissions between 2010 and 2020. Some of the scenarios already include full implementation of several mitigation policies and measures that have already been approved, as described in the policies chapter. Some of energy intensive industries such as cement and steel already have been implementing abatement measures through the years.

5.3 Transport Projections

In H Gercek's study, "National Transport Rehabilitation in Turkey under the UNDP-GEF Project" ITU 2006 which is recommended and supported by "Emission Reduction in the Transport Sector Group" of the MoT, a different approach is used to forecast the impact of GHG emissions originating from the transport sector by promotion of a long-term modal shift to more efficient and less polluting forms of transport. [3]. The results of this study differ from the results presented in the energy projections, owing to the different models that has been employed. Detailed analysis of projections for short and long term scenarios and the resulting emission estimations are given in the present study based on the methodology and emission rates accepted in the report prepared as "Greenhouse Gas Emissions Resulting From Transport Sector In Turkey – 2006 Inventory Analysis And Projections Under The UNDP-GEF Project ITU 2006 [2].

5.3.1 Developing Future Scenarios

The quantitative description of emission scenarios can be used as input for computing the future extent of climate change and for assessing strategies to reduce emissions.

In most of these scenarios, significant developments in energy efficiency, energy conservation and alternative energy technologies are key to emission reduction.

It is important that emission scenarios consider qualitative aspects that are potentially important for future GHG emissions and mitigation policies. A fruitful way of incorporating qualitative dimensions into quantitative scenarios is to develop quantitative estimates of key variables based on qualitative description of future worlds.

With a population of about 73 million and a GDP of €215 billion at current prices, Turkey is among the 20 biggest economies in the world. Furthermore, it is an unsaturated market in almost every category of consumer goods ranging from fast moving consumer goods to high technology products. Its demographic transformation also contributes to a high growth potential. Chapter 2 fig 2.9 presents the population projection made by TURKSTAT for the period between 2005 and 2020. In this study, a higher growth rate of 6 % is assumed for the period between 2005 and 2020. This is the growth rate assumed in the "central scenario" in the TINA Turkey Project [4]. This scenario is also referred as the "new trend scenario", which is mostly based on recent trends of the past five years, directly influenced by breaks in trends having recently occurred in world trade.

Methodology for Estimating Emissions From Road and Rail Transport

In 2004, 98% of passenger transport and almost 100% of freight transport was carried by road and rail in Turkey. Therefore, GHG emission estimates have been made for road and rail transport in the period between 2005 and 2020.

Two separate approaches were used to estimate emissions from road transport:
1. Estimating emissions based on the fleet size of motor vehicles (Fleet-based estimation).
2. Estimating emissions based on traffic demand, considering the modal shift from road to rail (Demand-based estimation).

For railway transportation, demand-based estimation methodology was used based on the emission factors that were adopted by Soruşbay and Ergeneman (2006). [2]

5.3.2 Fleet-Based Estimation of Emissions From Road Transport

Motor Vehicle Fleet Size Projections

At present, 95% of passenger transport and 94% of freight transport are carried by road resulting in considerable GHG emissions in the transport sector. There are currently 5.4 million passenger cars on Turkey's roads and the domestic demand for motor vehicles continues to grow unabated.

The number of motor vehicles between 1990 and2004 in Turkey is given in Chapter 2 Fig 2.16. Vehicle ownership (number of vehicles per 1,000 inhabitants) has increased from 78 in 1992 to 143 in 2005 (Fig. 5.18). Automobile ownership has increased from 37 to 75 in the same period. In general, there is a strong relationship between per capita GDP and vehicle ownership (Fig. 5.19) according to regression analyses carried out with data from the 1992-2005 period.

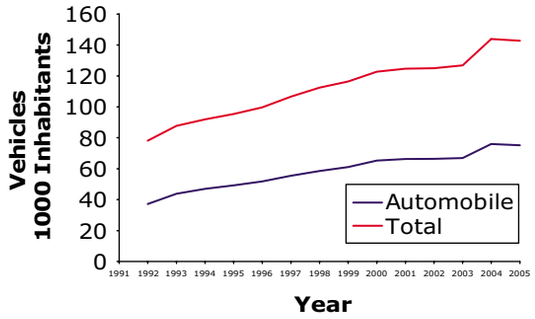


Fig. 5.18 Number of Vehicles per 1000

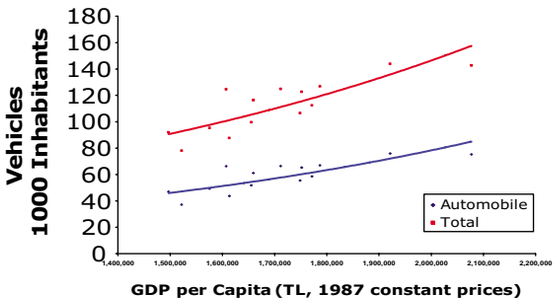


Fig 5.19 Vehicle Ownership vs. per capita GDP Inhabitants in Turkey

Assuming an average growth rate of 6% in GDP and considering the population projections given in Table 5.10, vehicle ownership projections have been made as shown in Fig. 5.20. It is estimated that automobile and motor vehicle ownership will increase to 332 and 535 in 2020, respectively. As shown in Fig 5.21 the number of cars in Turkey is estimated to increase 4.4 times and the number of motor vehicles by 5.2 times in the 2005–2020 period. Motor Vehicle Fleet Projections are given in Ffig.5.22

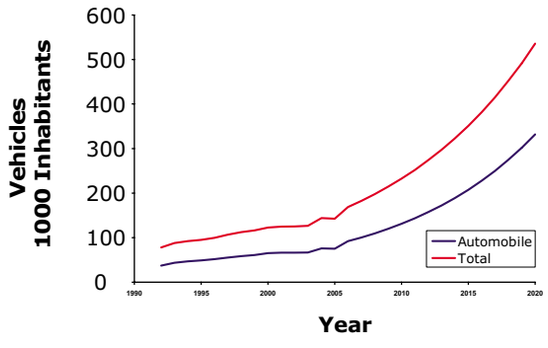


Fig. 5.20 Vehicle Ownership Projections

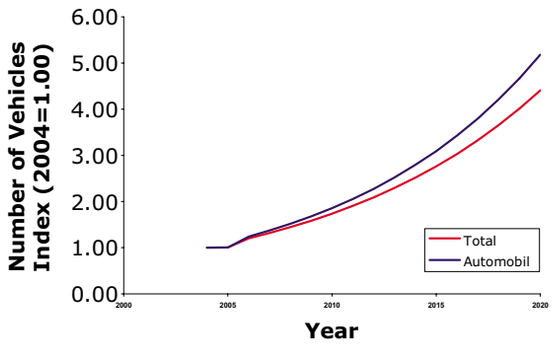


Fig. 5.21 Vehicle Ownership Growth Index

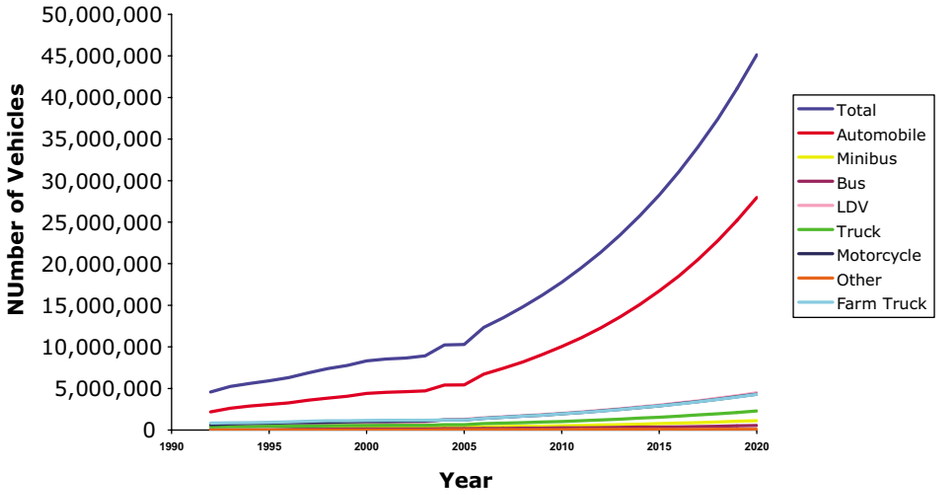


Fig 5.22 Motor Vehicle Fleet Projections

Emissions From Motor Vehicle Fleet

As explained in the study [2],the fuel-based approach was used to estimate future GHG emissions from road vehicles. Emission factors were used in the (IPCC) Tier 1 approach. Combustion efficiency is assumed to be 99% in most cases, depending on the fuel used. The average distance travelled by each vehicle category every year was assumed as that given in [2] and Fig 4.9, Chapter 4.

Estimates for annual vehicle-km for each vehicle category in the 2005 – 2020 period are given in Table 5.10, GHG emissions estimates for the same period are given in Table 5.11.

Table 5.10 Projections for Vehicle-Km in Turkey [2]

Year	Vehicle-Km (Million)					
	Automobile	Minibus	Bus	LDV	Truck	Motorcycle
2005	66,556	6,406	10,253	24,843	22,707	2,449
2010	121,355	10,228	16,369	39,393	36,323	3,908
2015	190,484	15,260	24,422	58,775	54,194	5,831
2020	299,326	22,641	36,236	87,206	80,410	8,651

Table 5.11 Estimation of Emissions From The Motor Vehicle Fleet in Turkey

Year	CO2 (Mt)	NOx (t)	CH4 (t)	NMVOC (t)	CO (t)	N2O (t)
2005	49.82	501,838	4,790.34	361,477.48	2,245,411.04	2,350.26
2010	82.47	811,014	7,970.18	582,839.28	3,596,770.49	4,328.50
2015	123.60	1,149,906	11,200.04	722,197.33	4,232,315.31	8,317.68
2020	184.55	1,608,295	15,505.68	830,523.60	4,424,120.69	15,441.73

It should be noted that older vehicles, or those with antiquated or malfunctioning pollution control systems are a major source of emissions in Turkey for a variety of reasons. Turkey has a large number of older, uncontrolled vehicles that make a disproportionate contribution to air pollution problems. One third of trucks in Turkey are older than 20 years (Table 5.12).

Table 5.12 Age Distribution of Motor Vehicles (%)

Age (Years)	Automobil	Minibus	Bus	Small Truck	Truck	Total
>25	7.1	10.8	12.5	14.2	22.6	9.8
21-25	3.5	4.9	7.3	3.2	10.7	4.2
16-20	9.8	9.6	10.4	4.4	11.3	9.0
11-15	26.7	17.4	21.5	10.6	15.1	22.6
6-10	24.8	28.9	21.4	25.1	22.2	24.8
0-5	28.1	28.4	26.9	42.5	18.1	29.6
Total	100.0	100.0	100.0	100.0	100.0	100.0

It is estimated that removal of about 320,000 old vehicles from registers by providing a tax advantage to consumers in 2003 and 2004 has resulted in a 4.87% reduction in CO2 emission in total on a yearly basis [2].

5.3.3 Demand-Based Estimation of Emissions From Road to Rail

Cities in Turkey are linked by a good network of about 64,000km of highways. As a part of the Trans-European Motorway (TEM) project, 1,851km of motorways have been built in the last two decades. Lack of investment in railways has resulted in inadequate rail transport and a dramatic decline in rail traffic. In 2005, road transport represented 94% of the freight transport market and 95 % of the passenger transport market in Turkey. Strategic and demand based solutions generally rely on influencing behaviour and can use a wide variety of methods to do so. Data are often not complete enough to allow for estimates of the cost-effectiveness of these "non-technical" type measures. The main increase in passenger vehicle kilometres seems to arise not from people travelling more often, but from travelling further and with greater use of private cars.

In this study, emissions were estimated on the basis of future traffic demand by:
a) Analysing the relationship between total transport demand and GDP growth according to data from the 197 –2004 period.
b) Estimating future transport demand by road and rail.
c) Analysing the relationship between transport demand and emissions from road and rail transport.
d) Estimating emissions from road and rail transport in the 2005–2020 period.

Relationship Between Transport Demand and GDP Growth in Turkey

In the 1970–2004 period, transport demand was strongly linked to GDP growth in Turkey. Passenger demand (as measured by passenger kilometres) has grown at an annual rate of 4.20% and freight demand (as measured by ton-kilometres) at an annual rate of 5.31%, whilst GDP (as measured at 1987 constant prices) has grown at an annual rate of 4.20%. Fig. 5.23 shows regression analyses carried out with data from the 1970-2004 period, the log-linear type of relationship between the economic growth and transport demand in Turkey during this period.

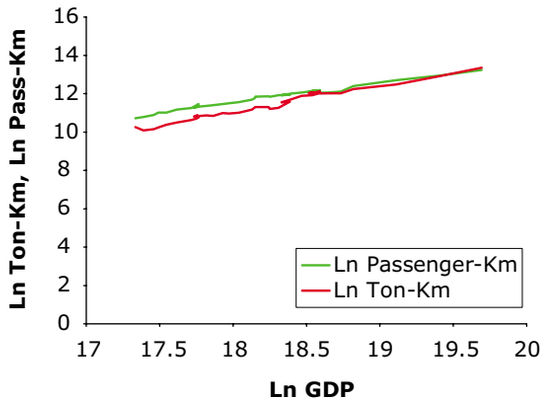


Fig. 5.23 Log-Linear Relationship between GDP and Transport Demand in Turkey (1970 – 2005)

Future Transport Demand by Road and Rail

The Turkish railway network is relatively underdeveloped. The existing railway network is concentrated on a few major routes. One of the primary objectives of Turkish transport policy is to restructure the railways. In 2005, rail market shares were 3% and 6% for passenger and freight transport, respectively. In this study, it is assumed that rail transport will increase its market share as shown in Table 5.13.

Table 5.13 Assumed Market Shares of Road and Rail Transport in Turkey (2010-2020)

Year	Railways		Highways	
	Passenger-Km	Ton-Km	Passenger-Km	Ton-Km
2010	0.05	0.08	0.92	0.90
2015	0.07	0.12	0.89	0.85
2020	0.09	0.15	0.86	0.80

Assuming an average annual GDP growth of 6% in the future and modal shifts from road to rail as given in Table 5.13, passenger and freight transport demand by road and rail are estimated in Table 5.14.

Table 5.14 Estimated Transport Demand by Road and Rail

Year	Passenger-Km (Million)			Ton-Km (Million)		
	Railways	Highways	Total	Railways	Highways	Total
1990	6,410	134,991	142,736	8,031	65,710	81,082
1995	5,797	155,202	163,726	8,632	112,515	121,654
2000	5,833	185,681	195,099	9,895	161,552	179,657
2005	6,972	232,060	243,323	11,712	195,080	207,192
2010	16,490	303,409	329,792	21,135	237,764	264,182
2015	29,128	370,339	416,111	48,792	345,610	406,600
2020	50,704	484,505	563,378	93,869	500,634	625,793

Relationship Between Emissions and Transport Demand

Soruşbay and Ergeneman (2006) [2] estimate emissions from road transport in the 1990–2004 period by using the emission factors used in (IPCC) Tier 1 approach. The final report in 2006 of the researchers [2] presents the IPCC Tier 2/3 refinements of emissions from road transport in Turkey. Estimated fuel-based emissions from railway transport are also given.

Table 5.15 and Table 5.16 show transport demand (as measured by passenger-km and ton-m) and emissions from road and rail transport, respectively.

By using the data provided, linear regression analyses were carried out to look at the relationship between emissions and transport demand for road transport. The results of regression analyses are shown in Table 5.17.

Table 5.15 Transport Demand and Emissions From Road Transport

Year	Passenger-Km (M)	Ton-Km (M)	CO2 (Mt)	NOx (t)	CH4 (t)	NMVOC (t)	CO (t)	N2O (t)
1990	134,991	65,710	22.71	238,413.03	3,233.85	208,090.27	1,499,833.46	796.34
1991	131,029	61,969	21.45	223,729.57	3,135.67	205,089.93	1,452,805.36	748.01
1992	142,172	67,704	21.98	227,037.64	3,426.78	230,268.23	1,617,451.86	742.42
1993	146,029	97,843	26.55	273,186.96	4,091.63	274,174.06	1,937,961.51	904.71
1994	140,743	95,020	28.39	286,607.94	4,948.39	340,032.55	2,420,536.79	904.08
1995	155,202	112,515	30.40	306,766.78	5,434.96	373,918.54	2,588,099.30	971.49
1996	167,871	135,781	32.78	332,834.80	5,850.09	398,825.36	2,697,910.83	1,068.58
1997	180,967	139,789	30.78	306,657.93	5,794.54	401,689.78	2,730,020.14	979.60
1998	186,159	152,210	28.84	283,448.78	5,735.12	400,925.03	2,707,076.67	912.35
1999	175,236	150,947	31.55	313,718.08	5,727.33	391,659.80	2,570,564.72	1,092.11
2000	185,681	161,552	32.28	327,744.42	5,127.33	335,095.29	2,189,338.57	1,208.70
2001	168,211	151,421	32.26	331,834.28	4,725.42	299,961.01	1,918,439.95	1,265.10
2002	163,327	150,912	33.63	348,251.84	4,680.01	290,427.08	1,851,551.89	1,366.29
2003	164,311	152,163	35.80	368,445.50	4,621.52	280,537.62	1,749,873.25	1,539.98
2004	174,312	156,853	39.09	394,434.76	4,648.26	272,841.25	1,645,523.87	1,905.15

Table 5.16 Transport Demand and Emissions From Rail Transport

Year	Passenger-Km (M)	Ton-Km (M)	Fuel (Lt)	Fuel (Ton)	CO2 (Mt)	NOx (t)	CH4 (t)	NMVOC (t)	CO (t)	N2O (t)
1990	6,410	8,031	190,661,176	162,062	0.517	12,041	40.5	891	4,230	13.0
1991	6,048	8,093	194,117,647	165,000	0.526	12,259	41.2	907	4,306	13.2
1992	6,259	8,383	183,529,412	156,000	0.497	11,591	39.0	858	4,072	12.5
1993	7,147	8,511	215,294,118	183,000	0.583	13,597	45.8	1,007	4,776	14.6
1994	6,335	8,338	228,235,294	194,000	0.618	14,414	48.5	1,067	5,063	15.5
1995	5,797	8,632	228,235,294	194,000	0.618	14,414	48.5	1,067	5,063	15.5
1996	5,229	9,018	233,294,118	198,300	0.632	14,734	49.6	1,091	5,176	15.9
1997	5,840	9,716	232,941,176	198,000	0.631	14,711	49.5	1,089	5,168	15.8
1998	6,160	8,466	235,294,118	200,000	0.638	14,860	50.0	1,100	5,220	16.0
1999	6,146	8,446	235,294,118	200,000	0.638	14,860	50.0	1,100	5,220	16.0
2000	5,833	9,895	176,295,000	149,851	0.478	11,134	37.5	824	3,911	12.0
2001	5,568	7,562	139,288,000	118,395	0.377	8,797	29.6	651	3,090	9.5
2002	5,204	7,224	140,053,000	119,045	0.380	8,845	29.8	655	3,107	9.5
2003	5,878	8,669	145,614,000	123,772	0.395	9,196	30.9	681	3,230	9.9
2004	5,237	9,417	138,116,000	117,399	0.374	8,723	29.3	646	3,064	9.4

Table 5.17 Results of Regression Analysis of Emissions vs. Transport Demand for Road Transport

	Coefficients					
	CO2 (Mt)	NOx (t)	CH4 (t)	NMVOC (t)	CO (t)	N2O (t)
PKM	0.00012355	1.310819857	0.023804436	1.758322839	14.40027381	0.0018285
TKM	7.9785E-05	0.739819474	0.007415774	0.252770134	-1.685239549	0.0063967
R Square	0.991	0.989	0.987	0.976	0.969	0.961
Standard Error	3.09	34,076.50	589.87	53,034.10	405,521.36	240.73

PKM: Passenger-Km (Million), TKM: Ton-Km (Million)

Similarly, a linear regression analysis was carried out to find a relationship between fuel consumption (in tons) and transport demand in railways.

Results of Demand-Based Estimations of Emissions From Road and Rail Transport

For each emission category, emissions from road transport were calculated by multiplying future transport demand with the coefficients given in Table 5.17. In order to estimate emissions from rail transport, emission factors given in the Appendix D of the Final Report [2] were used to make the calculations. Assuming an annual GDP growth of 6% in the 2005-2020 period, Table 5.18 summarises the total emissions from road and rail transport estimated by a demand-based approach.

Table 5.18 Results of Demand-Based Estimates of Emissions

Year	CO2 (Mt)	NOx (t)	CH4 (t)	NMVOC (t)	CO (t)	N2O (t)
2005	44.89	463,729.40	7,021.93	458,473.43	3,018,316.98	1,688.56
2010	57.87	606,562.57	9,096.53	596,028.90	3,980,051.72	2,111.15
2015	76.05	804,642.66	11,592.35	743,236.12	4,772,853.49	2,956.28
2020	104.72	1,120,165.56	15,631.85	986,951.21	6,173,602.16	4,211.78

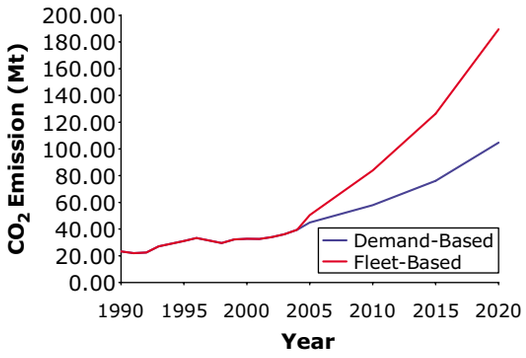


Fig 5.24 CO2 Emissions From Road and Rail

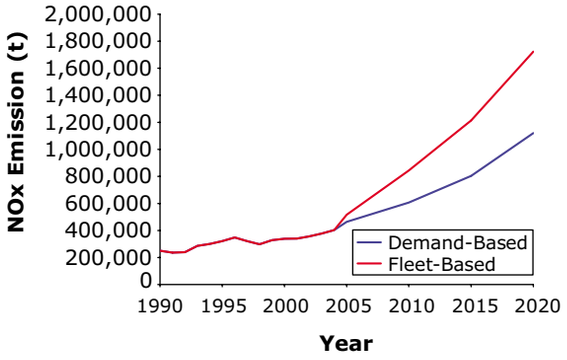


Fig. 5.25 NOx Emissions From Road and Rail

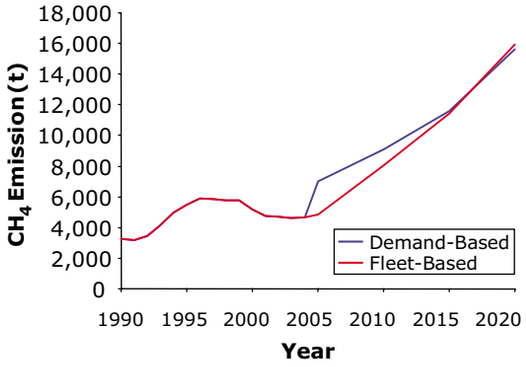


Fig. 5.26 CH4 Emissions From Road and Rail

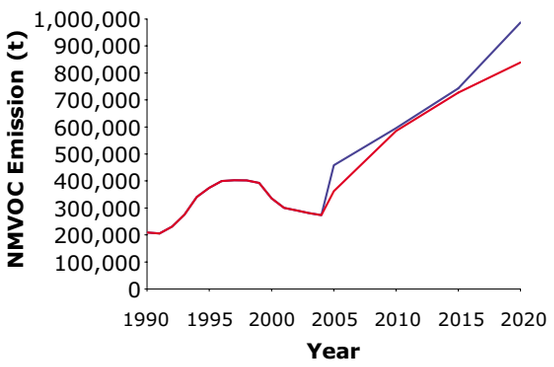


Fig. 5.27 NMVOC Emissions From Road and Rail

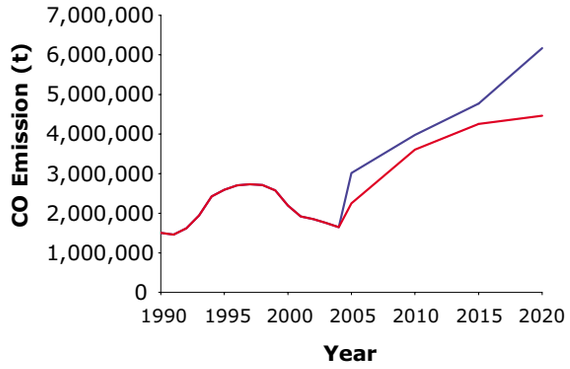


Fig. 5.28 CO Emissions From Road and Rail

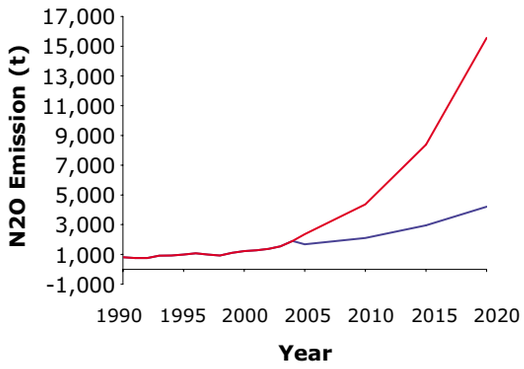


Fig. 5.29 N2O Emissions From Road and Rail

The resulting emissions estimated by using fleet-based and demand-based approaches are shown in Fig. 5.24 through to 5.29. Differences between fleet-based and demand-based emissions are due to a number of reasons:

The fleet-based approach assumes average annual kilometres travelled for each vehicle category estimated from fuel consumption in the past.

Even a moderate modal shift from road to rail is estimated to reduce total emissions by 9-12%. In this study, it is assumed that road transport will lose its passenger market by 9% and the freight market by 14 % between 2005 and 2020. In 2020, these modal shifts are estimated to reduce total emissions by 9 % for CO2, 5% for NOx, 9.6% for CH4, 10% for NMVOC, 8.6% for CO and 12.1% for N2O.

Finally, it should be noted that estimated elasticities of output variables of the transport system (such as motor vehicle fleet size, road vehicle-km travelled, passenger-km and ton-km) with respect to GDP growth as well as the estimated elasticities of emissions with respect to transportation system outputs are the main determinants of the emission estimation results. Table 5.19 summarises the changes in emissions estimated with two approaches with respect to changes in the main variables used.

Table 5.19 Changes in Variables and Emissions in the 2005-2020 Period

Variables	(%)	
GDP	139. 7	
Number of Motor Vehicles	338.9	
Road Vehicle-Km	301. 2	
Passenger-Km H	131. 5	
Ton-Km (*)	202. 0	
Emissions	**Fleet-Based**	**Demand-Based**
CO_2	270. 5	133. 3
NO_x	220. 5	141. 6
CH_4	223. 7	122. 6
NMVOC	129. 8	115.3
CO_2	97.0	104. 5
N_2O	557. 0	149. 4

5.3.4 Conclusions For Transport Scenario Projections

There are three main ways to reduce GHG emissions from transport:
Operational – reducing energy use and emissions per vehicle-km driven.
Strategic – optimising vehicle use, reducing total vehicle-km per passenger-km or per tone-km.
Demand – reducing the overall demand (passenger-km or tone-km) for travel.

A number of policy levers are available for implementing measures in these three categories.
For the purpose of preparing a detailed inventory of transport-based GHG emissions and to investigate the major parameters effecting these emissions and provide certain solutions to control them, a project is proposed by the MoT on "Abatement of Greenhouse Gases Emissions Resulted From Transport" in collaboration with TUBITA-MAM, Istanbul Technical University Mechanical Engineering Faculty and Istanbul Technical University Civil Engineering Faculty. The project was accepted by TUBITAK in Oct 2005 and it began in Oct 2006. At the end of this study more realistic and detailed scenarios will be produced in order to provide information to policy makers.

5.4. Industrial Projections

Turkey is aware of its responsibilities and has been taking measures in all economic sectors, particularly in the energy-intensive industrial sector, with the co-operation and contribution of the Manufacturers Associations of these industries, to increase energy efficiency and to reduce the impact on environment. These applications have revealed the great financial burden these measures put on the producers. Detailed measures for two industrial sectors, namely the cement industry and the iron and steel industry, will be discussed here because of their high energy intensity and their big impact on climate change.

5.4.1 Turkish Steel Industry

The study of "Estimation of Carbon Dioxide Gas Emissions in Turkish Iron And Steel Industry For The Preparation of Turkey's FNC under the UNDP" GEF Project TOBB ETU–EIE 2006 reports CO_2 emissions related to direct use of energy in the Turkish Iron and Steel Industry [5]. The Turkish Iron and Steel Producers Association, EIE, Erdemir and Isdemir provided full support and consultation during the course of this study. A survey was made in the sector and specific energy consumption values, as well as specific CO_2 emission values, were determined for the years 1990, 2004, 2010, 2015 and 2020. Total CO_2 emissions were estimated by using the total amount of steel produced and specific CO_2 emission values. It has to be noted that emission values used in these projections are based on sector-specific estimates from the Turkish Iron and Steel Producers Association. Whereas in Chapter 3 and Annex 4 industrial emission factors are estimated by using IPCC Tier1 methodology.

CO_2 Emissions and the Steel Industry

The iron and steel industry is the highest energy consuming industry in the world. During iron and steel production, energy is consumed directly by using coal, natural gas, electricity and oil. CO_2 emissions associated with the direct use of energy in the iron and steel industry were estimated to represent 7% of global CO_2 emissions [6,7]. Including indirect consumption of energy in mining and transportation of raw materials such as coal, iron ore pellets, scrap and lime used in iron and steel production, total CO_2 emissions related to the iron and steel industry might be as high as 10% of global CO_2 emissions [7]. In 1990 and 2004, the total amount of CO_2 emissions globally were estimated as 20,736 Mt and 24,983 Mt respectively [8]. Hence, in 1990 about 1,450 Mt of CO_2 and in 2003 about 1,750 Mt of CO_2 was emitted due to the direct use of energy in steel production.

Steel can be produced in integrated steel plants (ISPs) and electric arc furnaces (EAFs). Most of the CO_2 emissions from the steel industry occur during iron making in blast furnaces. The coal and coke used in the production of pig iron is responsible for about 75% of CO_2 emissions from the steel industry.

Steel making by EAFs technology is relatively new, and constitutes about 5% of the total steel production in 2004.
The amount of CO_2 emissions from iron and steel production is closely related to the type of process (ISP or EAF) and to the specific energy consumed. In ISPs, where steel is produced by BOF, the specific CO_2 emission per ton of steel is 2.5 whereas in EAFs, which uses scrap or directly reduced iron, specific CO_2 emissions are reported at 0.6 and 1.2 respectively ([7]. These values are approximate and may show variation from one country to another. In 1995, one ton of steel produced by BOF led to 2.0 tons of CO_2 emissions in Europe and in North America, but nearly 2.5 and 3.9 tons of CO_2 in Japan and China, respectively. Similarly, steel produced by EAFs led to an emission value of 0.2 ton of CO_2 in Europe, but 0.4 tons of CO_2 and 0.9 tons of CO_2 in Japan and China, respectively ([7].

In 1990, 9.31 Mt of the 733.4 Mt of steel produced globally was made in Turkey. About 53% of this amount was produced by electric arc furnaces (EAFs) and 47% by integrated steel plants (ISPs). In ISPs, 13% of the steel was produced by open-hearth furnaces (OHF) and the remaining 87% by basic oxygen furnaces (BOF). In 2004, steel production was increased to

1,038.6 Mt [9]), of which 63% was produced by BOF, 34% by EAF and 3% by OHF [10]. In the same year, the Turkish Iron and Steel Industry produced 20.60 Mt of steel, which represents about 2% of global steel production [11]. 71.5% of this steel was produced by EAFs and the remaining 28.5% by BOF [11]. Since steel production by EAFs leads to lower specific CO_2 emission values, the high EAF steel/BOF steel production ratio of the Turkish Iron and Steel Industry in 2004 (0.54 for the world and 2.5 for Turkey).

Turkish Iron and Steel Industry and CO_2 Emissions

Currently, the Turkish Iron and Steel Industry produces steel in ISPs with basic oxygen furnaces (BOF) and by electric arc furnaces (EAFs). There are three ISP and 18 EAF companies in Turkey. The companies in the Turkish Iron and Steel Industry are owned by the private sector. Only one EAF company belongs to the state.

In 2004, the total amount of CO_2 emissions was about 15.2 Mt, where 87% of it resulted from production from ISPs and 13% by EAFs [11]. According to the survey results, in 1990, these figures were 12 Mt of CO_2 and 0.668, respectively. In 2020, predicted CO_2 emissions will be about 26.54 Mt from ISPs and 2.66 Mt from EAFs, meaning that in 2020 more than 90% of CO_2 emissions will be due to emissions from ISPs.

Specific Energy Consumption and Specific CO_2 Emissions in Integrated Steel Plants in Turkey

In ISPs, energy consumption per ton of steel is given as 4,550-10,750 Mcal/ton crude steel (tcs) [6]. This range in specific energy consumption is largely due to differences in technology, fuel input, operation and maintenance. In the 1990s, steel from ISPs was produced by BOF or OHF processes. Specific energy consumption for the BOF process is given as 4,550 to 9,550 Mcal/tcs, whereas specific energy consumption for the OHF process is 7,160 to 10,750 Mcal/tcs. Hence the BOF process in steel production is more efficient energy-wise than the OHF process. In 1990, steel was produced by the BOF process in Erdemir and Isdemir, whereas in Karabük by the OHF process. Specific energy consumption values for the ISPs with specific CO_2 emission values are given in Table 5.20.

In 1990, the specific energy consumption value of Erdemir was reported as 6,665 Mcal/tcs, which is close to the average world value of 6,210 Mcal/tcs. In the 1990s Erdemir conducted projects and investments to improve specific energy consumption values and achieved a specific energy consumption value of 5,125 Mcal/tcs in 2004, which is better than the best value of 5,250 Mcal/tcs, reported in the 1990s.

During the 1990s, apart from energy efficiency studies, two major investments were made at Erdemir in order to improve specific energy consumption. One of these investments was made for improving the injection of pulverised coal into blast furnace. Injection of pulverised coal replaces a certain amount of expensive coke used in the process, resulting in energy savings in the coke making process [12].

Table 5.20 Specific energy consumption and specific CO_2 emissions in Erdemir, Isdemir and Kardemir between 1990 to 2020.

Specific energy consumption (Mcal/tcs)	1990	2004	2010	2015	2020
Erdemir	6665	5125	4977	5614	5683
Isdemir	8340	6420	5300	5000	4800
Kardemir	8950	7347	5750	5250	5000
Specific CO_2 emission (ton CO_2/ton-crude steel)	**1990**	**2004**	**2010**	**2015**	**2020**
Erdemir	2.16	2.09	2.12	2.07	2.08
Isdemir	2.7	2.51	1.79	1.66	1.65
Kardemir	3.63	1.974	1.975	1.97	1.97

Source: The study of "Estimation of Carbon Dioxide Gas Emissions In Turkish Iron And Steel Industry For The Preparation of Turkey's FNC under the UNDP" GEF Project TOBB ETU–EIE 2006 [5]

The second investment that was made in Erdemir was for the recovery of energy in the processing gas from BOF. During steel production by BOF, the gas used in the process can be recovered and used as fuel. Calculated CO_2 emission savings from these two investments resulted in 200,000 tons of CO_2 emissions, which constitute nearly 3.4% of total CO_2 emissions of Turkey in 2004. Table 5.20 shows the specific CO_2 emission value for Erdemir as 2.16 tons CO_2/tcs in 1990, which is slightly higher than the value given for Europe and the US (2.0 tons CO_2/tcs), but better than that of Japan (2.5 tons CO_2/tcs) (3).

Thanks to the above mentioned investments made in the 1990s, a reduction in specific CO_2 emissions was achieved besides reduction in specific energy consumption. This value was estimated as 2.08 tons CO_2/tcs in 2004.

On the other hand, in 1990 specific energy consumption values given for Isdemir and Kardemir were relatively higher than the average values reported for ISPs in Table 5.20. Since 1990, several studies have been made at Isdemir as in Erdemir in order to improve energy efficiency in steel production. These studies involve improvements in coke dry quenching, use of water vapour from coke dry quenching in turbo blowers, improvements in sintering furnaces, reductions in the use of fuel oil (65%), and improvements in the use of product gases. As a result of these studies, a 23% reduction was achieved in specific energy consumption and a further 7% reduction in specific CO_2 emissions in 2004. Investment in increasing the capacity at Isdemir are still under way. Once these projects are completed, a considerable reduction will be achieved in specific energy consumption and specific CO_2 emissions by 2010 as shown in Table 5.20.

In 1990, high specific energy consumption and the high level of CO_2 emissions at Kardemir were mainly due to the use of the OHF process in steel making. In 1999, Kardemir started producing steel by the BOF process with energy efficient continuous casting technology. These led to lower specific energy consumption and low specific CO_2 emission values in 2004. The BOF gas recovery unit will be working in 2007 and further reductions can be expected in CO_2 emissions for the period 2010 to 2020.

According to projections, crude steel production is expected to reach 28.37 Mt in 2010, 32.36 Mt in 2015, and 33.86 Mt in 2020. In 2010, 63% of crude steel will be produced by EAFs, reaching about 41% in the years 2015 and 2020. Throughout these years, no change is expected in specific emission values of the steel produced by EAFs. On the other hand, a further reduction is expected in specific emission values of steel produced by BOF. For 2010, this value is estimated at 1.91 ton CO_2/ton crude steel, with an expected level of 1.87 ton CO_2/ton crude steel by 2015 and 2020.

Crude Steel Production and CO_2 Emissions in Integrated Steel Plants in Turkey

The total CO_2 emissions in Erdemir, Isdemir and Kardemir, for the years 1990 to 2020 is obtained by using the total amount of crude steel produced and the specific CO_2 emission values given in Table 5.20. The results are given in Table 5.21.

In 1990, 4.36 Mt of crude steel was produced in Turkey's three ISPs. The estimated CO_2 emission from this amount of steel production was 11.28 Mt. In 2004, total steel production by ISPs increased by 36.5% to 5.95 Mt. On the other hand, within the same period, CO_2 emissions from ISPs increased by only 17%, reaching 13.21 Mt in 2004. Between 1990 and 2004, in spite of steel production by ISPs increasing by 36.5%, the specific CO_2 emission value for crude steel produced by ISPs which was 2.59 ton CO_2/tcs in 1990 had dropped to 2.22 ton CO_2/tcs in 2004, see Table 5.20. As stated above, within the period 1990-2004, ISPs made investments in order to reduce specific energy consumption and hence specific CO_2 emissions. Due to these developments in the sector a considerable reduction was achieved in CO_2 emissions. In 2004, the amount of CO_2 saved due to energy efficiency studies and improvements in steel production technology was calculated at 2.2 Mt of CO_2. According to projections, crude steel production in ISPs will reach 10.62 Mt in 2010, 13.41 Mt in 2015, and 14.16 Mt in 2020.

This implies an increase in the amount of total CO_2 emissions in the period 2004-2020. For the years 2010, 2015 and 2020, the total amount of CO_2 emissions from ISPs are estimated at 20.27 Mt, 25.06 Mt, and 26.54 Mt, respectively (Table 5.21). However, as stated in the previous section, Erdemir, Isdemir and Kardemir are all making investments in order to increase steel producing capacity by reducing the specific energy consumption. Due to these developments in the sector, as shown in Table 5.21, a further reduction in specific CO_2 emission values are expected.

Table 5.21 Crude steel production, related total CO2 emissions and specific CO2 emission value for integrated steel plants of the Turkish Iron and Steel Industry.

Crude steel production (Mtcs)	1990	2004	2010	2015	2020
Erdemir	1.94	3.03	3.15	5.91	5.91
Isdemir	1.82	2.09	6.25	6.25	6.25
Kardemir	0.605	0.828	1.22	1.25	2.00
Total crude steel production	4.36	5.95	10.62	13.41	14.16
CO_2 emission (Mt/year)	1990	2004	2010	2015	2020
Erdemir	4.19	6.33	6.68	12.23	12.29
Isdemir	4.91	5.25	11.19	10.37	10.31
Kardemir	2.18	1.63	2.40	2.46	3.94
Total CO_2 emission (Mt/year)	11.28	13.21	20.27	25.06	26.54
Specific CO_2 emission of the ISPs (ton CO_2/tcs)	2.59	2.22	1.91	1.87	1.87

Conclusions for Steel Industry Scenario Projections

A survey is being conducted in the sector laying down specific energy consumption values as well as specific CO2 emission values for the years 1990, 2004, 2010, 2015 and 2020. By using the total amount of steel production and specific CO2 emission values, total CO2 emissions related to steel production are estimated. It has to be underlined that emission values used in these projections are based on sector specific estimates from the Turkish Iron and Steel Producers Association. Whereas in Chapter 3 and Annex 4 industrial emission factors are estimated by using IPCC Tier1 methodology. A summary of the results is given in Table 5.22. Some of the data given was obtained from the Turkish Iron and Steel Producers Association [11].

Analysis of Table 5.22 leads to three main conclusions with regard to CO2 emissions in relation to steel production in Turkey.

1. For the period 1990-2004, the amount of steel produced increased from 9.31 Mt to 20.6 Mt. In 1990, 53% of the steel was produced by EAFs and 47% by ISPs. On the other hand, in 2004, steel production by EAFs increased to 71.5% and production by ISPs decreased to 21.5%. As explained, in terms of CO2 emissions, steel production with EAFs yields much less CO2 than steel production by ISPs. In the Turkish Iron and Steel Industry, specific CO2 emission values for EAFs are estimated as 0.135 ton CO2/tcs for the period 1990-2020 [11]. This specific emission value is lower than the value given for EAF steel produced in Western Europe in 1995 (0.2 ton CO2/tcs), [7]. Moreover, it is much lower than the specific CO2 emission values given for steel produced by ISPs, which has been estimated as 2.22 in 2004, see Table 5.22. In 2004, about 1,035.6 Mt of steel was produced globally and 34% of this amount was produced by EAFs. It seems that the large amount of steel produced by EAFs in the Turkish Iron and Steel Industry, and its low specific CO2 emission value constitute a clear advantage in terms of lowering CO2 emissions.

2. Comparison of estimated specific CO2 emission values from Turkish ISPs in 1990 and 2004, show a decrease from 2.59 ton CO2/tcs to 2.22 ton CO2/tcs. This means an almost 14% reduction in specific CO2 emissions. This reduction is due to investments made to reduce specific energy consumption in steel production and to change steel production technology from OHF to BOF. In 2004, the amount of CO2 saved by making these investments is estimated at 2.2 Mt.

Table 5.22 Total Amount of Crude Steel Production, Related to CO_2 Emissions and Specific CO_2 Emissions in ISP's and EAFs in the Turkish Iron and Steel Industry for the Years 1990 to 2020.

Crude Steel Production (Mtcs)	1990	2004	2010	2015	2020
Integrated Steel Plants	4.36	5.95	10.621	13.411	14.161
Electric Arc Furnaces	4.95	14.65	17.752	18.952	19.702
Total CO_2 Emission (Mt CO_2)	9.31	20.6	28.37	32.36	33.86
Integrated Steel Plants	11.29	13.22	20.25	25.06	26.54
Electric Arc Furnaces	0.67	1.98	2.4	2.56	2.66
Total	11.96	15.2	22.65	27.62	29.2
Specific CO_2 Emission (ton CO_2/tcs)	1990	2004	2010	2015	2020
Integrated Steel Plants	2.59	2.22	1.91	1.87	1.87
Electric Arc Furnaces	0.135	0.135	0.135	0.135	0.135

Comparison of estimated specific CO2 emission values from ISPs in 2004, 2010, 2015 and 2020 also show a decrease from 2.22 ton CO2/tcs to 1.87 ton CO2/tcs. This implies that in the next 15 years steel will be produced with a lower specific energy consumption, resulting in lower CO2 emissions. In the three ISPs in the Turkish Iron and Steel industry, investment to increase capacity and efficient use of energy is under way.

5.4.2 Turkish Cement Industry: Sectoral Mitigation Approach

The study conducted on the "Cost-Benefit Analyses Of Measures For Improving Energy Efficiency And Reducing Greenhouse Gas Emissions Of The Turkish Cement Industry Under The UNDP-GEF Project FNC Of Turkey" TOBB Edu, Gazi Univ. 2006 [13] with the contribution of EIE, TOBB, TCMA and presented in this section gives an in-depth analysis of the Turkish cement industry, identifying energy saving and carbon dioxide emission reduction potential and developing an implementation schedule for the necessary measures based on the cost-benefit analyses.

There are 40 integrated cement plants in Turkey, which produce clinker and final product cement. There are also 18 cement plants in Turkey producing only cement from the clinker produced by other plants. The clinker production capacity of Turkey was 39.0 million tons-clinker/year in 2004, whereas the actual production was 32.8 million tons-clinker/year. The cement grinding capacity in the same year was 66.0 million tons-cement/year, which produced 38.8 million tons-cement during the same year.

The Aggregated Energy Efficiency and CO2 Emissions Model of the Turkish Cement Industry

An aggregated model was developed for the Turkish cement industry to calculate the energy used for production and to determine CO2 emissions resulting from the use of energy (fuel and electricity) as well as from the chemical process of clinker production, see Fig. 5.30. In this study, all the plants are assumed to be operating with the dry system. The developed model was then used to investigate different scenarios concerning energy efficiency and CO2 emissions, and the best implementation plan was developed for the necessary measures to increase energy efficiency and to reduce CO2 emissions for 2004-2020.

The model developed in this study aggregates the 40 clinker plants in Turkey into a single plant with a production capacity equal to the total capacity of Turkey. The aggregated clinker plant displays the overall characteristics of energy usage and CO2 emission of the individual plants. Similarly, the 58 existing cement grinding plants in Turkey are aggregated into a single cement grinding plant; all thermal power plants are aggregated to an equivalent thermal power plant; all hydro power plants to an equivalent hydro power plant, and the Turkish interconnected electricity network is represented by an aggregated equivalent power line that connects the aggregated power stations to the aggregated clinker and cement production plants, see Fig 5.30. The primary energy inputs to the model are aggregated as fuel mixes used for production of clinker at the cement plants and for production of electricity at the power plants. Raw material inputs to the model are an aggregated raw material mix for clinker production, and an aggregated additive mix for cement production.

CO2 emissions in the model represent total emissions from the Turkish cement industry in an aggregated form. CO2 emissions result from the calcination of raw meal, burning of fuel in rotary kilns, and the burning of fuel in thermal power plants, which produce electricity for clinker production and cement grinding.

A questionnaire was prepared to determine past and future status and future trends in the Turkish cement industry. Information concerning system characteristics, production capacities, raw material and product specifications, energy consumption, and measures to increase energy efficiency were gathered. The participation of companies in this activity has been encouraging; 24 companies, representing 60% of integrated cement plants in Turkey, have completed the questionnaire that was used to produce input data for the model. Additional data were obtained from related literature, the archives of Gecer Research Centre of Gazi University, energy conservation studies carried of by Turkish cement companies, plant visits, and contacts with Electricity Studies Directorate (EIE) of the MENR, and the Turkish Cement Manufacturers Association (TCMA).

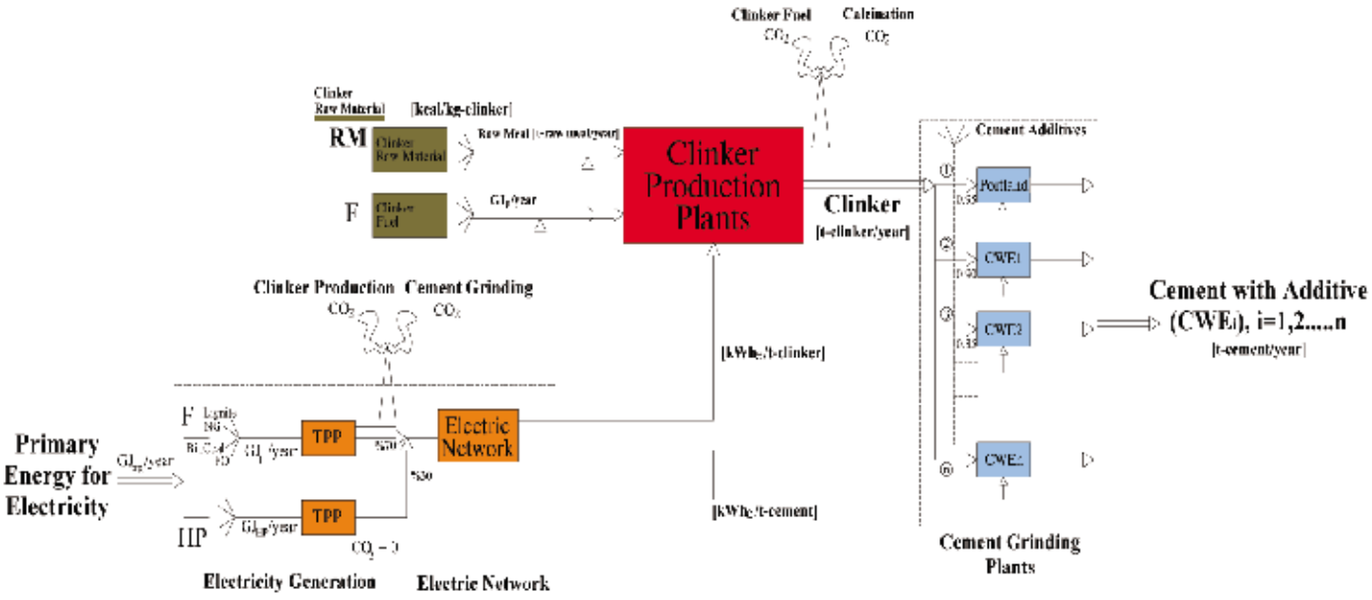


Fig.5.30 Agregated Energy and CO2 Emisions Model of the Turkish Cement Industry

Only two kilns with relatively smaller capacities utilise the wet process in Turkey. In addition, cement plants, which used fuel-oil before the 1973 energy crisis, have switched to coal since then. Therefore, the energy saving and CO2 reduction measures considered in the model focus specifically on plants that utilise the dry clinker production system and use coal as fuel.

The model calculates the cost of saved energy (CSE's) for each measure. Then the CSEs (in $/GJ) are compared to the primary energy purchase prices (PEP' in $/GJ) as the year's progress. An implementation schedule for energy saving measures 2004 to 2020 are determined by applying the criterion CSE<PEP resulting in the Energy Saving Supply Curve of the Turkish Cement Industry. The amount of saved energy and CO2 reduction by each measure, the required investment, year of implementation, limitations on implementation and logistics etc., are determined accurately and ahead of time in a systematic way by the use of the Energy Saving Supply Curve.

The aggregated model developed in this study may also be used for energy efficiency and CO2 emission analysis of single plants, provided that appropriate inputs be used for single plants.

Table 5.23 Average Specific Heat, Specific Electricity Savings and Specific Investment Costs of Measures.

Code Number of Measure	Measure	Specific Heat Saving (GJ/ton)	Specific Electricity Saving (kWh/ton)	Specific Investment Cost ($/ton-capacity)		Ratio of Applicability (%)
				1994	2004	
MEASURES FOR RAW MEAL PREPARATION						
1	Using Efficient Transport Systems	0	2.25	5.36	6.61	31
2	Using Efficient Raw Meal Homogenisation	0	1.79	6.61	8.16	40
3	Using Continuous Homogenisation	0	0.5		3	53
4	Using Roller Press and Roller Mill	0	7.55	9.46	11.68	52
5	Using High Efficiency Classifiers	0	1.75	3.57	4.41	46
MEASURES FOR CLINKER PRODUCTION						
6	Kiln Combustion System Improvements	0.052	0	0.98	1.21	30
7	Reduction of Kiln Shell Heat Losses	0.15	0	0.25	0.31	25
8a (%3 waste)	Use of Waste Fuels	0.10	0	1	1.23	50
8b (%6 waste)		0.21	0	1	1.23	50
8c (%12 waste)		0.42	0	1	1.23	50
9	Conversion to Modern Grate Coolers	0.3	-3	0.6	0.74	19
10	Heat Recovery for Power Generation (Only for long kilns in wet process)	0	20	3.25		
11	Conversion from Wet Process to Dry Process with Pre-heater, Pre-calciner Kiln	2.8	-10	75	92.59	1.36
12	Conversion to Multi-stage Cyclone Type Pre-heaters in Dry Process	0.9	0	20	24.69	0
13	Conversion to Low Pressure Drop, Multi-stage Cyclone, Suspension Pre-heaters in Dry Process.	0	4	3	3.70	100
14	Optimise Heat Recovery in Grate Coolers	0.08	0	0.2	0.25	40
15	Conversion of Long Dry Kiln to Multi-stage Pre-heater, Pre-calciner Kiln (Dry process)	1.3	0	28	34.57	0
16	Adding Pre-calciner to Pre-heater Kiln	0.4	0	4.79	5.92	24

MEASURES FOR CEMENT GRINDING						
17	Using Efficient Transport Systems	0	2	3	3.70	47
18	Using Roller Press Pre-grinder before Ball Mills	0	8	2.5	3.09	41
19	Conversion from Ball Mill to Horomill	0	27	4	4.94	50
20	Using High Efficiency Classifiers	0	2.5	2.25	2.78	13
21	Improving Mill Internals	0	2	0.7	0.86	91
GENERAL ENERGY SAVING MEASURES						
22	Preventive Maintenance (Insulation, reduction of pressurized air losses, preventive maintenance, etc.)	0.05	3	0.1	0.12	100
23	Process Control and Energy Management	0.2	4	1.5	1.85	17
24	Using High Efficiency Motors	0	1	0.2	0.25	100
25	Using Variable Speed Drives with Fans	0	4	0.10	0.12	46

Implementation of Measures to Increase Energy Efficiency in the Turkish Cement Industry

Possible measures to increase energy efficiency in the Turkish cement industry are listed in Table 5.23 along with their specific heat and electricity savings, specific investments and their ratios of applicability to the total production capacity of Turkey. The aggregated model was used to analyse each one of these measures. The corresponding costs of saved energy (CSE's) were calculated for interest rate values of 12% and 30%. The measures were arranged in increasing order of their CSE values to obtain the Energy Saving Supply Curve of the Turkish Cement Industry. Table 5.24, Figs. 5.31 and 5.32 give the Energy Saving Supply Curves corresponding to 12% and 30% interest rates.

Table 5.24 Energy Saving Measures Arranged in Order of Increasing Cost of Saved Energy (CSE).

Priority of Implementation	Code Number of Measure	CSE ($/GJ) (12% interest rate)	CSE ($/GJ) (30% interest rate)
1	22	0.198	0.479
2	7	0.255	0.618
3	9	0.337	0.815
4	14	0.367	0.886
5	25	0.409	0.989
6	23	0.972	2.351
7*	8a	1.602	3.873
8	16	1.836	4.439
9	19	2.494	6.030
10	10	2.736	6.614
11	6	2.875	6.949
12	15	3.301	7.980
13	24	3.367	8.140
14	12	3.406	8.234
15	11	4.243	10.258
16*	8b	0.815	1.970
17	18	5.261	12.719
18	21	5.893	14.245

19*	8c	0.407	0.985
20	13	12.627	30.526
21	20	15.165	36.660
22	4	21.105	51.020
23	17	25.254	61.051
24	5	34.359	83.063
25	1	40.086	96.906
26	2	62.293	150.593
27	3	81.823	197.805

* Order is determined by enforcing the implementation year

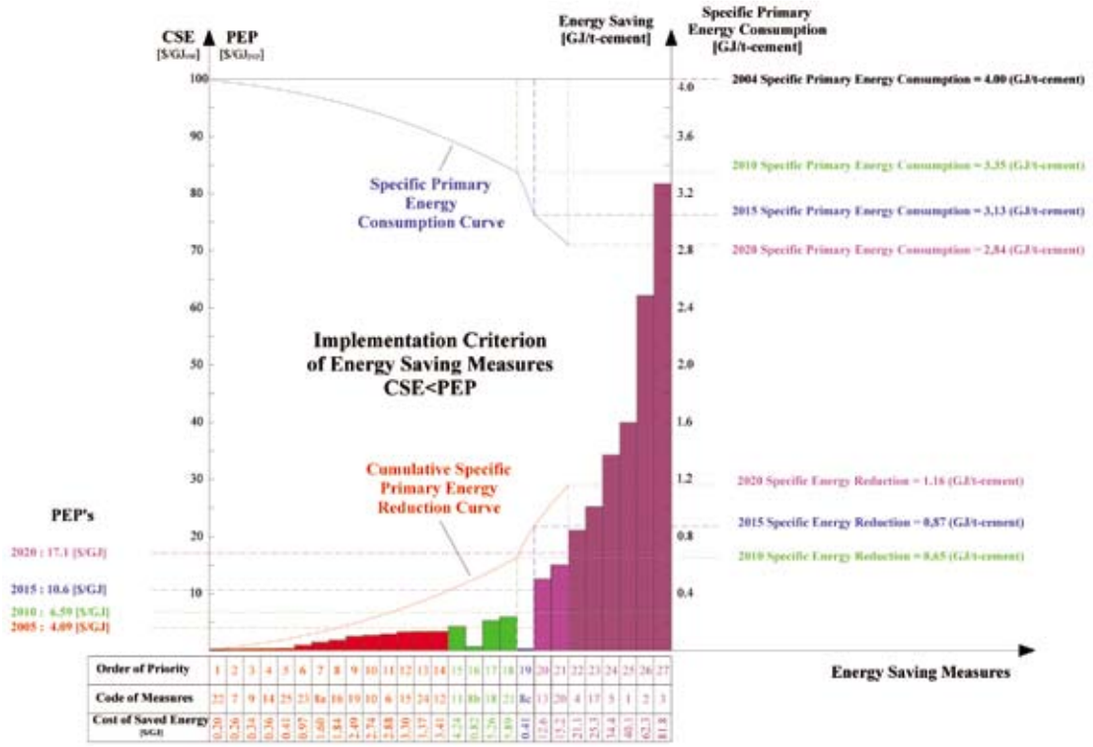


Fig. 5.31 The Energy Saving Supply Curve of the Turkish Cement Industry and the Years of Implementing Energy Saving Measures (12% interest rate)

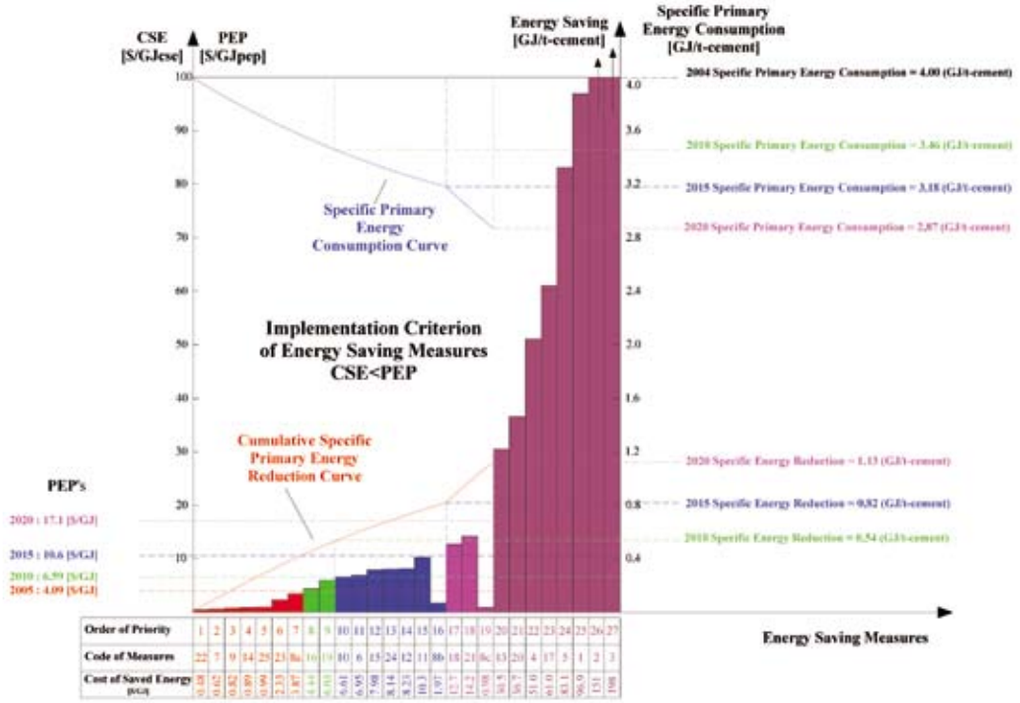


Fig. 5.32 Energy Saving Supply Curve of the Turkish Cement Industry and Years of Implementing Energy Saving Measures (30% interest rate)

As observed in Table 5.23, the measure with code number 22 has the minimum value of CSE, and is the most advantageous one. On the other hand, the measure with code number 3 has the highest value of CSE, and must be implemented with the lowest priority. The measures 8b and 8c seem to violate the order. This is due to constraints placed on the ratio of waste fuel used, which is assumed to be 0%, 3%, 6% and 12% in the years 2004, 2010, 2015 and 2020, respectively.

The results show that using a lower value for the interest rate shifts implementation of the measures to earlier years, while using a higher value of interest rate, shifts them to the later years. The rate of increase of CSEs is 3 to 5 times less than the rate of increase of PEPs; therefore, applying measures with higher CSE values becomes feasible as the years progress.

The criterion for implementation of an energy saving measure is expressed as "Cost of Saved Energy CSE ($/GJ) < Primary Energy Price PEP ($/GJ)". In other words, those measures with CSE values, which are below the horizontal line corresponding to the PEP value of a specific year can be implemented feasibly before that specific year. Figs. 5.31 and 5.32 show code numbers of the measures that may be implemented on or before the milestone years 2005, 2010, 2015 and 2020. The steady decrease in specific primary energy consumption for cement production (GJ/t-cement) between 2004 and 2020 is also observed in Figs. 5.31 and 5.32. The specific primary energy consumption is 4.00 GJ/ton-cement in the year 2004. It drops to 2.84 GJ/ton-cement and 2.87 GJ/ton-cement for interest rates of 12% and 30% respectively in the year 2020. Therefore, reduction in the specific primary energy consumption from 2004 to 2020 is 29%, given interest rates of 12% and 28% with an interest rate of 30%.

Scenario Studies

Three scenario studies were carried out by using the aggregated model. These scenarios make it possible to make comparisons between the following cement production alternatives: using the technology of 1990; using the technology of 2004; and implementing measures after the year 2004 for saving energy.

Scenario 1: Using the Technology of 1990 for Production

This scenario assumes that the technology which was available in 1994 is used for producing cement between the years 2004 and 2020. Therefore, specific primary energy consumption is assumed to be 4.35 GJ/t-cement for all years. This scenario assumes that the capacities of existing plants are used so long as there is available capacity. When the existing capacity is completely used up, additional capacity is created by adding pre-calciners to the existing plants, in which case the energy savings due to pre-calciners are also taken into account. The expanded capacity due to newly added pre-calciners becomes insufficient by 2015, by then, new plants are assumed to have been built with the latest technology to create additional production capacity. The technologies used in the new plants depend on prevailing economic conditions; hence, they may have different measures applied to them depending on whether a 12% or 30% interest rate is assumed.

Scenario 2: Using the Technology of 2004 for Production

This scenario assumes that the technology of 2004 is used after 2004. Therefore, specific primary energy consumption is assumed to be 4.35 GJ/t-cement for the years 1990 to 2004, and 4.0 GJ/t-cement for all years after 2004. The assumptions concerning expansion of capacity are the same as in Scenario 1.

Scenario 3: Implementing Energy Saving Measures after 2004

Scenario 3 assumes that energy saving measures implemented after 2004 will correspond with the energy saving supply curves given in Figs. 5.31 and 5.32, and the priority order given in Table 5.23. The results obtained from Scenario 3 are presented in Table 5.25, together with the results of Scenario 1 and Scenario 2.

Total primary energy consumptions and total cost of energy of the Turkish cement industry for 3 scenarios are given in Tables 5.25 and 5.26 as well as in Figs. 5.33 and 5.34.

Table 5.25 Total Primary Energy Consumption for the 3 Scenarios

	12% interest					30 % interest				
(PJ/year)	1990	2004	2010	2015	2020	1990	2004	2010	2015	2020
Total Primary Energy Consumption for 1990 technology	88.02	142.47	189.91	210.81	235.66	88.02	142.47	189.91	210.84	235.98
Total Primary Energy Consumption for 2004 technology	88.02	131.06	174.55	193.83	218.68	88.02	131.06	174.55	193.86	219.00
Total Primary Energy Consumption for after 2004 measures	88.02	131.06	148.02	155.15	165.96	88.02	131.06	152.73	157.82	167.90

Note: 1 PJ = 10^{15} Joule

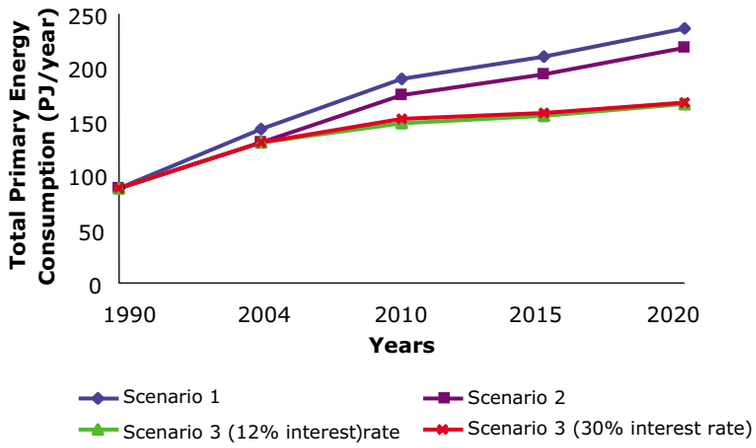


Fig. 5.33 The Total Primary Energy Consumptions of the Turkish Cement Industry For the Investigated Scenarios.

Scenario 3 results are given in Table 5.27 through to Table 5.31. Although the investment is shown to be stated in 2010 part of the investment has already been realised in the industry.

Fig. 5.35 shows the specific primary energy consumptions and the corresponding investment costs if energy saving measures are implemented starting in the year 2004 (Scenario 3) for interest rates of 12% and 30%

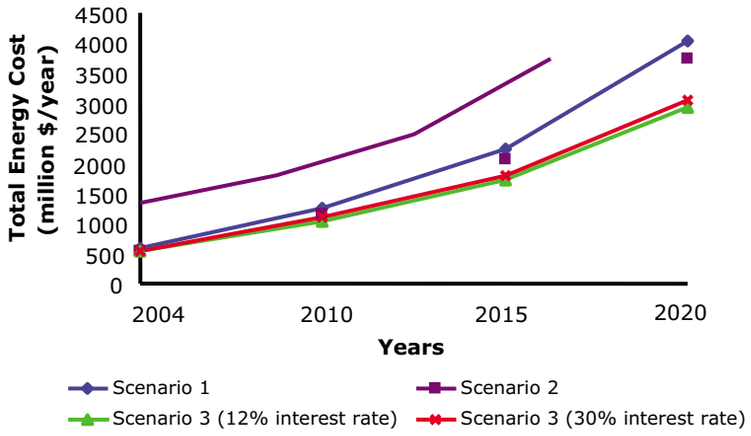


Fig. 5.34 The Total Energy Costs of the Turkish Cement Industry for the Investigated Scenarios.

Table 5.27 The Specific Costs of Saved Energy and Investment Cost

Years	2010	2015	2020
Specific Cost of Saved Energy			
Specific Cost of Saved Energy ($/GJ) (12% interest rate)	25934	25934	12451
Specific Cost of Saved Energy ($/GJ) (30% interest rate)	38720	20149	23833
Investment Costs			
Investment Cost (million $) (12% interest rate)	525.3	0	271.3
Investment Cost (million $) (30% interest rate)	319.9	113.3	179.6

Table 5.28 Specific Heat Consumption for Clinker Production: Kcal / kg- clinker

	12% interest					30 % interest				
	1990	2004	2010	2015	2020	1990	2004	2010	2015	2020
Specific Heat Consumption using waste fuel)	935.90	836.60	738.63	727.57	705.07	935.90	836.60	751.49	727.57	705.07
Specific Heat Consumption no waste fuel)	935.90	836.60	750.07	750.07	750.07	935.90	836.60	762.93	750.07	750.07

Table 5.29 Specific Electricity and Primary Energy Consumptions for Clinker Production and Grinding

	12% interest					30 % interest				
	1990	2004	2010	2015	2020	1990	2004	2010	2015	2020
Specific Electricity Consumption (kWh_e/ton-clinker)	82.60	75.06	68.97	68.97	64.97	82.60	75.06	70.11	68.97	68.97
Specific Primary Energy Consumption (GJ/ton-clinker)	28946	47209	30011	28185	23437	28946	47209	32203	28185	24898
Specific Electricity Consumption Grinding (kWh/ton-cement)	51.23	46.58	27.97	27.97	27.65	51.23	46.58	33.07	33.07	27.97

Fig 5.35 shows the specific primary energy consumptions and the corresponding investment costs if energy saving measures are implemented starting with 2004 (Scenario 3) for interest rates of 12% and 30%.

Table 5.30 Specific Electricity Consumption for Cement with Additives

	12% interest					30 % interest				
	1990	2004	2010	2015	2020	1990	2004	2010	2015	2020
Specific Electricity Consumption for Cement with Additives (kWh_e/ton-cement)	116,85	107,86	83,15	79,7	73,12	116,85	107,86	89,16	84,80	76,25
Additive Ratio (%)	20.56	18.36	20,00	25,00	30,00	20.56	18.36	20,00	25,00	30,00

It has to be noted that 30% additive is a very ambitious limit, which can be difficult to achieve due to the poor availability of such additives.

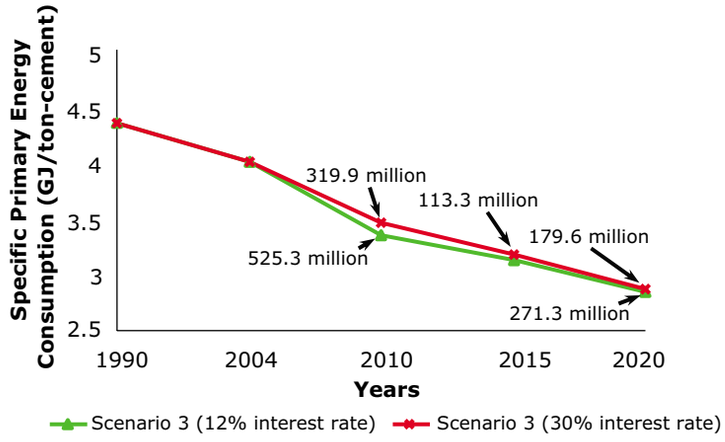


Fig.5.35 Change of Specific Primary Energy Consumptions of Cement with Additives by Years and the Investments.

Table 5.31 Specific and Total Primary Energy Consumptions for Cement Production.

	12% interest					30 % interest				
	1990	2004	2010	2015	2020	1990	2004	2010	2015	2020
Specific Primary Energy Consumption (GJ/ton-cement)	12875	4.00	12844	41334	30713	12875	4.00	16862	43160	31809
Total Primary Energy Consumption (PJ/year)	88.02	131.06	148.02	155.15	165.96	88.02	131.06	152.73	157.82	167.90

Determination of CO_2 Emissions from the Cement Industry and Emission Scenarios for Calculation of CO_2 Emissions

CO_2 emissions from the Turkish cement industry were calculated by using The Aggregated Energy Efficiency and CO_2 Emission Model, which is given in Fig. 5.30 showing CO_2 emission sources in the cement industry. The stacks of rotary kilns in clinker production plants and the stacks of power plants that supply electricity for cement production emit CO_2. The aggregated model calculates the components of CO_2 emissions as explained below and determines total emissions by adding them.

- CO_2 Emissions Resulting from Calcinations of Raw Meal

The raw materials used for clinker production in Turkey have negligible amounts MgO and clinker produced has an average content of 60-67% CaO and 0.1-4% MgO that result from the $CaCO_3$ and $MgCO_3$ present in the raw materials. Based on these data, specific CO_2 emissions resulting from calcinations of the raw meal was assumed as 520 kg-CO_2/ton-clinker whereas it is reported as 540 kg-CO_2/ton-clinker in Greece and 562 kg-CO_2/ton-clinker in Austria for cement manufacturing.

- CO_2 Emissions Resulting from the Fuel Burned for Production of Clinker

The fuel mix and CO_2 emission factors of fuels were assumed to be the same for all years in the model. However, the average combined emission factors expressed in terms of kg-CO_2-mixed fuel/ton-clinker were calculated for each year by considering emission factors, the fuel mix, heating values of fuels and the specific heat needed for clinker production. For example, the emission factor calculated in this way was 335.7 kg-CO_2-mixed fuel/ton-clinker for the year 2004. It should be noted that the fuel mix may vary due to fuel availability and market condition.

- CO_2 Emissions from Power Plant Stacks Due to Production of Electricity Used in Clinker Production

The model assumes that the ratio of thermal to hydro electricity production, the average efficiencies of thermal power plants and the efficiency of transportation and distribution of electricity would stay constant throughout the years. The real values of fuel usage ratios are used for the years 1990 and 2004. The fuel usage ratios for the years after 2004 are assumed to be the same as for 2004.

Average combined emission factors expressed in terms of kg-CO_2-thpfuel/ton-clinker were calculated for each year by considering the emission factors, the fuel mix, the heating values of fuels and the specific electricity needed for clinker production. For example, the emission factor calculated in this way was 49.9 kg-CO_2-thpfuel/ton-clinker for the year 2004.

- CO2 Emissions from Power Plant Stacks Due to Production of Electricity Used in Cement Grinding

The average combined emission factors expressed in terms of kg-CO2-thpfuel/ton-cement were calculated for each year by considering the emission factors, the fuel mix, the heating values of fuels and the specific electricity needed for grinding of cement. For example, the emission factor calculated in this way was 30.95 kg-CO2-thpfuel/ton-cement for the year 2004.

Scenario Studies

The Aggregated Energy Efficiency and CO2 Emission Model may be used for studying different CO2 emissions for the selected scenarios by changing the underlying assumptions for calculating the input data. The results obtained from the three scenarios are presented below in Tables 5.32 through to 5.36 for interest rates of 12% and 30%.

Specific primary energy consumption will reduce from 4.00 GJ/ton-cement in the year 2004 to 2.84 GJ/ton-cement in 2020 if the interest rate is 12%. The required investment to realise this reduction is $525.3 million in the year 2010, and $271.3 million in the year 2020. These investment costs are in terms of US dollars in the specified years, which represent a huge burden for industry.

Table 5.32 CO2 Emissions if the Technology of 1990 is used for Production

	12% interest					30% interest				
CO_2 Emission from... (million ton-CO_2/year)	**1990**	**2004**	**2010**	**2015**	**2020**	**1990**	**2004**	**2010**	**2015**	**2020**
Calcination	10.5	17.1	23	25.9	30.4	10.5	17.1	23	25.9	30.4
Fuel Used for Clinker Production	7.61	12.3	16.6	18.6	21.1	7.61	12.3	16.6	18.6	21.1
Production of Clinker	1.4	2.26	3.05	3.41	3.79	1.4	2.26	3.05	3.41	3.81
Production of Electricity Used in Grinding	1.05	1.66	2.27	2.66	3.01	1.05	1.66	2.27	2.66	3.01
Total CO_2 Emission	**20.6**	**33.3**	**44.9**	**50.5**	**58.3**	**20.6**	**33.3**	**44.9**	**50.5**	**58.3**

Table 5.33 CO2 Emissions If the Technology of 2004 is used for Production

	12% interest					30% interest				
CO_2 Emission from... (million ton-CO_2/year)	**1990**	**2004**	**2010**	**2015**	**2020**	**1990**	**2004**	**2010**	**2015**	**2020**
Calcination	10.5	17.1	23	25.9	30.4	10.5	17.1	23	25.9	30.4
Fuel Used for Clinker Production	7.61	11	14.8	16.6	19.1	7.61	11	14.8	16.6	19.1
Production of Clinker	1.4	1.63	2.2	2.47	2.85	1.4	1.63	2.2	2.48	2.88
Production of Electricity Used in Grinding	1.05	1.2	1.64	1.92	2.23	1.05	1.2	1.64	1.92	2.23
Total CO_2 Emission	**20.6**	**30.9**	**41.7**	**46.9**	**54.6**	**20.6**	**30.9**	**41.7**	**46.9**	**54.7**

Table 5.34 CO2 Emissions If Energy Saving Measures are Implemented After 2004

	12% interest					30% interest				
CO_2 Emission from... (million ton-CO_2/year)	**1990**	**2004**	**2010**	**2015**	**2020**	**1990**	**2004**	**2010**	**2015**	**2020**
Calcination	11	17	23	26	30	11	17	23	26	30
Fuel Used for Clinker Production	7.6	11	13	15	17	7.6	11	13	15	17
Production of Clinker	1.4	1.6	2	2.3	2.5	1.4	1.6	2.1	2.3	2.7
Production of Electricity Used in Grinding	1.1	1.2	1	1.2	1.4	1.1	1.2	1.2	1.4	1.4
Total CO_2 Emission	**21**	**31**	**39**	**44**	**51**	**21**	**31**	**40**	**44**	**51**

Table 5.35 Comparison of CO2 Emissions for the Investigated Scenarios

	12% interest					30 % interest				
	1990	2004	2010	2015	2020	1990	2004	2010	2015	2020
Scenario 1: CO_2 Emissions If Technology of 1990 is Used (million ton-CO_2/year)	20.59	33.29	44.89	50.53	58.29	20.59	33.29	44.89	50.54	58.32
Scenario 2: CO_2 Emissions If Technology of 2004 is Used (million ton-CO_2/year)	20.59	30.90	41.66	46.92	54.63	20.59	30.90	41.66	46.92	54.66
Scenario 3: CO_2 Emissions If Energy Saving Measures are Implemented after 2004 (million ton-CO_2/year)	20.59	30.90	39.09	43.82	50.90	20.59	30.90	39.53	44.03	51.07

Comparisons of CO2 emissions obtained from the three scenarios studied are presented in Tables 5.36

Table 5.36 The Savings Resulting from Measures Taken Between 1990 and 2004.

Quantity	Reduction in 2004 as Compared to 1990 (Scenario 1 Values – Scenario 2 Values)	
	Absolute Reduction	Percent Reduction
Total Primary Energy Consumption	11.41 PJ/year	8
Total Cost of Energy	46.71 $/year	8
Specific Heat Consumption	99.3 kcal/kg-clinker	10.6
Specific Electricity Consumption	10.81 kWh_e/ton-cement	9.1

Conclusions for Cement Industry Projections

The study presented in this report is an in-depth analysis of the Turkish cement industry, identifying energy saving and carbon dioxide emission reduction potentials and develops an implementation schedule of necessary measures based on cost-benefit analyses. An aggregated model of the Turkish cement industry was developed in this study in order to investigate the energy used for production, and to determine CO2 emissions resulting from use of energy (fuel and electricity) as well as from the chemical process of clinker production. The model developed in this study aggregates the clinker plants, cement grinding plants and the power plants which produce electricity for cement production, and the interconnected electricity network supplying electricity to the cement plants to single plants respectively. The aggregated components of the model represent total production capacities, as well as overall energy usage and the CO2 emission characteristics of individual plants in Turkey.

As shown by these figures, the Turkish cement industry has taken some measures, and has undertaken rehabilitation work to save energy between 1990 and 2004 by making considerable investments. As a result of these activities, a reduction in energy consumption and energy costs have been achieved in 2004 as compared to 1990, as shown in Table 5.36. The results in Fig. 5.36 demonstrate that CO2 emissions from the Turkish cement industry have been reduced by 2.39 million ton-CO2/year or by 7% from 1990 to 2004 (Scenario 1 value - Scenario 2 value in the year 2004) as a result of voluntary measures taken during this period. If production is carried out by using 1990 technology , total CO2 emissions in 2020 will be 58.29 million ton-CO2/year, whereas if the technology of 2004 is used it will be 54.63 million ton-CO2/year. However, if energy saving measures were implemented after 2004, total CO2 emissions will be 50.90 million ton-CO2/year for a 12% interest rate, and 51.07 million ton-CO2/year for a 30% interest rate. The reduction in the total CO2 emissions in 2020 is 7.4 million ton-CO2/year, or 12.7% compared to Scenario 1 emissions for the interest rate of 12%, and 7.2 million ton-CO2/year, or 12.4% for the interest rate of 30% with proper measures taken for this purpose. Fig. 5.37 shows the changing specific CO2 emissions of cement with additives by years for the cases with 12% and 30% interest rates, respectively. The specific CO2 emission, which is 770.66 kg-CO2/ton–cement in 2004, reduces to 610.94 kg-

CO2/ton–cement or by 21% if the interest rate is 12%. For the case with 30% interest rate, the specific CO2 emission reduces to 613.02 kg-CO2/ton–cement or by 20% in the year 2020. The specific CO2 emission in the year 1990 was 809.42 kg-CO2/ton–cement. Hence, the specific CO2 emission reduction from 1990 to 2020 is 24.5% for the interest rate of 12% and 24.3% for the interest rate of 30%.

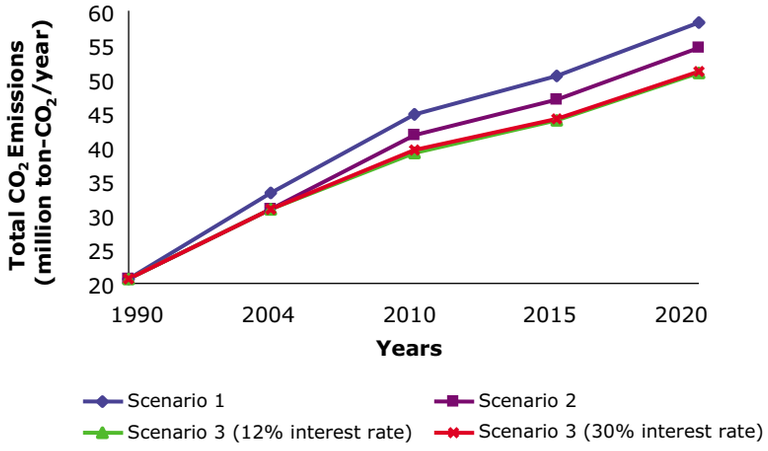


Fig. 5.36 The Total CO2 Emissions of the Turkish Cement Industry for the Investigated Scenarios

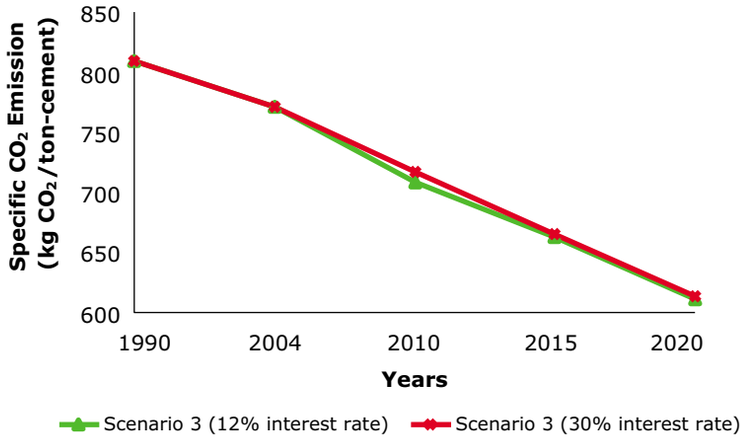


Fig 5.37 The Specific CO2 Emissions of Cement with Additives.

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CHAPTER 6

CLIMATE CHANGE, VULNERABILITY ASSESSMENT AND ADAPTATION MEASURES

6. CLIMATE CHANGE, VULNERABILITY ASSESSMENT and ADAPTATION MEASURES

6. CLIMATE CHANGE, VULNERABILITY ASSESSMENT and ADAPTATION MEASURES

This chapter describes the impacts and vulnerability of climate change in Turkey. Considering the summary of work related to climate trends and projections as well as case studies dealing with the vulnerability of water resources, agriculture, human health, natural ecosystems. Information related to coastal zone management efforts and the relation with the projected climate change and sea level rise are also included. In terms of adaptation to climate change, the implementations for protection of natural systems in order to boost up the resilience capacity of those and recommended measures for adaptation are briefly addressed in the chapter.

6.1 Climate Changes for Turkey: Trends and Projections

6.1.1 Temperature and Precipitation Trends

Once 'climate change' became an issue of central importance, there arose much needed scepticism about the reliability of the data used in the analyses. It is well recognized that variations and trends in most long-term climatological time series are caused not only by the changes in weather and climate but also by the relocation of monitoring stations or the alteration of instruments, observation practices or the station environment.

The period for analysis of station data is 1951–2004 and the stations that do not fulfil this criterion are eliminated from the study data.

The data sets are analysed for outliers, and those identified as outliers are reduced to a present threshold value according to Barnett and Lewis (1994). Finally, the time series are analysed for non-climatic events that might have taken place during the life of the stations, and detection and adjustment of such inhomogeneties in the time series are made following a procedure developed by Hanssen-Bauer and Forland (1994). The final data set consists of 113 stations, distribution of which is depicted in figure 6.1.

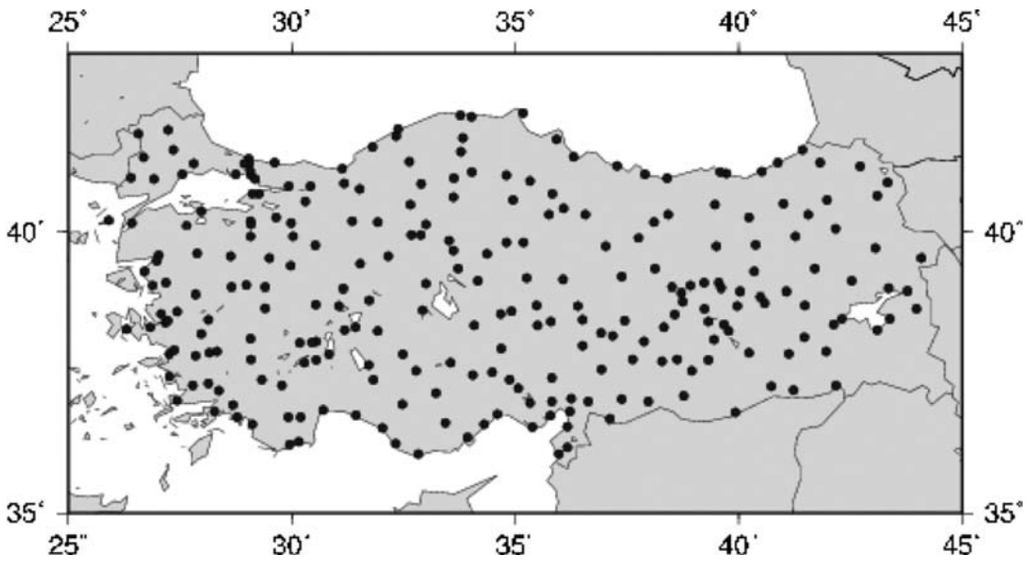


Fig. 6.1 Distribution of Turkish Climate Stations Used in Trend Studies

Precipitation

There is no doubt that any persistent change in precipitation patterns or in the characteristics of the precipitation (intensity, frequency and duration), would have significant consequences for the environment. Thus, global warming studies pay special attention to this crucial climatic variable. There are, however, difficulties in identifying climate change signals in precipitation.

Some of these difficulties are related to the quality of the data, given that precipitation measurements are prone to several types of errors. The length of the precipitation data highlights another difficulty in tracking the climate change signal, since precipitation is temporally, as well as spatially, a highly variable parameter. Sometimes it is possible to detect a trend in a 'short' time series of precipitation, which, in reality, could be a part of long-term variability. Therefore, care has to be taken when interpreting the trend analysis of precipitation data. In the trend analysis, we deployed the commonly used nonparametric Mann-Kendall method to identify significant trends in the quality-controlled station data (Karaca et al.,1995).

Figure 6.2 illustrates the results of the Mann-Kendall trend test for the four seasons. Coherent areas of significant change in precipitation can be seen in both winter and fall seasons. Winter precipitation in the western provinces of Turkey has decreased significantly in the last five decades. Fall precipitation, on the other hand, has increased at the stations that lie mostly in the northern parts of the Central Anatolia. The reasons behind these changes are not well understood. They definitely require a comprehensive study, which should also look into the link between cyclone tracks and these changes (Karaca et al., 2000a). In the other seasons (spring and summer), there are only a few stations with statistically significant changes, however, they do not show coherent regional behaviour.

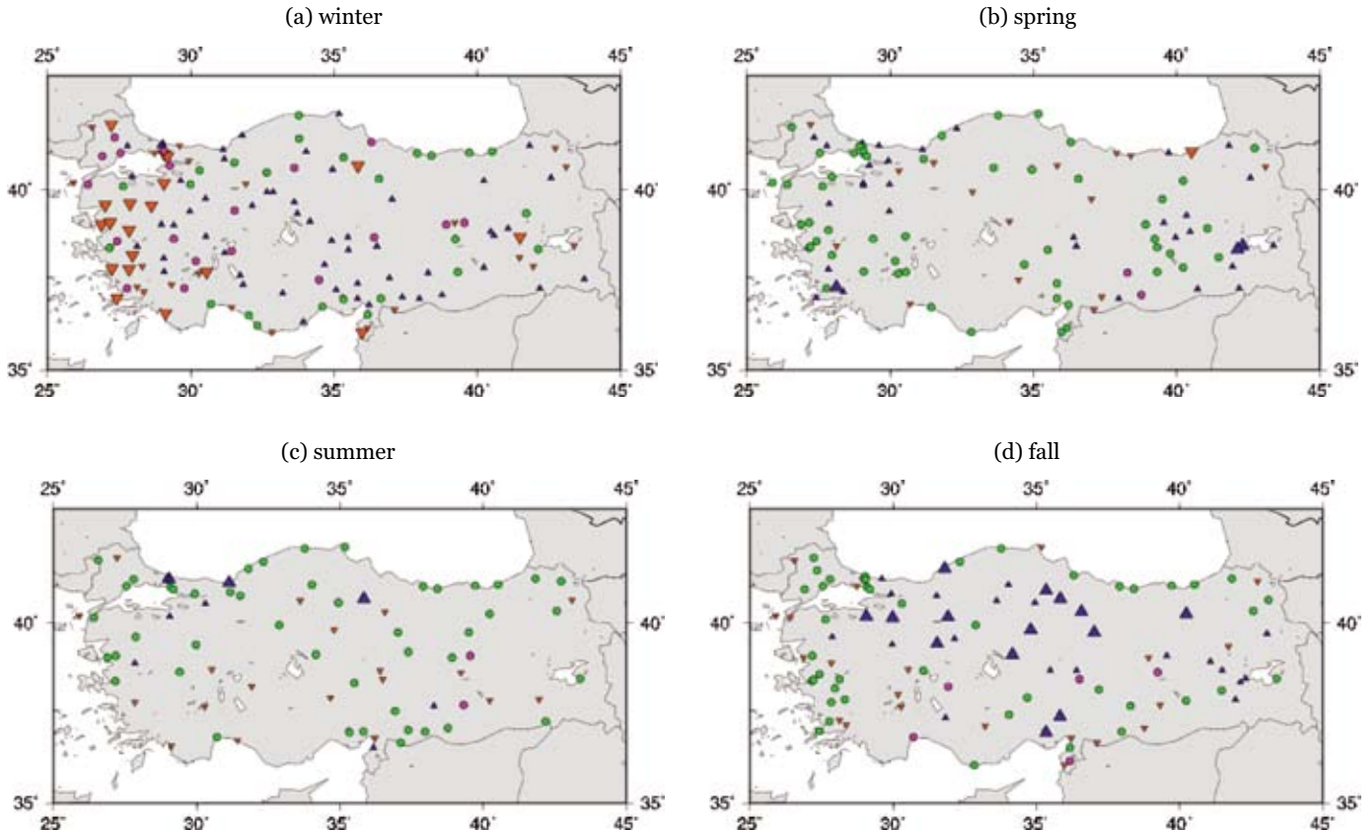


Fig. 6.2 Seasonal precipitation trends for the period 1951-2004
• denotes no trend ▲ significant increase ▲ insignificant increase
▼ significant decrease ▼ insignificant decrease and • insignificant increases and decreases.

Temperature

Compared to precipitation, temperature is a variable that can be measured easily and more accurately at meteorological stations, therefore uncertainties resulting from measurement errors are of lesser concern for temperature. Nonetheless, climate change signals in temperature are usually contaminated by the effects of urbanisation effects because most of the stations in Turkey or elsewhere have been gradually encircled by city residential and/or commercial areas. It is, therefore, difficult to separate climate change signals from urbanisation effects on temperature time series.

Figure 6.3 shows the results of the Mann-Kendall trend analysis applied to seasonally averaged annual temperature series between 1951 and 2004. The most prominent feature is the widespread increase in summer temperatures. Summer temperatures increase mostly in the western and south-western parts of Turkey. Urban heat island studies (e.g. Ezber et al., 2006, and Karaca et al., 1995) indicate that temperature increase as a result of urbanisation is most notable in summer in Mediterranean

cities, when the region comes under the influence of high pressure systems. Thus, a widespread increase in temperature in the western stations of Turkey may mainly be related to this phenomenon. Winter temperatures also show a general tendency to decrease in Turkey. It can be noted that the more significant ones are mostly concentrated in the coastal stations. During transition seasons, stations with significant trends are usually sporadic in nature, and they do not show coherent regional behaviour.

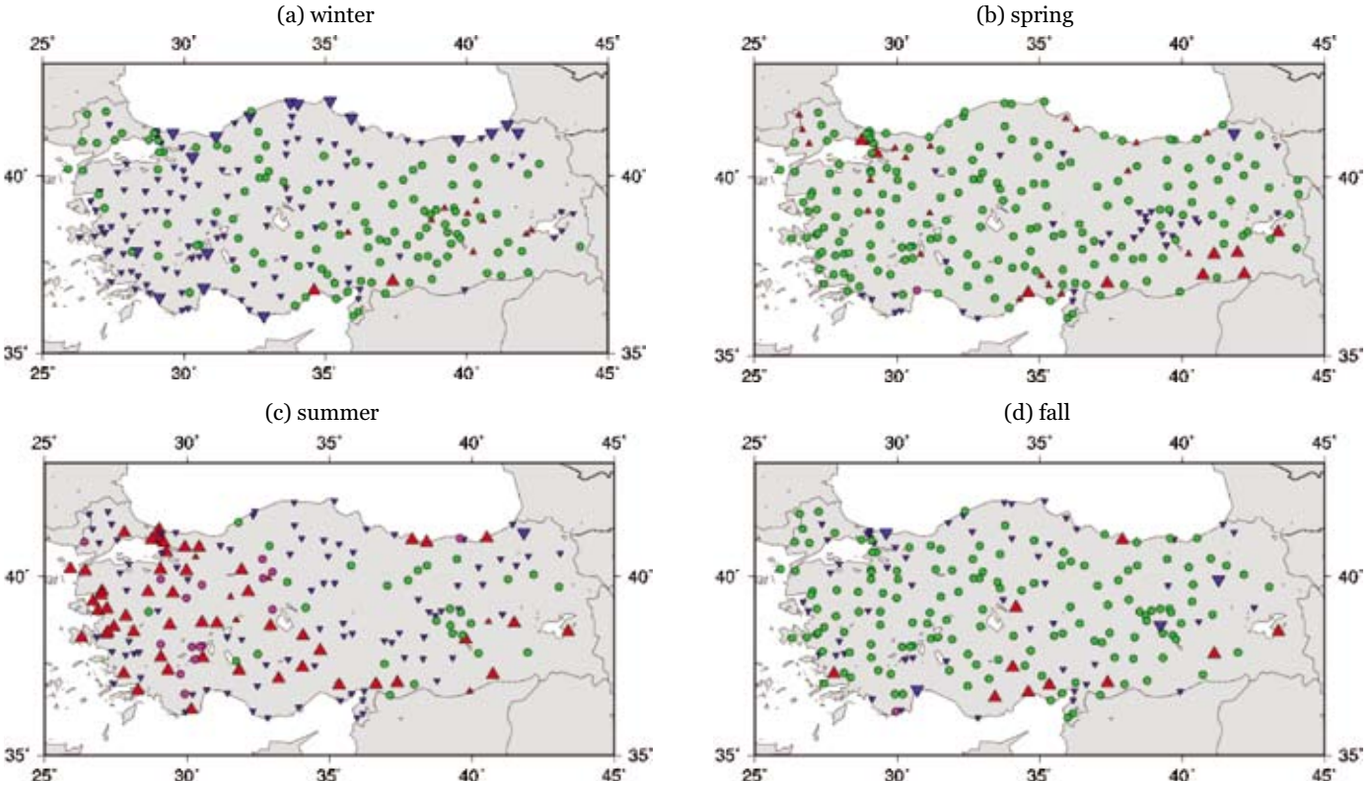


Fig. 6.3 Seasonal temperature trends for the period 1951-2004
● denotes no trend ▲ increase ▲ insignificant increase
▼ significant decrease ▼ insignificant decrease and ● insignificant increase and decrease.

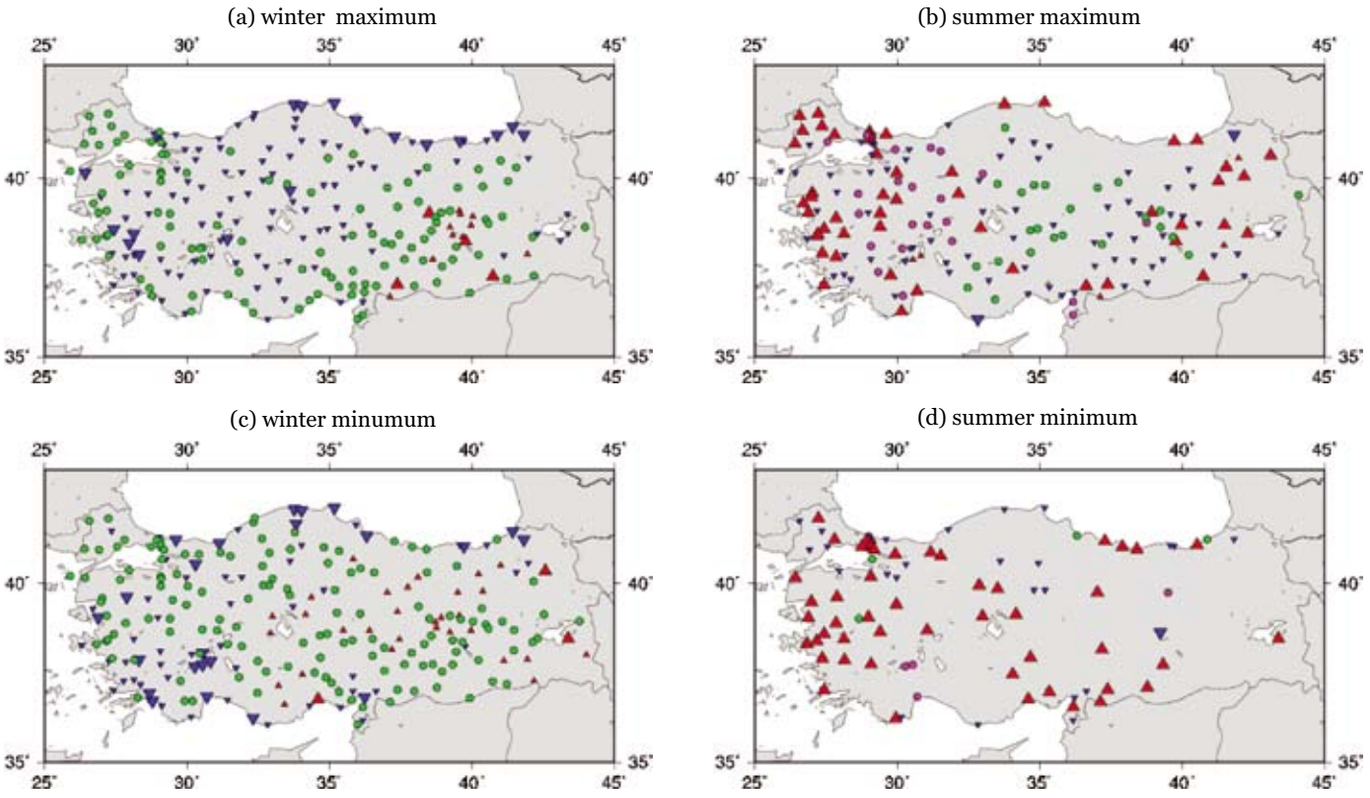


Fig. 6.4 Seasonal maximum and minimum temperature trends for the period 1951-2004
● denotes no trend ▲ increase ▲ insignificant increase ▼ decrease ▼ insignificant decrease ● insignificant increase and decrease.

Figure 6.4 illustrates the seasonal maximum (first row) and minimum (second row) temperature trends for winter (left column) and summer (right column). The maximum temperatures for the winter season exhibit significant decreasing trends in the coastal stations of the Black Sea region and a widespread decreasing tendency in the central Anatolian region (a). In summer, however, the general trend of maximum temperatures is increasing, particularly in western Turkey (b). Several stations in eastern Anatolia also show significant increases in the maximum temperature. In general, minimum temperatures depict similar distributions in both winter and summer. Winter minimums show significant decreases only in the northern and southern coastal regions (c). Summer minimums exhibit significant increasing trends at almost all stations that are observed during the relevant period of the study (d).

6.1.2 Climate Change Projections

Future Climate Projections through Dynamical Downscaling

Downscaling studies are performed using the RegCM3 regional climate model developed by Giorgi and Bates (1989). A series of tests has been conducted to determine an 'optimum' horizontal resolution, and thus a resolution of 30 km is chosen. At the moment, two sets of simulations are conducted: control run forced at the boundaries with NCEP/NCAR Reanalysis data; and 'future' simulation forced by the A2 emission scenario results from the Finite Volume General Circulation Model (FVGCM) of NASA (Lin, 2004). Control runs will cover the 'standard' 30-year climatological period, namely 1961-1990. Future simulations cover the interval 2071-2100.

Future simulation with RegCM3 is forced by the general circulation model FVGCM run based on SRES A2 emission scenario. RegCM3 has therefore been modified to take into account yearly variations in CO_2, CH_4, N_2O, CFC11 and CFC12. Figure 6.5 displays the absolute change in precipitation (i.e. the difference between future and control simulations). In general, precipitation decreases along the Aegean and Mediterranean coasts and increases along the Black Sea coast of Turkey. Central Anatolia shows little or no change in precipitation. The most severe (absolute) reductions will be observed on the south western Coast; in contrast, the Caucasian coastal region is expected to receive substantially more precipitation. These observations are valid both for winter and spring totals. In summer there will not be much change in the amount of precipitation over Turkey. A slight total precipitation increase is expected in the fall season for Turkey as a whole. It is worth mentioning that precipitation in the fall will increase more in the Euphrates-Tigris basin.

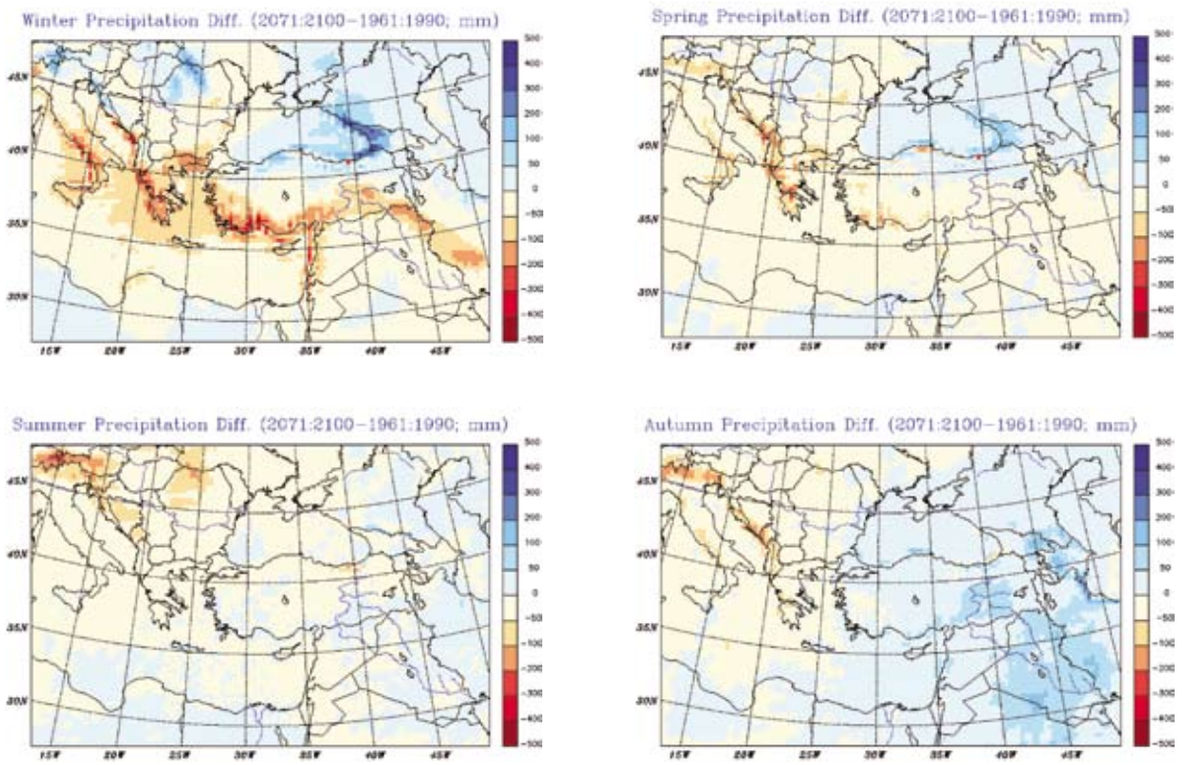


Fig. 6.5 Climate Change Projections for Turkey: Changes in Precipitation for All Seasons (Onol and Semazzi, 2006)

Changes in mean temperature are depicted in Figure 6.6. From the perspective of Turkey, one can observe that in the wintertime, projected temperature increase is higher in the eastern half of the country. In the summer, this pattern is reversed and the western half of the country, especially the Aegean region, will experience temperature increases up to 6 °C; whereas the area-averaged annual mean temperature increase for the entire country is estimated to be around 2-3°C.

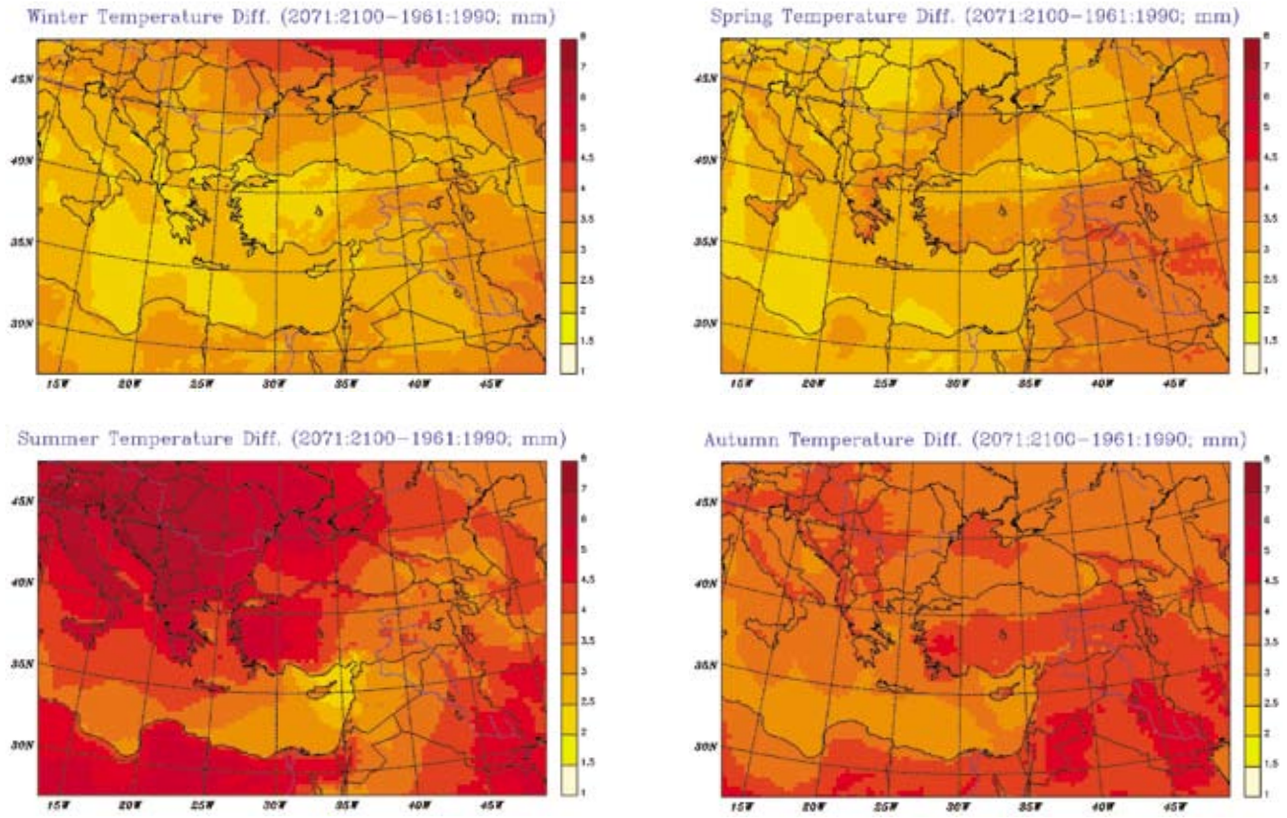


Fig. 6.6 Climate Change Projections for Turkey: Changes in Temperatures for All Seasons (Onol and Semazzi, 2006)

Figure 6.7 illustrates the change in snow water equivalent. As seen from the figure, the reduction is found to be up to 200mm over the high plains of eastern Anatolia and the eastern part of the Black Sea mountains. These figures show that major changes may occur in the streamflow for the river basins in Turkey. Rivers are the main sources of water for Turkey, not only for safe drinking water, domestic and industrial use, but also for irrigation and power generation.

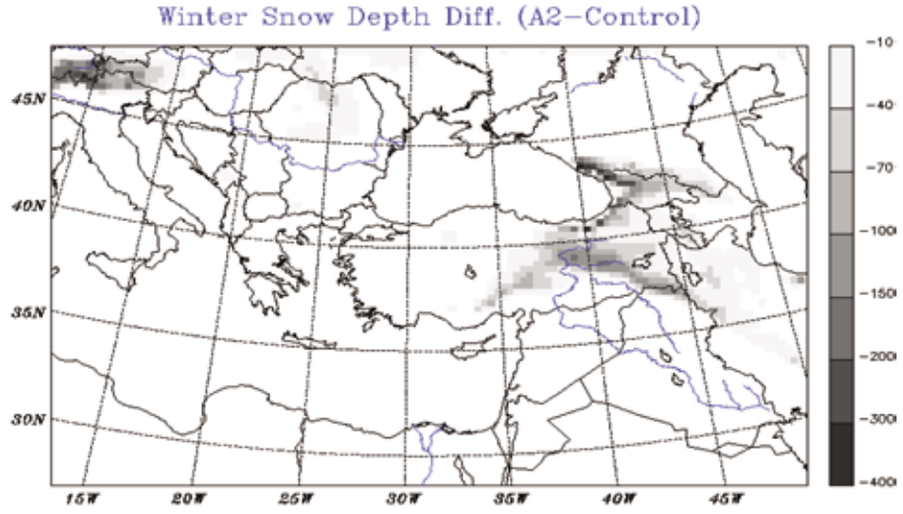


Fig. 6.7 Climate Change Projections for Turkey: Changes in Snow Water Equivalent (in mm) (Onol and Semazzi, 2006)

6.1.3 Sea Level Rise and Coastal Implications

Global sea-level rise for the last century has been estimated between 10 and 20 cm. For the Mediterranean and Black Sea regions, the sea-level rise is around 12 cm in the last century. Although coastal cities cover less than 5% of the total surface area of Turkey, over 30 million people live in coastal areas.

Sea-level measurements are being performed by the Turkish National Sea Level Observation System (TUDES) in Turkey. Average sea-level relative linear change is calculated with harmonic analysis of sea-level change measurements obtained in 20 years' time in Antalya-II (Mediterranean), Bodrum-II and Mentes (Aegean) mareographic stations and in 21 years' time in Erdek (Marmara Sea) mareographic station are 7.4±0.6 mm/year, 4.3±0.8 mm/year, 3.8±0.6 mm/year and 7.7±0.7 mm/year, respectively. There is an obvious rise in average sea-level measurements from all four mareographic stations. The local (relative) sea-level rise of an average of 4-8 mm/year detected by four mareographic stations may be a threat to fertile land in settled areas as well as engineering structures in coastal areas, including roads. It is recommended that the detected relative level trends be taken into consideration in preparing coastal plans and coastal engineering works in Turkey so as to minimise future risks against human life and the economy of the country. Similarly, it would be vital to continuously monitor sea-level changes in coastal areas. (Demir et al. ,2005)

Much of the Turkish coasts appear to have experienced sea-level changes within the generally accepted range of sea-level rise (1-2 mm/year). The areas in which the rate of the sea-level rise has been less than 1-2 mm/yr (e.g. Samsun to Antalya) are assumed to have undergone tectonic uplift, whereas several larger river deltas have experienced sea-level rises greater than the global rise. These areas are assumed to have undergone subsidence.(Karaca et al., 2001)

The main impacts of sea-level rise will be erosion, flooding, inundation of coastal lowlands and saltwater intrusion. The implications of sea-level rise on coastal morphology are various. First, on high rocky cliff coasts, the rising sea will not cause great changes or shifts of the coastline, but the rate of cliff recession may accelerate, increasing the frequency and extent of landslides, potentially damaging coastal roads and communications. Secondly, along low, eroding soil cliffs, there may not be immediate changes, but accelerated wave erosion will gradually increase the rate of cliff migration inland. Because these areas are already densely populated, including the narrow terrace at the cliff base, serious damage or destruction of coastal establishments would result. Protecting these areas from waves and inundation will cause erosion elsewhere. Finally, along deltaic coasts that are advancing seawards today, rising sea-level will slow and may even reverse the shoreline change and these coasts will begin to retreat. The result of this will be increased flooding (and sedimentation) across the delta plain, interrupting agricultural activity (particularly on the Kizilirmak, Yesilirmak, Gediz, Seyhan and Ceyhan plains). (Karaca et al., 2001)

Adaptation

In comparison with other countries lying on low sea level corridors, Turkey does not appear especially vulnerable to sea-level rise. However, Accelerated Sea Level Rise (ASLR) needs to be taken into account. So far, there has only been limited assessment of potential impacts for Turkey based on future sea-level rise scenarios (Karaca, 2000). Nevertheless, a number of expectations seem reasonable such as the impact on daily life in big coastal cities, particularly on the Black Sea and Istanbul, and tourism and agriculture along the Aegean and Mediterranean coasts.

Addressing the necessary adaptation measures in the short term in respect to observed sea-level rise trend along the coastline of Izmir Bay situated on the Aegean coastline, is underlined with the results of the INCO-MED project[2] completed by SUMER in 2005. The study covering Izmir Bay and its coastal zone had the findings of increasing demand for an integrated coastal management scheme. The initial step required to be taken under such a management scheme would be addressing the prevailing pollution problem inland as a priority, given that it is basically the inland processes that contribute to the pollution in the bay. Turkey, being a coastal country, has recognised the increasing number of problems in coastal zones and many precautions have been taken by several governmental institutions and agencies. For example, most of the protection areas declared by the Turkish government are located in the coastal zones such as Fethiye-Gocek, Gokova, Patara, Kekova, Foca, Datca-Bozburun, and Belek etc. The Ministry of Environment is planning to establish a Coastal Zone Department for Environmental Impact Assessment (EIA) and the Authority for the Protection of Special Areas (APSA) is declaring new areas as protection areas and developing special environmental programmes.

2. The INCO-MED Project called as "Sustainable Management of Scarce Resources in the Coastal Zone - SMART" is supported by the European Commission FP5 Programme.

6.1.4 Impacts at Socio-Economic Levels

Uncontrolled growth and development pressure have been the main causes of coastal and near-shore degradation and environmental problems in the Mediterranean, Aegean and Marmara Seas. Water demand is met mostly from groundwater reserves. Overexploitation leads to saltwater intrusion and a decrease in the water resources for other uses such as agriculture. Tangerine, olive and fig growing areas on the Aegean coast (particularly Izmir, Aydin and Mugla provinces) are the worst affected. Saltwater intrusion is also a problem around the western coasts of Turkey (e.g. around Cesme, Marmaris and Bodrum). While, human use is the major problem, sea-level rise is a background change that has exacerbated the problems, and this will be more serious issue through the 21st Century.

Istanbul is the largest coastal city in Turkey. The metropolitan area has a growing population of eleven million (in 2000), a total area of 5,220 km^2 and a population density of 2,107 people/km^2. The length of Istanbul's coastline is approximately 452 km. About 10% and more than 90% of the city's population live within 1 km and 10 km of the coast, respectively. When its industrial infrastructure and other economic features are considered, Istanbul is Turkey's leading city. The importance of Istanbul to the Turkish economy can be summarised as follows: the largest contribution to Turkey's GDP; highest tax revenue collection; the most prosperous banking sector; superior employment opportunities; and the highest concentration of large workplaces, private investments, technology-intensive sectors and trading: export and import. Istanbul is responsible for 21% of GDP, Izmir 7%, and Ankara 8%. Istanbul and Kocaeli, a coastal city located to the east of Istanbul, collectively represent 25% of total national GDP.

One of the major climate-induced impacts on Istanbul is probably saltwater intrusion. Two big lagoons (Buyukcekmece and Kucukcekmece) and the Halic estuary that separates Istanbul's old town from the business district, are vulnerable to possible ASLR, particularly in terms of salinisation, as well as the freshwater supply of Istanbul; Terkos lake, located near the coastline of the Black Sea. 'Flagship' cultural and historical sites along the Bosphorus in Istanbul will definitely be affected by the projected rise in sea level, such as the 200-years-old Dolmabahce Palace and Mosque, the Ortakoy Mosque, the Beylerbeyi Palace and the Kucuksu Kiosk. (Karaca, 2000b)

Adaptation

Coastal erosion, flooding and inundation along Turkish shorelines are coastal problems of national significance, particularly in the middle and eastern Black Sea, the northern Aegean Sea (Saros Bay) and eastern Mediterranean (Hatay, Iskenderun, Ceyhan and Yumurtalik). Tourist and coastal cities are particularly under threat. Many 'flagship' cultural sites would also be damaged or destroyed by ASLR, like ancient cities of Phaselis and Patara on the south western coast. Some of them could be destroyed by increased wave activity, whereas burial by more active sand dunes is also possible (e.g. the ancient city of Pompeipolis [Viransehir] on the Mediterranean coast has recently been covered by sand dunes). Because of the large number and size of the ruins, relocation is impossible in practical terms, and it may change their character and context, as well. As a first step, an inventory of threatened sites would be useful.

More than 60% of the GNP in Turkey according to SPO figures is produced in the coastal strip from Tekirdag to Kocaeli (along the northern shoreline of the Marmara Sea). According to Karaca (2001) in case the Common Methodology of the IPCC CZMS (1992) is applied to both Turkey and Istanbul province assuming 1-m ASLR scenario, Turkey is in the class of low risk countries, but Istanbul has high-risk values. The preliminary assessment of vulnerability analysis yields about 6% of its Gross National Product (GNP) for capital loss, and about 10% of its GNP[3] for protection/adaptation costs of the country.

3. The estimations of capital loss ratio in GNP is based on the dike installments for coastal protection per km.

6.2 Assessment of Impacts and Adaptation Measures

6.2.1 Water Resources

Projections on Gediz and Buyuk Menderes River Basins through MAGICC/SCENGEN Modelling

To investigate the likely consequences of possible global climate change on watershed scale, the Gediz and the Buyuk Menderes River Basins are used as test cases in the modelling studies carried out by Dokuz Eylul University – Water Resources Management Research and Application Center (DEU-SUMER, 2006). Each basin is analysed by dividing it into sub-basins for more accurate watershed modelling results.

The case study is focused on two major and closely located river basins in western Anatolia along the Aegean Sea (Figure 6.8). The first one is the Gediz River Basin, near the city of Izmir. The basin is the second largest in the Aegean region and has a total drainage area of about 18,000 km^2. The most significant feature of the Gediz Basin is water scarcity, which is due basically to competition for water among various uses (water allocation problems), mainly irrigation with a total command area of 110,000 ha versus the domestic and fast growing industrial demand in the coastal zone, and environmental pollution despite of the fact that the basin experiences drought from time to time. Current analysis of the hydrological budget of the basin indicate that the overall supply of water for various uses is approximately equal to the overall demand. In other words, there is no reserve for further water allocation in Gediz. (SUMER, 2006)

The second case considered is the Buyuk Menderes, which is the longest river in the Aegean region. It meanders for 584 km through western Turkey before reaching the Aegean Sea in the form of a large delta, consisting of several lagoons, extensive salt steppes and mudflats (the biggest in Turkey). The Buyuk Menderes Delta is an important wetland with an area of 9,800 ha' like the Gediz Delta, it is recognised as a RAMSAR site. Buyuk Menderes has a total drainage area of 24,976 km^2, and the annual runoff is in the order of 3 km^3, which accounts for 1.6% of Turkey's water potential.

Fig. 6.8 Gediz and Buyuk Menderes Basins along the Aegean coast of Turkey

The basin has been turned into extensive water resources systems, including 13 dams and a large number of irrigation schemes. The total irrigated agricultural area in the basin is more than 88,000 ha. The most important crop is cotton. The basin is the main cotton producer of Turkey. Three major cities of the Aegean Turkey, namely Aydin, Mugla and Denizli, are located in the region and account for a population of more than 2.5 million. The region is rich not only in terms of agriculture but also in industry, the major ones being the textiles and tourism. These activities indicate significant demand and competition for water. (SUMER, 2006)

Fig. 6.9 Location of the Selected Meteorological and Stream Gauging Stations

Climate change effects in spatially averaged temperature and precipitation in the Gediz and Buyuk Menderes River Basins have been assessed using a new version of the MAGICC/SCENGEN model, developed by NCAR-CRU using over a dozen recent GCMs.

MAGICC/SCENGEN is a coupled gas-cycle/climate model (MAGICC) that drives a spatial climate change scenario generator (SCENGEN). MAGICC is a Simple Climate Model that computes the mean global surface air temperature and sea-level rise for particular emissions scenarios for greenhouse gases and sulphur dioxide (Raper et al., 1996).

The 49 emission scenarios involved in MAGICC model are investigated and the ASF model of A2 and MESSAGE model of B2 storylines, which represent the marker scenarios of IPCC SRES, are selected to evaluate climate change effects in the case basins. On the other hand, there are 17 different GCM models in the SCENGEN package, which are run simultaneously to find the total error between the generated and the observed values of temperature and precipitation. Next, to determine the best combinations of GCMs, different selections of model runs are realised, and the best combinations of GCMs are selected as those which have minimum error terms for each variable (temperature and precipitation) and for each period (annual, seasonal and monthly). Then, these combinations are employed to generate changes in temperature and precipitation in the regions investigated.

The abovementioned global change scenarios are downscaled to the regional scale by using SCENGEN. In the regional analysis, changes in the temperature and precipitation are examined on an annual, seasonal (four seasons) and monthly (12 months) basis. The procedure is repeated for both emission scenarios, i.e. A2-ASF[4] and B2-MESSAGE[5] and for the three projection years of 2030, 2050 and 2100. The estimated changes in temperature and precipitation are summarised in Tables 6.1 and 6.2.6

Table 6.1 Generated Changes in Temperature under the IPCC B2-MES Scenario

Period	Baseline			2030		2050		2100	
	Observed	Modeled							
	Mean	Mean	Std.	Change	Ch. in Var.	Change	Ch. in Var.	Change	Ch. in Var.
	°C	°C	°C	°C	%	°C	%	°C	%
Annual	16.3	16.4	0.4	1.2	5.1	1.8	7.9	3.2	14.7
DJF	9.4	9.4	0.8	1.0	-2.5	1.5	-3.9	2.6	-7.2
MAM	14.4	14.4	0.6	1.1	2.7	1.7	4.1	2.9	7.7
JJA	23.4	23.5	0.6	1.6	3.8	2.4	5.9	4.1	10.9
SON	17.8	17.8	0.8	1.4	-2.0	2.0	-3.1	3.6	-5.7

DJF: December, January, February MAM: March, April, May
JJA: June, July, August SON: September, October, November

Table 6.2 Generated Changes in Temperature under the IPCC A2-ASF Scenario.

Period	Baseline			2030		2050		2100	
	Observed	Modeled							
	Mean	Mean	Std.	Change	Ch. in Var.	Change	Ch. in Var.	Change	Ch. in Var.
	°C	°C	°C	0C	%	°C	%	°C	%
Annual	16.3	16.4	0.4	1.2	4.0	2.0	7.7	4.4	20.6
DJF	9.4	9.4	0.8	1.0	-2.0	1.6	-3.8	3.5	-10.1
MAM	14.4	14.4	0.6	1.2	2.1	1.9	4.0	4.1	10.8
JJA	23.4	23.5	0.6	1.5	3.0	2.5	5.7	5.5	15.3
SON	17.8	17.8	0.8	1.2	-1.6	2.0	-3.0	4.7	-8.0

Simulation results of the water budget model, based on the prescribed climate change scenarios, show that nearly 20% of surface water will be reduced by the year 2030. By the years 2050 and 2100, this amount will rise to nearly 35% and more than 50%, respectively (Table 6.3). The decreasing surface water potential of the basins will cause serious water stress problems among water users, mainly agricultural, domestic and industrial water users.

4. The IPCC SRES A2 scenario assumes a world of high population growth and an intermediate level of economic development and technological change. SCENGEN estimates a global mean temperature increase of 0.67 °C by 2030, 1.29 °C by 2050, and 3.47 °C by 2100 for the A2 scenario.
5. The IPCC SRES B2 scenario assumes a world of moderate population growth and an intermediate level of economic development and technological change. SCENGEN estimates a global mean temperature increase of 0.85 °C by 2030, 1.33 °C by 2050, and 2.48 °C by 2100 for the B2 scenario.

Table 6.3 Runoff Changes under Climatic Conditions in 2030, 2050 and 2100 in the Gediz and Buyuk Menderes River Basins

	2030		2050		2100	
	B2	A2	B2	A2	B2	A2
EIE509 Gediz Basin	-%23	-%32	-%35	-%48	-%58	-%71
EIE701 B. Menderes Basin	-%10	-%21	-%20	-%38	-%45	-%71

Expected changes in water demand of crops specific to the region studied are also evaluated with respect to the climate change scenarios of B2 and A2. Monthly potential evapotranspiration (PET) values of selected crops are computed, using the Blaney-Criddle formula, which is the common method employed by the DSI of Turkey in irrigation planning.

According to the climate change scenarios of B2 and A2, the PET and crop water demands increase dramatically for the year 2100. Although the increases in PET are approximately 10%, 15% and 30% for the years 2030, 2050 and 2100 respectively, changes in water demand are higher than those in PET due to decreases in estimated rainfall amounts, namely, the effective rainfall in the climate change scenarios (Table 6.4). Thus, while crops will demand more water than usual, the climate-induced reduction in rainfall values creates an additional impact and therefore the crop water demand increases dramatically.

Table 6.4 The Average Percentage Change (increase) in PET and Crop Water Demand at Selected Meteorological Stations in the Region Studied

	2030				2050				2100			
	B2		A2		B2		A2		B2		A2	
GEDIZ	PET %	Demand %	PET %	Demand %	PET %	Demand %	PET %	Demand %	PET %	Demand %	PET %	Demand%
Menemen	12	13	10	11	16	20	17	19	27	36	36	47
Manisa	10	14	9	11	15	20	15	19	26	37	35	48
B.MENDERES												
Denizli	11	16	8	12	15	23	16	21	26	42	35	54
Nazilli	10	12	9	10	14	18	15	18	24	33	33	44

Simulation results of the modelling study have shown that nearly 20% of surface water in the studied basins will be gone by the year 2030. By the years 2050 and 2100, this percentage will increase to 35% and more than 50%, respectively. The decreasing surface water potential of the basins will cause serious water stress problems among water users, mainly agricultural, domestic and industrial users. Furthermore, the increasing potential crop evapotranspiration (up to 10% and 54% for the years 2030 and 2100 respectively) will increase the irrigation water demand enormously. In addition to the expected water scarcity problems, land use and land cover of the basins will also be seriously affected by the results of climate change.

Adaptation

Effective land use management programmes, promoting technological change in water transport and distribution systems in irrigation and settlement areas, and rationalising water demand management efforts between water users shall be considered as the adaptation instruments for coping with vulnerability to the expected future climate change. (SUMER, 2006)

6.2.2 Agriculture

Agricultural Sector Model of Turkey (TASM)

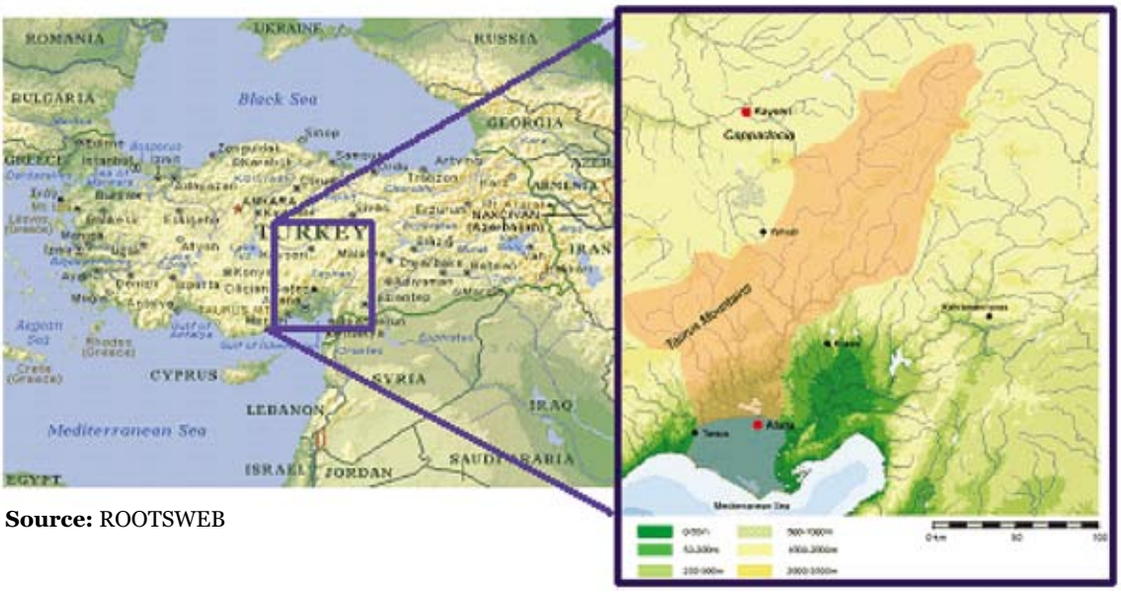
Research conducted by Dellal et al. highlights the impacts of climate change on Turkish agriculture with the help of the Turkish Agricultural Sector Model (TASM). By using 2050 projections of HadCM, possible changes in productivity, arable lands, production and production patterns were discussed in seven geographical regions and on a national scale in five basic products (wheat, barley, maize, cotton, sunflower), calculations were made for possible shifts in producer surplus, consumer surplus and prices, which indicated a possible decline of 2-13% in productivity throughout Turkey to possibly change arable

lands and production patterns. The decline in productivity is expected to reduce the amount of production, leading to an increase in prices, in the favour of producer surplus against consumer surplus. (Dellal et al., 2004). This research is still underway. In the future, the model is expected to be improved by including CO2 ration, adaptation and other agricultural products as well as processed products.

Impact of Climatic Changes on Agricultural Production System in Arid Areas

In order to analyse the relationship between climate and agricultural systems, the research project 'Impact of Climate Change on Agricultural Production System in Arid Areas' (ICCAP)[7] is being implemented jointly by the Research Institute for Humanity and Nature (RIHN) Scientific and the Technical Research Council of Turkey (TUBITAK).

The project selected case study areas in arid and semi-arid areas on the eastern coast of the Mediterranean Sea, including the Seyhan River basin in Turkey, as a main case study area (figure 6.10)



Source: ROOTSWEB

Fig. 6.10 Main Case Study Area: Seyhan River Basin in Turkey

The disciplines of the collaborators include climatology, meteorology, surface and groundwater hydrology, irrigation engineering, agronomy, crop physiology, soil sciences, forestry, animal husbandry, economics, anthropology, etc. The sytematics of the ICCAP research studies is given in Fig. 6.11

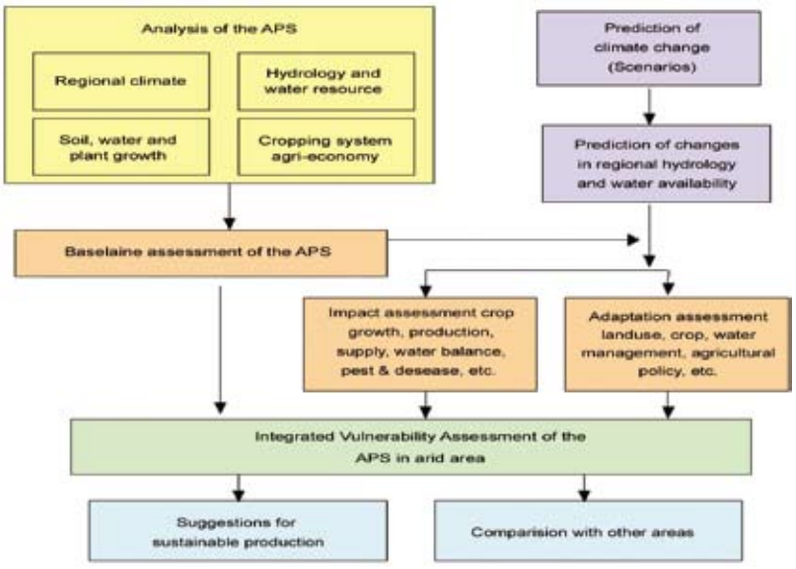


Fig. 6.11 The Sytematics of the ICCAP Research Studies

7. The collaborators of ICCAP consist of almost forty researchers including graduate students in the Japanese team from fifteen universities and research institutes in Japan, and almost the same number of researchers and engineers in the Turkish team from five universities, Israeli researchers and governmental organisations, mainly from Cukurova University in Adana under their focal point role in Turkey.

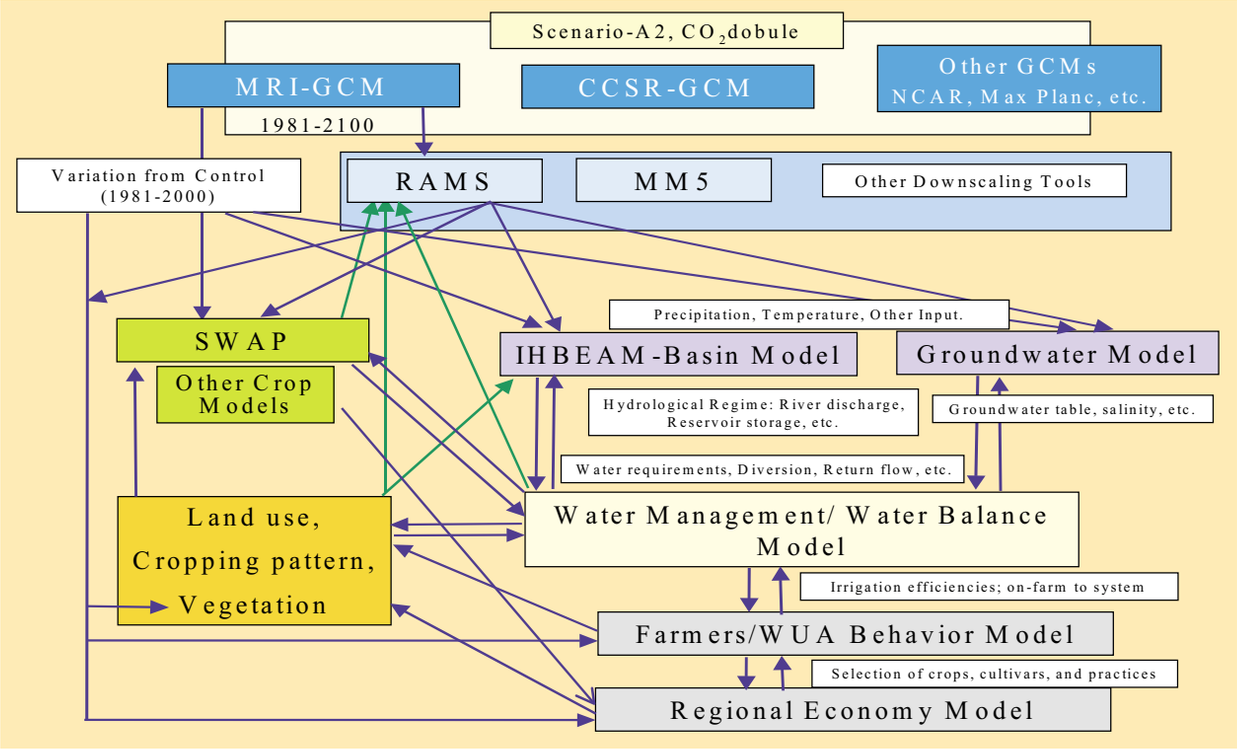


Fig 6.12 Linkage of sub-models and sub-groups

The methodology applied through various topics and the run base models linked to sub-models are depicted in figure 6.12. The future regional climate is predicted basically by the Regional Climate Models linked with the GCMs. With the output of RCM, the future hydrological regime is estimated by using the Basin Hydrology Model. The future condition of groundwater is to be estimated by this basin hydrology model and the groundwater model that should treat future possible sea level rise.

Preliminary Findings of ICCAP

Preliminary outcomes of the MRI-CGCM2 studies underline that the average temperature will increase by 2.3°C in the southern part of Turkey by 2070, according to data provided by global warming experiments. In addition annual precipitation will decrease from 470 mm to 360 mm according to data from the Meteorology Research Institute of Japan. A method is being developed to downscale the outputs of GCM with RCM and with re-analysed meteorological data such as those of the NCEP or ECMWF. Analysis of the archived data of the meteorological station confirms the trend of temperature increase and precipitation decrease in the past.

Hydrology and Water Resources

The annual average runoff discharge of the Seyhan River is 282 mm and the available water resources of the basin are relatively stable. Since the 1990s, there has been no serious drought with drying up of reservoirs, while in the future some drought may result from a reduction in runoff discharge caused by climate change.

Sea-level rise will cause poor drainage in the lower region of the delta, while seawater intrusion into ground water will be very limited. In the delta region, irrigation depends on only 1% of water supplied from ground water.

Vegetation and Crop Productivity

In the Seyhan Basin, vegetation varies from the lower coastal region to semi-alpine at 1,000 metres or more above sea level. In the area below 600mm above sea level, original or natural vegetation is lost by human activities. It is predicted that global warming may be expected in the area with, steppe, deciduous broadleaf trees, and savanna and shrink semi-alpine evergreen trees in the basin.

The increase of CO2 concentration, temperature and water stress with climate change may affect production of major crops in the basin, including wheat in rain-fed condition and maize in irrigated land.

The multi regression analysis estimates prove a future reduction of cereal production in the Adana region and in rain-fed region with changes in temperature and rainfall due to global warming.

Irrigation and Drainage

Water use in irrigation has been increasing. The reasons for this increase are diversification of cultivated crops; increased loss in delivery systems due to their age and poor maintenance, and lack of incentives for farmers to save water. Soil salinity was a serious problem after construction of irrigation systems in the lower delta and has been mitigated by leaching with much water application.

Adaptation

The predicted water demand increase due to climate change could be managed by improvement of irrigation efficiency even with the present facilities. [1]

The proposed measures according to climate change scenarios, include setting new criteria according to time, region and position of the project in the basin for planning and operation of water storage facilities.[8]

Some of the identified adaptation measures in respect to the predicted findings from the impact studies comprise the following:[9]

- Developing techniques for non-traditional use of water resources.
- Improving and developing new plant species to stand against drought and salinity
- Developing plant species that may yield quality products with low-quality water

8. One of the outcomes of the Workshop for Preparation of Turkey's Climate Change Action Plan Framework, held 8-9 June 2006.
9. The recommended adaptation measures were determined during the GEF Project Country Workshop on Impacts of Climate Change and Adaptation held 2-3 March 2006.

6.2.3 Marine Ecosystems and Fisheries

Dramatic changes were experienced in the Black Sea ecosystem during the 1980s and 1990s due to a combination of eutrophication, overfishing, a huge increase in the alien gelatinous carnivore species Mnemiopsis leidyi, and Beroe ovata, abrupt decadal cooling and warming events and associated changes in hydro-meteorological properties (Oguz, 2005a).

Using time series data from the different trophic levels shown, the last 4 decades of the ecosystem transformations were examined in four distinct phases (pre/early/intense and post-eutrophication phases).

'Regime shift' referred to in research carried out by Oguz (2005a), defines a transition between two quantifiable, quasi-equilibrium states (or regimes), when resilience declines and an ecosystem becomes vulnerable to low frequency, high-amplitude changes in multiple trophic levels introduced by external forces (Collie et al., 2004). The ecosystem then alters its regime by top-down forcing (e.g. removal of functional groups by means of overfishing, introduction of alien species), bottom-up forcing (e.g. nutrient and pollutant inputs) and climate change (Oguz, 2006).

Subsequent research conducted by counting the variations due to climate change in the Blacksea ecosystem presents regime shifts at higher and lower trophic levels. The regime shift is diagnosed by examining small pelagic catch variations with respect to the fishing pressure at higher tropic levels resulting with the findings of "discontinuous regime shift" events.

The regime shifts at the lower trophic level considers phytoplankton biomass variations that are controlled concomitantly by climate, eutrophication and overfishing as described by Oguz, 2005. According to data provided by Sorokin (2002) the anthropogenic-based nitrogen load, being the main limiting nutrient for most parts of the Black Sea ecosystem, was ~150 kilotonnes/year in the 1960s, increasing almost linearly up to ~600 kilotonnes/year in the mid-1980s and later decreasing to ~300 kilotonnes /year in the 1990s. According to Collie et al. (2004), findings of the research at a higher trophic level introduces transition that may be identified as "smooth regime shift".

6.2.4 Terrestrial, Freshwater Ecosystems, Wetlands and Biodiversity

Impacts on Terrestrial Ecosystem

Climate change over the past 30 years has produced numerous shifts in the distribution and abundance of species. Recent studies have tried to quantify future changes under different warming scenarios. [2]

Turkey has some 737 known species of amphibians, birds, mammals and reptiles. Of these, 3.5% are endemic, meaning that they exist in no other country, and 6.2% are threatened. Turkey is home to at least 8650 species of vascular plants, of which 30.9% are endemic. 0.7% of Turkey is protected under IUCN categories I-V.1 Turkey has been a party to the UN Biological Diversity Convention since 1996. [3]

Thuiller et al. (2005) show that a 3.6°C rise in global warming could lead to a loss of over 50% of plant species in the northern Mediterranean and the Mediterranean mountainous region, while loss of species is likely to exceed 80% in northcentral Spain and the Cevennes and Massif Central in France.

These results are in line with earlier studies (e.g. Thomas et al., 2004) although estimates of magnitudes extinction risks are lower than earlier predictions. Climate change may also have indirect impact on the ecosystem.

Effects of Climate Change on Ecosystem of Buyuk Menderes River

The research area, Buyuk Menderes River, is an important river system, which includes wetland areas of the eastern Mediterranean region, such as Bafa Lake.

The Buyuk Menderes River arises as springs in limestone formations near Dinar and flows west for about 560km, draining 24,000 km^2 of south western Turkey before joining the Aegean Sea at Bafa Lake and the Buyuk Menderes Delta, 115 km to the south of Izmir.

Research conducted by Kazanci N. aimed to determine the composition of benthic macroinvertebrates and the relationship between their distribution environmental quality characteristics of Buyuk Menderes River and to identify possible effects of climate change on benthic macroinvertebrate assemblages. Therefore, benthic macroinvertebrates[10] and physicochemical data were assessed for 17 sites in Buyuk Menderes River in south western Turkey for a period of one year between 1998 and 1999. Relationships between macroinvertebrate assemblages and environmental variables were explored by canonical correspondence analysis. This is the first attempt to present a detailed ecological survey of benthic macroinvertebrate taxa and water quality relationships, providing a framework for understanding climate change in the Buyuk Menderes River ecosystem and biodiversity.

According to "Climate Change Scenarios for Turkey: Preliminary Studies" (Karaca et al., 2006), stream flow has significant decreasing trends in western and south western parts of Turkey. This is more or less similar in all seasons. Additionally, average annual temperatures show significant increases in the western and southern parts of Turkey in summertime. Increases in water temperatures as a result of climate change will affect ecological processes, geographic distribution of aquatic species resulting in extinction of species and loss of biodiversity. Climate changes will alter hydrologic characteristics and water quality of running waters and will affect species composition and ecosystem functions.

The taxa[11] preferring low temperature, high dissolved oxygen, high current velocity, does not tolerate climate change effects (high temperature, low dissolved oxygen, low water velocity) on running water ecosystems. Another classified taxa[12] differs in terms of its toleration to high temperature, low dissolved oxygen, low current velocity. (Kazancı N., 2006)

10. The benthic macroinvertebrate assemblages broadly reflect environmental conditions and are used as indicators of environmental degradation and restoration.
11. These are Taeniopterygidae, Nemouridae, Leuctridae from Plecoptera; Oligoneuriidae, Heptageniidae, Ephemerellidaefrom Ephemeroptera; Aeshnidae, Gomphidae from Odonata; Rhyacophilidae, Leptoceridae and some species of Hydropsychidae from Trichoptera; Gerridae, Notonectidae from Hemiptera; Elmidae from Coleoptera; Pyraustidae from Lepidoptera; Tipulidae, Athericidae from Diptera.
12. This taxa comprises Valvatidae, Bithyniidae, Planorbidae from Gastropoda; Unionidae, Sphaeriidae from Lamellibranchiata; Coenagrionidae from Odonata; Dytiscidae from Coleoptera; Lumbricidae, Tubuficidae, Naididaefrom Oligochaeta; Glossiphoniidaefrom Hirudinea; Platycnemididae, Calopterygidae from Odonata; Dytiscidae from Coleoptera; Sciomyzidae, Muscidae, Chironomidae from Diptera can tolerate high temperature

Impacts on Lakes

In Turkey, there are about 200 lakes, both small and large in size with a total surface area of more than 9,000 km^2. Studies recognising the climate change parameter conducted by Beklioglu et al (2006a) on shallow lakes, have demonstrated that the disappearance of water plants are associated with very high or very low water stands and that the period and amplitude of these changes are of crucial importance.

Although the density of nitrogen and phosphorus moving from basins into lakes, particularly in dry periods is too low to be measured, an increase in concentrations in the lake results in the release of nutritive salt from sediment (bottom sludge) due to lake water- sediment interaction in dry times.

Consequently, the level of water-borne nutritive salt (nitrogen and phosphorus) increases in dry periods and the increased lake water becomes denser at the end of this period of modification, boosting the frequency of algae explosions and resulting in the loss of ecological value of lakes and diminishing diversity of aquatic plants, prey fish and birds because of eutrification.

On the other hand, there occurs an increase in salt density (chlorine, sodium, etc.) in fresh water lakes in dry periods. The water, which is fresh in springtime (<1 g l-1), becomes semi-salty or bitter in mid-summer due to evaporation (1.5-2 g l-1). (Tan, 2002, M. Beklioglu)

These changes observed in Turkish lakes during dry periods together with global climate change, may result in loss of ecodiversity and protection value due to eutrification and saltification of shallow lakes and wetlands keeping in mind the possible drought and the increase in temperature in the Mediterranean Basin (Coops et al., 2003, Beklioglu et al., 2006b). These changes not only constitute an ecological problem, but also rapidly become an economic burden, since it may not be possible to use toxic algea explosions or salinated water for drinking or irrigation purposes.

Wetlands, Special Protection Areas and Biodiversity

In Turkey, there are 200 wetlands matching the criteria of the Ramsar Convention, nine of which have been already defined as Ramsar sites and the rest as potential Ramsar sites. Protection of wetlands hosting mainly water birds and presenting biologic and ecologic particularities as well as economic value has been a priority of the MoEF. Out of 76 wetlands, the nine having international importance are classified under the Ramsar Convention[13] Turkey acceded to the Ramsar Convention on Wetlands on 13 November 1994.3. The General Directorate of Environmental Protection of the MoEF executes the preparation and implementation issues of the Turkish wetlands declared as 'Ramsar Sites', it also determines their biological and ecological status such as the Manyas Lake Management Plan completed in 2001.

However, in order to mitigate the severe threat to human health caused by malaria vector hosted in marshes, particularly in hot regions of Turkey, necessary drainage works had to be conducted in the relevant marshes back in the 1960s. As a result of this, several hectares of marshes resulted in the loss of wetlands. After the 1970s, the successful results were achieved by campaigns that eradicated malaria on the one hand and raised environmental awareness on the other, halted the policy of draining marshes. According to the official records, more than 100,000 ha of marshes were dried out between 1955 and 1970 as shown in the Fig.6.13.

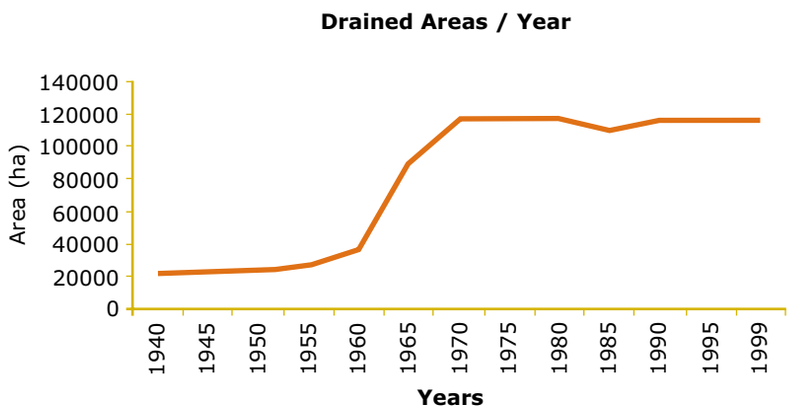


Fig. 6.13 Drained Marshes Between 1955-1999

13. Ratifying the Ramsar Convention on Wetlands, Turkey enacted the Convention on 13 November 1994.

In this context, especially in the last 10-15 years, significant steps have been taken to protect wetlands in the country. A new regulation on the conservation of wetlands has been prepared and put into force in order to establish a framework for the implementation of the Ramsar Convention.

The General Directorate of Environmental Protection of the MoEF continues to carry out conservation studies within the framework of the regulations. Turkey became a signatory to the Cartagena Bio-Security Protocol related to genetically modified organisms (GMO) in May 2000. The UNDP/GEF allocated a grant for identification of areas having genetically rich diversity and their in-situ protection through management plans with the aim of ensuring their sustainable usage. Within the framework of the Bern Convention ratified in 1984, Turkey became one of the three pilot countries of the 'Emerald Network' established for cooperation development aiming at the efficient protection of special areas.

NGOs in Turkey continue to play strong roles in the preservation of the environment, like their counterparts in the West. The leading national conservation NGO is the Society for the Protection of Natural Life (DHKD) in Turkey (WWF[14]). It plays a crucial role in developing conservation strategies and establishes international projects to preserve the natural environment. Three out of twelve Ramsar sites are coastal: Gediz Delta; Goksu Delta (Lakes Akgol and Paradeniz) and Kizilirmak Delta.

With respect to specially protected areas (see table 6.5), there are relatively few major protected areas covering a total of just 3,000 km², with another 2,000 km² classified as protected areas according to the 'Turkish National Parks Law' that are subdivided into 33 national parks, 35 nature protection areas, sixteen nature parks, 118 reserves and 54 nature monuments. In addition, 750 natural sites and thirteen specially protected areas are classified according to the Conservation of Cultural and National Heritage Act and the 'Decree on the Establishment of the Authority for the Protection of Special Areas', respectively. (Burak Z., 2002)

Table 6.5 Number and size of protected areas

Type of protected area	Number	Area (ha)	Type of protected area	Number	Area (ha)
National Park	37	853,222	Reserve Forests	54	316,125
Nature Park	18	72,315	Gene Protection Forests	188	25,703
Nature Protection Area	33	64,663	Seed Orchards	337	45,858
Nature Monument	102	5,285	Special Environmental protection Area	14	1,200,247
Wildlife Development Site	88	1,450,000	Ramsar Sites Natural Reserves Natural Assets	12 750 2,370	200,000 NA NA

Source: UCES, 2006

6.2.5 Health

Climate Change and Malaria Cases in Turkey

Malaria is one of the vector borne infectious diseases that is affected by climate changes, and climate has been known to be a driving force in malaria transmission since the earliest days of research. Temperature and rainfall may have synergistic effects on malaria transmission.

According to studies conducted by Ergonul, O. and researchers from the SMS (2006), in the last 35 years, there have been two important peaks in the number of malaria cases in Turkey. One was between 1977 and 1984, and the other between 1993 and 1999 (Figure 6.14). However, distribution of the cases varies in different regions.

Within the last three decades, there have been two periods characterised by a high number of malaria cases. These were 1977-1987 and 1993-1998. The mean temperature during 1977-1987 was significantly higher than that of 1930 and 2004 in Adana. This is a significant result, which shows parallelism between high temperature and malaria cases within the 1977-1987 period. On the other hand, within the same time period, there was no significant increase in temperature in the south eastern provinces, although the number of malaria cases remained very high.

14. WWF is represented by the DHKD in Turkey

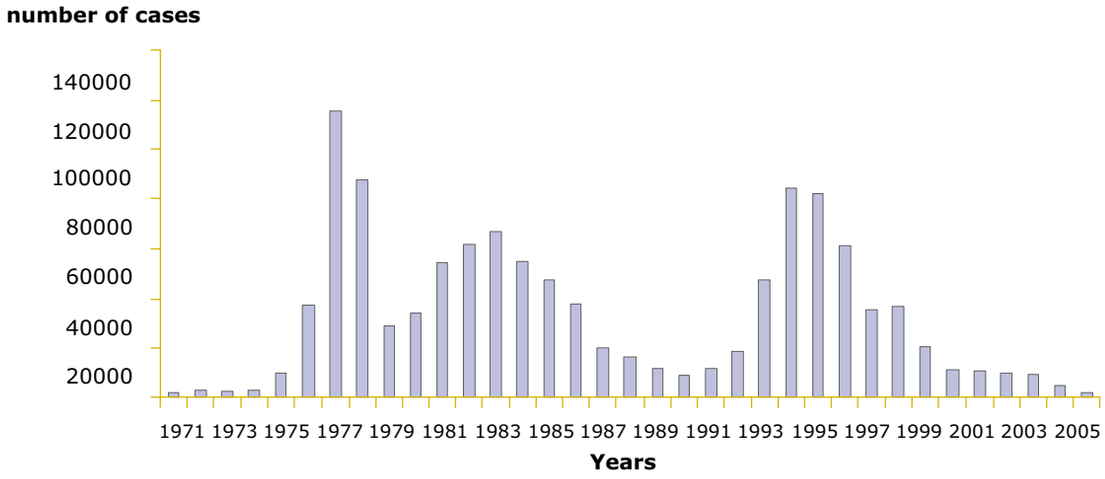


Fig. 6.14 Number of Malaria Cases in Turkey since 1971

In the 1993-1998 period, the mean temperatures of Urfa and Mardin were found to be significantly higher than those of the total duration. This finding could be related to the high number of malaria cases within the region. Besides this result, within this time period, there was a decline in the number of malaria cases, but no significant increase in the mean temperature in Adana.

The number of malaria cases is related to many other factors. One of these is migration, which eventually resulted in the decrease of population in rural areas. Another factor is the coincidental implementation of malaria control programmes. The Turkish government and local health authorities established awareness-raising programmes to fight against malaria. In 1998, as a part of the Roll Back Malaria campaign of the UN's World Health Organization (WHO), an awareness-raising project, namely "Enhancement of the National Capacity of Malaria Units in Turkey" was launched in cooperation with UNDP and WHO. The technical capacity of local malaria units in Southern provinces involved in the project was upgraded and 110 staff members in these units were educated in different aspects of the fight against malaria. The training including diagnosis, treatment, larvae control, pesticides etc. These and similar efforts might well have played a large role in the control of malaria in Turkey.

Analysis of temperature changes within certain time intervals revealed a parallelism between higher temperature and the number of malaria cases. Although climatic changes may play some role in the incidence of malaria, preventive efforts for controlling malaria have had a substantial impact. Malaria cases increased in parallel to the increase in mean temperature within certain time periods. However, the number of malaria cases declined significantly in Turkey. The primary explanation is the implementation of control measures.

Climate Change and Leptospirosis Cases in Turkey

The leptospira is one of infectious disease that is affected by climate change. The importance of climate as a driving force in leptospira transmission has been known since the earliest research. Temperature and rainfall may have synergistic effects on leptosira transmission. According to a study conducted by Polat, E., between 2004 and –2006, particularly during the months of January,February and March, there was no detectable increase or decrease in the number of Weill Patients and accordingly similar results have been observed in the X^2 test (X^2=1,36,P=0,97). During January and February, in spite of an increase in rainfall there was no difference in leptospirosis, indicating that an increase in environmental temperature is as important as an increase in rainfall.

The numbers of Weill patients during January, February and March 2004 - 2005 and 2006 are approximately similar with a relative increase of 50% in April according to the total number of patients during 2004 - 2005 and 2006. This situation indicates that temperature and rainfall may have synergistic effects on leptospira transmission.

Climate Change and the Crimean Congo Hemorrhagic Fever Outbreaks in Turkey

Changes in climatic conditions were suggested to be one of the factors that could facilitate the reproduction of the tick population, and lead to an increase in the incidence of tick-born infectious diseases. As one of the tick-born infection entities, Crimean-Congo hemorrhagic fever (CCHF) is a fatal viral infection found in parts of Africa, Asia, Eastern Europe and the

Middle East. Crimean Congo Hemorrhagic Fever (CCHF) infection was first diagnosed in 2002 in Turkey and persisted in 2003 and 2004. Cases were mainly from three provinces: Tokat; Sivas; and Yozgat. All the cases were people dealing with husbandry, 53% had a history of tick bites (Ergonul et al., 2005). Ergonul et all investigated the role of climatic factors that could affect the activation of the Hyalomma marginatum marginatum population, which is usually activated by increasing temperatures in the spring, particularly in April and May and leading to the emergence of a Crimean-Congo Hemorrhagic Fever (CCHF) epidemic. Meteorological data from Tokat, Sivas, and Yozgat stations for the period 1930-2004 were analysed where the majority of CCHF cases were reported over the last two years. According to the results of the study, the number of days where the temperature was >5°C and daily mean temperatures in April in the region substantially increased in the years before the outbreak. Recent climatic changes will inevitably coincide with any recent epidemiological phenomena, but this does not necessarily indicate causality. At the same time, changes in biotic environmental factors, of the sort that could be beneficial for survival of large numbers of hyalommas have also occurred.

6.2.6 Land Degradation and Desertification

Land degradation and desertification currently threatens approximately 1.2 billion people living on four billion ha of land in 100 countries (UNCDD, 2005), which in turn causes socio-economic conflicts (health, environment, livelihood securities and migration) within nations. Turkey, due to its physiographic environment combined with its past cultural and economic heritage and the current socio-economic situation of land users, is highly vulnerable to desertification with 86.5% of its total land area and 73% of its arable land at risk of erosion,land degradation and desertification. [4]

According to studies conducted by Turkes in 1999 and 2002, based on the annual aridity index series of Turkey for the period 1930-1993, there was a general tendency from the humid conditions of around 1960 towards dry sub-humid climatic conditions at many Turkish stations. It is also indicated that there was a significant shift from humid or semi-humid conditions in the 1960s to dry sub-humid or semi-arid climatic conditions in the mid- and late 1980s and early 1990s in the Aegean part of the Mediterranean region. In contrast, aridity index values tended to increase significantly towards humid or semi-humid climatic conditions over the northern part of the Continental Central Anatolian region of Turkey.

Semi-arid and dry sub-humid climatic conditions are dominant over continental interiors and the south eastern Anatolia region. Regarding climatic factors and sparse and vulnerable vegetation cover, southeastern Anatolia and continental interiors of Turkey appear to be the arid lands that are prone to desertification. When other natural and anthropogenic factors, such as high topography, unsustainable use of agricultural land and forest fires are also taken into account, the Mediterranean and Aegean regions could be considered as areas that may be more vulnerable to the desertification process in the future.

Turkey has been a signatory to the United Nations Convention to Combat Desertification (UNCCD)[15] since 1998 and accordingly, several plans and programmes were prepared to mitigate desertification and land degradation issues in the country.

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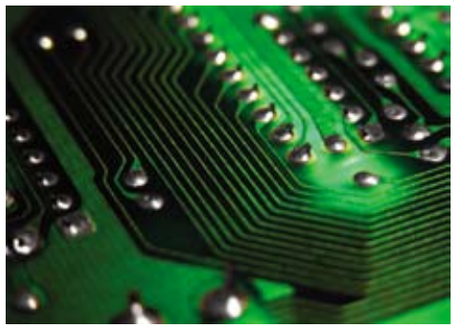


CHAPTER 7
FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

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7.1. Environmental Finance Policies and Implementations in Turkey

Pursuant to Articles 4.3, 4.4 and 4.5 of the UN Framework Convention on Climate Change, the countries listed in Annex II to this Convention are obliged to provide financial assistance, as well as to implement measures aimed at technology transfer to developing countries. These activities would enable developing countries to implement the provisions of the convention and to cover the cost of adapting to climate change. Turkey is not an Annex II country, and so, it is not directly obliged to provide any financial or technological assistance to developing countries, however it participates in many international projects which are co-financed by the Turkish government.

The Turkish government co-finances several environmental projects, however, the exact amount other than the contribution of the Turkish government to the related activities on climate change is not known.

Due to economic barriers, there is insufficient environmental expenditure in Turkey. Expenditure of the sectors related to the environment (energy, industry, agriculture, tourism etc.) are as important as the expenditure of the MoEF. The situation is not encouraging when the environmental expenditure data of the entire government is examined. The share of environmental investment expenditure in the gross domestic product (GDP) for the government was 1.60 ‰ in 2003 and 1.26 ‰ in 2004 (TURKSTAT).

7.1.1 Tubitak Research Policy and Funding of Programs and Projects

TUBITAK is in charge of national science and technology development and research funding in Turkey. The Turkish Research Area (TRA) executed by TUBITAK, aims at providing synergy among institutions carrying out R&D activities, such as universities, public research institutions and private firms. (Table 7.1)
Total resources for the programme in 2005 were 205 million euros.

The Supreme Council for Science and Technology (SCST) Decision (2004-2005)

Starting with the 2005 budget, in order to increase the ratio of R&D expenses GERD (Gross Expenditures on R&D) expressed as a percentage of GDP from 0.67% in 2002 to 2% in 2005, has decided that complementary public funds have to be added to the R&D budget and the number of full-time equivalent R&D personnel which stood at 23,995 in 2002 must be increased to 40,000 by 2010. [1][5]

Table 7.1 Distribution of the TRA Funds for Public Sector (2005)

Components	Allocated Resources (M Euro)
Academic R&D	53
Defence and Space Programs	30
Public Institutions	30
Researcher Development	15
Science and Society	8

*Plus 69 M Euro will be allocated to the private sector research projects

Allocation of Resources for Public Sector R&D

Distribution of TRA Funds for the Public Sector (2005) are given in Table 7.2 and Table 7.3.

Table 7.2 Allocation of Resources for Public Sector R&D

Sector	2003	2004	2005
TUBITAK-TRA (Public sector component)	-	-	136
TUBITAK (Own projects)	51	43	83
Universities	129	132	168
Public Institutions	9	10	21
Total	189	185	408

Table 7.3 Total Public Support for R&D (Million euro)

Users Funds	2003	2004	2005
Public Sector	189	185	408
Private Sector	73	70	136
TOTAL SUPPORT	262	255	544

According to decisions taken by SCST, TUBITAK has supported related ministries that prepare their research programmes; i.e. Ministry of Agriculture and Rural Affairs, Ministry of Health, Ministry of Energy, Ministry of Public Works and Settlement "National Earthquake Program".

Research Grant Committees (RGC) are set up as follows: Agriculture, Forestry and Veterinary- Basic Sciences, Environment, Earth, Marine and Atmospheric Sciences, Electrical, Electronics and Informatics, Health Sciences, Engineering, Defence and Security Technologies, Space Technologies, Social Sciences and Humanities.

7.1.2 Technology Development Foundation (TTGV)

TTGV was established jointly by the private and public sectors as an independent non-profit organisation on 1 June 1991 in order to support national technological innovation by industrial and software companies and to enhance competitiveness in world markets.

The TTGV supplies funds for technology development, technological innovation, new products, new processes and new production development projects in industrial companies. In addition to these funds, TTGV promotes building technology service centres, techno parks and technology development areas. It also supplies funds for these and thus has a catalytic role in the development of technology-based venture capital mechanisms and for the first time in Turkey.

Technology Development Project Support (TDP)

Since August 2006, TTGV's support mechanisms have been enlarged and new support has been developed. This includes consecutive and integrated mechanisms that will enable enterprises to make the best of their technological development potential so that developed technologies serve Turkish enterprises to achieve a competitive position in the global market.

TTGV's financial support mechanisms have been enlarged to provide financial incentives to the private companies in order to promote their innovative R&D activities. These supports are given for the following activities:

Technological Entrepreneurship Support

To provide financial support to entrepreneurs that have an innovative idea, new product development, process development, or in innovation to existing products and/or processes by sharing R&D projects' capital requirements.

Environmental Supports

i) Renewable Energy Support: The aim of this support is to increase the utilisation of Renewable Energy (RE) resources by industry by supporting development of RE technologies and dissemination of RE applications.

ii) Industrial Energy Efficiency Support: The aim of this support is to decrease GHG emissions by removing financial barriers for energy efficient investments by industry, decreasing the energy intensity of Turkish industry and promoting energy audits by industry.

iii) Environmental Technologies Support: Development and dissemination of cleaner technologies which provide a better use of chemicals, raw materials and energy, thus decreasing the amount of industrial waste and pollution.

7.1.3 European Environment Agency (Access to Environmental Information)

A key point in the field of Turkish environmental information management was its membership of the EEA. The Law came into effect in 2003 on "Approving the Republic of Turkey's Accession Agreement to the European Environment Agency and European Union and Observation Network Agreement between the Republic of Turkey and the European Communities and Final Note of the Negotiations Concerning the Approval of the Agreement between the European Community and the Republic of Turkey on the Republic of Turkey's Joining the European Environment Agency and European Information and Observation Network".

A General Directorate of EIA and Planning of Ministry of Environment and Forestry was appointed as the National Focal Point to the EEA by MoEF.

The MoEF aims to establish a link with the European Environment Information and Observation Network (EIONET) through the National EIONET system. The system will fulfil the reporting requirements of the EEA, and capacity building within those institutions involved, and dissemination of experience and knowledge gained from the EEA to relevant national institutions and experts. This will enable Turkey to have access to data for inventory preparations and climate change mitigation and adaptation projects.

There is also an ongoing Corine Land Cover project.
Turkey financially contributed to the EEA for EIONET. The contribution was made over a 3-year period:

First Year	2.3 million euros (1.5 million euros will be financed by MEDA)
Second Year	2.5 million euros (1.5 million euros will be financed by MEDA)
Third Year	3.1 million euros

The EIONET is used for monitoring and reporting, and also conducts preliminary examination of environmental conditions. This infrastructure is a more rapid, effective, system ensuring information safety. After Turkey joins the European Environment Agency, the country will have to use the same data collection (production) methods as the EU and the same database., and in brief, Turkey will have to speak the same language as the EU in order to contribute to the realisation of the aforementioned tasks of the agency.

7.1.4 Ministry of Industry and Trade New Technologies and Innovation Funding

Main Objectives of the Industrial Policy is:

- To increase competitiveness and productivity of industry,
- To promote and maintain sustainable growth within an outward oriented structure in the face of increased global competition, in compliance with market principles and international agreements.

Special importance shall be given to;

- Support SMEs,
- Improve innovation,
- Encourage new entrepreneurs,
- Improve business environment favorable to Industrial competitiveness, where entrepreneurs and enterprises can take initiatives, create opportunities and use their potential.

Law No 4691 on Technology Development Zones (TDZ) was put into force in 2001:

- 20 Technology Development Zones have been established, 10 of which have been in operation.
- Supports have been provided to administrative companies, entrepreneurs and academic staff in the TDZs.

To become an information society, achieving competitiveness at international level by the use of scientific and technological development.

Main Policy Priorities:

- Increased university-public-private sector cooperation,
- Research projects mainly focused on priority areas, (Advanced new materials, biotechnology, nanotechnology, IT, clean energy, nuclear, aerospace technologies and exploiting sea and underwater.)
- Increased public support for research.

A new project called "SAN-TEZ" has been launched in Sept.2006, for developing university industry collaboration. 75% of the project cost will be funded bf MoIT and 25% will be provided by the industry. Aim of the project is to;

- Commercialize academic knowledge,
- Transfer academic knowledge into high value added technological products,
- Solve problems of industry during production process in cooperation with universities,
- Provide R&D and technological culture for SMEs.

7.2 International Funding

7.2.1 Turkey's Status in EU Research Framework Programmes

Turkey has participated in the FP4 and FP5 on a project basis, is an associate country to the FP6 and is already a full partner of the EU in science and research. [3]

EU's 6th Framework Program Supports R&D activities throughout Europe in order to improve Europe's scientific and technological infrastructure and to increase global competitiveness of the European economy (Implementation Period: 2002-2006.) All member states and candidate countries including Turkey are eligible. Research projects are funded in seven priority areas including "sustainable development, global change and ecosystems" which focus on sustainable energy systems, sustainable transport, global change and ecosystems.

The Turkish R&D Liaison Office located in Brussels is another initiative that facilitates the relationship between Turkish agencies and individual researchers with the representatives of the commission and their counterparts in countries participating in the EU Framework Program. As a member of IGLO, TuR&Bo-ppp is a public-private partnership formed by TUBITAK, TOBB, KOSGEB and TESK.

FP6 National Coordination System in Turkey

Most of FP6-related activities within the National Coordination Office (NCO) are financed either directly by TUBITAK or by the Specific Support Actions projects funded by the EC and carried out by TUBITAK. The use of project budget from FP6 and similar grants were regulated by Law No. 5234, Article 32.

A Turkish web portal was established to provide updated information on joint research programme (JRC) opportunities, (http://www.fp6.org.tr/_etkinlikalanlari/jrc) some examples of collaboration between Turkish research area and DG JRC are the Bright Solar Energy Future for Turkey, contribution of research and innovation in the context of the Lisbon Strategy.

7.2.2 Global Environment Facility- GEF Contributions

Turkey has become eligible for GEF assistance after becoming a party to the UNFCCC. Turkey, as an Annex I country, contributed a total of $23,326,400 to the GEF funding mechanism as annual fees. In the meantime, as a developing country Turkey has received $33,134,000 funding in total, $21,507,000 for national projects and $11,627,000 for regional projects. The only project directly related to climate change is the NFC Enabling Activity project with a budget of $415,000. The rest of the GEF projects have indirect relationships such as the Anatolian Water Basin and biodiversity projects. Table 7.4 shows donation projects and amounts provided by the GEF.

Table 7.4 Donations Provided by GEF (1 SDR =1.3682$).

Managing Institution	Project Title	Amount $
W.B.	Project for On Site Protection of Vegetal Genetic Resources	5.1 million
UNDP	Small Donations Program	400,000
UNDP	Program for Protection and Management Of Environment In the Black Sea (Regional)	9.22 million
UNDP	Implementation of Strategic Environmental	1.77 million
	Action Program In the Black Sea (Regional)	
W.B.	Project for the Protection of Biological Diversity (Feasibility Study)	347.000
UNEP	Mediterranean Plan on Land based Pollutants (Regional)	337,000
W.B.	Project for the Protection of Biological Diversity	8.1 million
W.B.	Control of Agricultural Pollution (Black Sea Partnership Program) (Regional)	300,000
UNIDO	Establishing Institutional Capacity for the implementation of the Stockholm Convention on the Permanent Organic Pollutants	470,000
W.B.	Anatolian Water Basins Project	7.0 million
TOTAL FUNDING PROVIDED AS OF TODAY		33.13 million
(NATIONAL PROJECTS)		21.5 million
(REGIONAL PROJECTS)		11.62 million

7.2.3 Environmental Finance within EU Harmonisation and Bilaterally Founded Projects

To align Turkey's environmental infrastructure with European standards, an average of 59 billion euros is required. Besides economic instruments in environmental management (taxes, contributions, incentives), Turkey needs not only EU funds but also other international funds. Both donor organisations and credit institutions are expected to play an active role in the development of environmental management in Turkey.

Investment inn preventing environmental pollution is subject to investment reduction to a certain extent. In this scope, investment in the protection of the environment is included in the category of "sector investments of special importance". Environmental Finance within the EU Harmoniszation has been accelerated as a country under the category of non-EU "third countries" and as a Mediterranean Turkey utilises funds allocated for environmental issues by the EU under this category.

The relevant programmes are the MEDA Program, LIFE - Third Countries Program and SMAP. Funding from the European Investment Bank (EIB) has supported a number of environmental projects. Projects on the environment supported by EU funds: [3]

MEDA

- Izmit, Industrial Waste Water Treatment Project (Izmit GM, 50 million euros EIB loan + 11.395.000 euros EU donation)
- Adana, Waste Water Treatment Project (Adana GM. 45 million euros EIB loan + 10,800,000 euros EU donation)
- Diyarbakir Waste Water Processing (Diyarbakir GM, EIB loan + 9,100,000 euros EU donation)
- Tarsus, Waste Water Processing (Tarsus M, EIB loan + 9,550,000 euros EU donation)

LIFE

- Environmental Reference Laboratory (Project for Controlling Environmental Pollution) 3,385,000 ECU, the contribution of EC is 2,800,000 ECU Realisation: 1998)
- National Environment and Development Observatory in Turkey- Preparation Phaese

METAP (EEC + WB + EIB)

Coastland Management. Funding for Environment, Environment Institutionalisation and Implementation Problems in the EIA Process.

Environmental projects which were realised by the Administrative Cooperation Fund in 20022003:

- EIA Directive Harmonisation Project (January 2002, Dutch MATRA, completed) Improving the Capacity of the Ministry of Environment and Forestry with the participation of the European Environment Agency (April 2002, completed).
- Habitat Directive and Natura 2000 Network Seminar Project (April 2002, completed).
- CITES Convention Practices Seminar Project (May 2002, completed).
- The Project for Integrated Harmonisation Strategy in the field of Environment for Turkey (2001-2004),
- Water Directive Harmonisation Project (March 2002 Dutch MATRA, completed) In the scope of the “Project for Integrated Harmonisation Strategy in the field of Environment for Turkey” which was supported by the Administrative Cooperation Fund, it is envisaged first to develop a sector based strategy and then develop integrated harmonisation.

The implementation of programmes related to the Mediterranean and the Black Sea will constitute models for similar regional programmes elsewhere in the world. These projects, which are supported as part of the Financial Cooperation Programming and most of which are designed in the form of “Twining Project”, are as follows:

Four projects were supported as part of the "Capacity Development in the Field of Environment Project" (16.3 million euros in total):

a) *Environmental Heavy Cost Investment Planning Project* (5.8 million euros in the scope of the project, the works carried out are, determining environmental projects given priority for membership in the field of water, waste, air and industrial pollution and supporting the development of a mechanism for high cost investments required by EU directives on the environment, November 2003-November 2005). In 2003, an international consortium led by COWI and operated under the name of ENVEST Planners was appointed to help the Turkish MoEF to develop a comprehensive investment plan for the country's environmental sector. The EU financed the project, PEPA (urban infrastructure projects will be given priority). [4] Through parallel implementation, the Environmental Heavy Cost Investment Planning Project benefited from an iterative process between concrete project-related activities and strategic planning activities. At the same time, cross-cutting capacity development activities supported the implementation of both these elements. The implementation of the three was, hence, mutually supportive. The project ended on November 9th.

b) *Multilateral Environment Programmes*
The AC-IMPEL Network Project works on improving capacity for harmonisation with EU legislation on preparing the procedures of sanction, permit and supervision for EU environmental acquis to be implemented in Turkey, with a budget of 600,000 euros- (January 2004- December 2005).

c) *Protection of Nature Twinning Project* (Institutional Structuring and Investment, 5.5 million euros.)

d) *Institutional Structuring and Access to Environmental Information* (1.8 million euros, as part of the project, the targets are to ensure full harmonisation with the EU directives, to enable easy access to environmental information, and to develop the system and tools required for harmonisation and to establish the required capacity and infrastructure for accountable and updated environmental information, June 2004 - June 20006.

Establishment of Regional Environmental Centre REC Turkey (2.3 million euros) (April 2004-April 2006) [3]. The overall objective is to strengthen the capacity of governmental institutions, local authorities, NGOs and businesses in legal, institutional, technical and investment terms related to the approximation process in the field of the environment in Turkey. The REC Turkey Climate Change Work Programme was developed in 2005 with an aim to play an active role in improving the technical and institutional capacity of stakeholders within the scope of commitments of Turkey at the UNFCCC.

Environmental Projects Supported by LIFE-Third Countries Program in Turkey

2001

- Strengthening Environmental Control, Configuration of Globes National Environment Laboratory (MOEF)
- Establishing Solid Waste Management Capacity in Turkey, (MERKAT)

2002

- Project for the use of Agricultural Wastes in Turkey (Cukurova University) 2004
- Project for Supporting Education for Sustainable Development Activities in Turkey
- (REC Turkey, MOEF, MOE, Nature Association, Bird Research Association)
- Project for Establishing an Information System for SMEs on EU environmental legislation

2004

- Supporting Education for Sustainable Development in Turkey •'2d Rec Turkey Turkish Green Pack (345,700 euros)

2005

- Promoting Climate Change Policies in Turkey-Rec Turkey - MOEF (252,488 euros)

Environmental Projects Supported by the Dutch MATRA-PSO Bilateral Cooperation Program

2000

- Improving the Capacity of MoEF in joining the EEA.

2003

- Improving the Capacity concerning the adoption of the Directive on Integrated Prevention and Control of Pollution (IPCC) (525,000 euros, MATRA 2003)
- Project for Adoption and Implementation of Strategic EA Directive in Turkey.
- Establishment of EIA Education and Information Centre (450,000 euros),

2004

- Project for improving capacity of sea and shore management for the waters of crustaceans (200,000 euros MATRA)
- Establishing capacity for the wetlands education centre, completing required infrastructure and mechanisms (650,000 euros, MATRA)

2005

- The European Union will also support the "Project for Integration of Sustainable Development with Sectoral Policies" developed by the UNDP Ankara Office on the basis of donations and technical assistance. The timeframe of this Project is 2005-2007. Total cost of the Project is 3 million euros. (Of total amount, EUR 1 million is technical assistance and 2 million euros is donation.)

Pre-accession Financial Assistance 2003

- “Air Quality, Chemicals and Waste Management”, 2.49 million euros
- Institutional Structuring and Investment, 1.49 million euros for Germany Twinning Contract waste management. 1.49 million euros was donated by Germany.

- The Project for Improving Administrative Capacity for the Harmonisation and Implementation of the Air Quality Environment Directive No 2001/80/EC and the Directive on restricting certain pollutants diffusing into air from large combustion facilities.
- Capacity building in MoEF for ensuring the harmonisation of the Turkish legislation with the Directive on Packing and Packaging Wastes (94/62/EC), Framework Directive on Waste (75/442/EEC), Directive on Hazardous Waste (91/689/EC), Directive on Incineration of Wastes (2000/76/EC), Directive on Regular Storing (99/31/EC) and The Project for Strengthening Administrative Capacity and Developing Legal Regulations for the implementation of the Directives on Chemicals No 67/548/EEC, and 99/45/EC as well as the relevant Directives No 91/155/EEC and 93/67/EEC.

Pre-accession Financial Assistance 2005

- Canakkale-Kusadasi Solid waste disposal (Investment Projects)
- Twinning Project for Water Framework Directive Program for Supporting the Environmental NGOs Feasibility studies on environmental investment.
- Pre-accession Financial Assistance 2006: Tokat Plant and Nevsehir Waste Water Treatment Plant
- Preparation phase: Dilovasi (Domestic and industrial waste water management project)
- Karabuk Air Pollution Project
- Waste Landfill Projects for Amasya, Bitlis, Kutahya, Konya, Kayseri, Corum, Balikesir, Artvin and Rize
- Solid Waste Management Projects

Total cost of the above projects is approximately EUR 50-70 million.

Twinning Projects

Twinning is an important element under the 2004 programme, contributing to the results of 22 projects involving 12 EU member states. Some of the twinning projects are planned in the fields of agriculture, environment, and transport. Foreign companies have undertaken tasks in various areas such as water, waste water and solid waste management of approximately 600 million euros in 15 municipalities including the municipalities of Ankara, Adana, Bursa and Diyarbakir. The EIB's industry sector environment loan supports investments with the aim of obtaining ISO- 14000 Environment Management Standard or environment investments related to energy investments.

7.2.4 International Donor Agencies –Projects

United Nations Environment Program (UNEP)

"UNEP/GEF- Project for Improving National Bio-security Frameworks" was commenced by the Ministry of Agriculture and Rural Affairs (General Directorate of Agricultural Research - TAGEM) $450,000.

UNEP, Mediterranean Action Plan: The management of coastland, evaluation and control of Mediterranean-Aegean pollution assessment, protection of ecosystems and conservation of the Mediterranean bio-security. [3]

UNDP

For more than 30 years, the United Nations Development Program (UNDP) supports many projects in the field of the environment in Turkey.

National Agenda 21 and The National Program on Environment and Development are the two most important projects, which are executed under the coordination of the MoEF by the UNDP with a view to the improvement of environmental policies in Turkey. The Local Agenda 21, which is executed by local governments and the UNDP under the coordination of the IULA/EMME, is a significant social participation and information project, which largely focuses on the environmental aspect. The Climate Change 1st National Communication Project executed under the coordination of the MoEF was initiated in August 2005 with support of the UNDP and will continue until August 2006. The total budget for the project is $405,000 as GEF fund.

The projects of many environmental non-governmental organisations in Turkey are supported in the scope of the Global Support Fund/Small Support Program (GEF/SGP) implemented by the UNDP. These projects largely focus on the protection of biodiversity, soil degradation and protection of water resources as well as the protection of lakes and resources. Since 1993, GEF/SGP Turkey has supported more than 100 projects.

Since 2004, GEF/SGP has started to support projects for focal points struggling with climate change and concerning energy savings and "clean transportation". Recently, GEF/SGP has cooperated with the General Directorate of the Social Assistance and Solidarity affiliated to the Office of the Prime Minister on the "Project for Mitigating Social Risk". In this framework, the funds allocated to poverty and the protection of nature are expected to complement each other.

Black Sea Environment Program

This UNDP assisted programme is supported with GEF resources with the aim of fulfilling the requirements of the Convention on the Protection of the Black Sea against Pollution and its protocols to which the Black Sea countries are parties.

The United Nations Industrial Development Organisation (UNIDO)

UNIDO has supported various projects on supporting SMEs, protection of nature, energy savings, energy efficiency and genetic engineering and sustainable industrial development. As a supplementary project, "Phase out of Ozone Depleting Substances Project", which is executed by the TTGV according to an agreement signed between UNIDO and TTGV is significant for its outcomes.

World Bank

The Phase out of Ozone Depleting Substances Project which was supported by the Montreal Protocol Multilateral Fund through the World Bank and executed by the MoEF & TTGV is an important private sector environmental project. In addition, the "Environmental Institutionalisation Project," one of the sub-tasks of the Energy and Environment Project, which was executed in 2002 by the coordination of the Ministry of Energy and Natural Resources with the support of the World Bank, is another significant project, which evaluates the institutional capacity of the Ministry of Environment in detail. One of the country development themes of the "Country Assistance Strategy" (2004 -2006) of the World Bank is to provide Turkey with strong environmental management. The World Bank designs the activities to be supported in line with the National Environment Action Plan (NEAP) with the aim of supporting Turkey.

Another significant environmental project of the World Bank, which came into effect in 2004, is the "Renewable Energy Resources Project". The cost of the project covering 2004-2010 is $203.03 million. The basic goal of the project is to provide investment for firms which will produce electricity with renewable energy resources such as water, wind, and geothermal power owned by the private sector with funding. The project is executed by the Turkish Industrial Development Bank (private sector) and the Turkish Development Bank (public sector).

"Project for Biological Diversity and Natural Resources in Turkey", began in January 2001 by the GEF II resources of the Bank, under the responsibility of the MoEF. UNDP is the project partner. The cost of the project is $8.2 million.

Japanese International Cooperation Agency (JICA)

In the field of the environment, JICA focuses on issues such as improving environmental policies and environment management systems in Turkey, integration of the environment and development sectors, energy saving, increasing public awareness, participation of people in decision making mechanisms in environmental waste management and providing expertise and equipment support. JICA helped to establish a new training centre with a model plant for energy conservation. (2000-2005) This programme is expected to increase energy efficiency by 10% throughout Turkish industry by 2010.

EU Funded Projects

Project Title : Integrating-ACC "Integrating the Associated Candidate Countries into the 6th Framework Programme through networking activities and improved NCP services" FP 6 program
Total Budget 476446 euros (Tubitak Budget 9523 euros) (1st April 2004 – 31st March 2006)

Project Title : ERA-ENV "Integration of Associated Candidate Countries and New EU Member States in European Research Area by Environmental approaches" " FP 6 program
Total Budget 499,999.40 euros (Tubitak Budget 39,540 euros) (1st April 2005 – 30th September 2006)

Under the Sustainable Development global change and eco-systems thematic areas for EU Harmonization of the Candidate countries for integration to the research areas.
Project Title : SAFE "SME Action For the Environment in Candidate Countries" FP 6 program
Total Budget 300,000 euros (Tubitak Budget 14,240 euros) (1st Aug.2005 – 31st July 2007)

Food and Agriculture Organisation (FAO)

Primary support activities of FAO in Turkey include such issues as sector policies for the modernization of the Turkish agriculture, eligibility of the national agricultural policies for the World Trade Organisation and the European Union, sustainable agriculture, rural development and forestry as well as agricultural planning training.

German Development Bank (KfW)

KfW, the German development loan institution, has implemented projects in many fields including environment in line with the Technical Cooperation Agreement between Turkey and Germany. One of the two basic issues determined by the Ministry for Economic Cooperation and Development of Germany in the field of bilateral cooperation is the Environment Sensitive Municipality Infrastructure Sector. The second is the "Income Generating Measures and support to SMEs".

German Development Cooperation (GTZ)

GTZ has largely focused on urban environmental protection, relations between industry and the environment, agriculture, environmental services of local governments, energy efficiency, capacity improving studies for natural resources accounting and hazardous wastes. In the framework of the Turkish-German Bilateral Technical Cooperation Agreement, the Promotion of An Environmental Management System was initiated in April 2000. This project was executed between GTZ and the Ministry of Environment and Forestry.

DEFRA

Within the scope of the Environment for Europe Fund, the project entitled "Capacity Building for Government and Stakeholders in Turkey" was implemented by REC Turkey in 2005 and 2006. The project involves facilitation of the Turkish government and key stakeholders (business, environmental and academia) in participating in the climate change activities at the national and international level.

Support from Embassies

The embassies of a number of countries represented in Turkey provide projects on the environment with support. Some of these countries include the Netherlands, Germany, Britain, Sweden, Norway, Japan, Switzerland and Italy. Financial support is given to various institutions and organisations (non-governmental organisations, local governments and academic institutions).

Mediterranean Environmental Technical Assistance Program (METAP).

METAP is a multi-participant donor programme, which is supported by the European Commission, European Investment Bank (EIB), UNDP and World Bank. The programme has been active in various time periods (METAP I, II and III) and has focused on the issues of prevention and control of pollution, management of integrated water and coastal resources and capacity improvement as part of the METAP III (1996-2000).

7.3 Activities Related to Transfer of Technology

The mission of the UNIDO-International Centre for Hydrogen Energy Technologies in Turkey (UNIDO-ICHET) is to act as a link between developed and developing countries in bridging the gap between research and development organisations, innovative enterprises and the market in order to help convert the world economy to the Hydrogen Energy System, particularly in developing countries. UNIDO-ICHET Turkey is supporting and promoting a variety of pilot projects worldwide. UNIDO-ICHET will achieve its objectives through studies, applied research, training, advisory services and conferences and education programmes. The centre will also provide expert assistance in establishing, running and evaluating pilot projects. The Turkish government - through the Ministry of Energy and Natural Resources - is contributing $40 million to UNIDO

in the form of a Trust Fund towards the establishment of UNIDO-ICHET in Istanbul, Turkey. http://www.unido-ichet.org/ UNIDO-ICHET is supporting and promoting a variety of pilot projects worldwide. The objective of the pilot projects is to produce hydrogen from renewable energy sources, either by solving the energy needs of a town, or by running a bus or car on hydrogen, to implement this system throughout the world, thus promoting hydrogen technology in direct competition with those well-established, and to encourage high profile pilot projects that demonstrate the benefits the new technology can bring worldwide.

These projects are the following: Wind Hydrogen Pilot Project (Patagonia, Argentina), Hydro Hydrogen Pilot Project, (Niyazoba, Kuba-Khachmas, Azerbaijan), Hunan Hydro Hydrogen Pilot Project, (Youtang, China), Biological Hydrogen Production Pilot Project (Kakinada, Andhra Pradesh, India), Hydrogen Fuelled Tri-Wheel Transporter Pilot Project (Delhi, India), Solar Hydrogen Pilot Project (Misurata, Libya), Wind Hydrogen Pilot Project (Tarfaya, Morocco), Renewable Electricity/Hydrogen Pilot Project (Island of Terceria, Azores, Portugal), Biomass Hydrogen Production Pilot Project (Danube Delta and the Black Sea Coast, Romania), Korean South-West Hydrogen Fuelled Vehicles Pilot Project (South Korea), Wind Hydrogen Energy Pilot Project (Bozca Island, Turkey), Hydrogen Bus Pilot Project (Istanbul, Turkey).

The entire International project Directors are sponsored and identified by UNIDO-ICHET to prepare engineering reports and a Financing Proposals. The project Directors works in collaboration with UNIDO–ICHET. [6]

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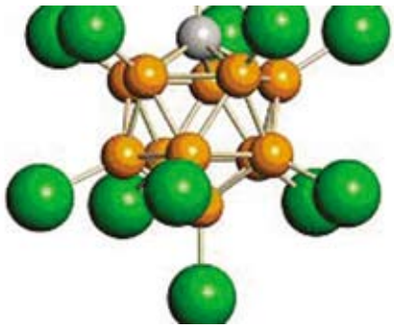


CHAPTER 8

RESEARCH AND SYSTEMATIC OBSERVATION

8. RESEARCH AND SYSTEMATIC OBSERVATION

8.1 General Policy and Financing

The Turkish government and researchers are becoming more and more aware of sustainable management of the environment and its resources through advanced knowledge of the interaction between the biosphere, ecosystems and human activities, and developing/transferring new technologies, tools and services, in order to address global environmental issues in an integrated way. In the future, emphasis will be put on predicting climate, ecological, earth and ocean system changes; on tools and technologies for monitoring, preventing and mitigating environmental pressures and risks including health; as well as for sustainable conservation and management of the natural and man-made environment.

The TSMS, DSI and EIE are the state organisations responsible for making observations on weather, climate and hydrology and monitoring climate systems. Some military organisations are also involved in oceanographic observations. Measuring air pollution is the responsibility of the MoEF, MoH and local governments. Climate change research is usually carried out in universities, public institutions and research centres.

The Turkish IPCC Focal Point was established in 2004 in the MoEF. The IPCC Focal Point is concerned with the co-ordination of activities aimed at IPCC in Turkey such as pronouncing opinions on IPCC documents, and nominating experts to participate in working groups and expert sessions.

Research and development (R&D) expenditure is financed mostly by the public sector. This is subsequently followed by the private sector and by other domestic and foreign sources.

8.2 Research

8.2.1 Evolution of Turkish Science and Technology Policy

The establishment of the TUBITAK in 1963 marked a turning point in the national science and technology policy of Turkey.

Strategic Objective

TUBITAK's main target is to promote science and technology culture among Turkish society, thus increasing the demand for R&D and to enhance the quality and quantity of R&D personnel and consequently to increase the share of R&D expenditure as a percentage of GDP.

Policies

Another task of the TUBITAK is to create national science and technology policies and to identify fields of priority for scientific and technological development. TUBITAK, as a central body, has a thorough knowledge of the resources and requirements of Turkey.

Turkish science and technology shall be given momentum by taking steps that include: the construction of national information infrastructure needed for the 21st Century and the telematic services network, promoting the R&D process, especially in flexible manufacturing and flexible automation technologies, for innovation in the Turkish manufacturing industry; upgrading the existing railway system on the basis of "High-Speed Train Technologies"; developing the aviation industry and R&D on the basis of selected aviation products; encouraging R&D in gene engineering and biotechnology with project based applications, as well as in areas which reflect climate change awareness and environment protection such as environmentally sound technologies, for effective use of energy and environment friendly "Renewable Energy Technologies" in nationwide applications and in Advanced Materials and related industries [1][5].

Vision 2023 Project

"Vision 2023: Strategies for Science and Technology" is an ongoing project, aiming at building a science and technology vision for Turkey and developing science and technology policies over the next 20 years.

The project is composed of the following sub-projects:

- Technology Foresight Project
- National Technology Competence Inventory Project
- Researcher Information System Project
- TUBITAK National Research Infrastructure Information System Project

Climate change is one of the topics considered in the thematic panel of Environment and Sustainable Development under the Technology Foresight Project.

Researcher Information System (TUBITAK-ARBIS) which has been designed as a system for research personnel, is a dynamic system that provides for the collection of researcher information, updating of collected data and evaluation of said data by different establishments for different purposes.

National Research Infrastructure Information System (TUBITAK-TARABIS) is a web-based application designed and developed by TUBITAK to create a database for the machine/system/device stock and R&D project accumulation related to research, experimental development, test/analysis and diagnosis activities.

Turkish Academic Network and Information Centre (TUBITAK-ULAKBIM) aims at proving technological facilities (computer networks, information technology support, information and document delivery services, etc.) to meet the information requirements of universities and research institutions and to increase the efficiency and productivity of their end users.

National Meterology Institute (TUBITAK-UME) was founded by TUBITAK with the main objective of establishing and maintaining national standards for all measurements carried out within the country.

University-Industry Joint research Centres (TUBITAK-USAMP). The aim is initiating and fostering university-industry cooperation, giving priority to research areas meeting the needs of industry.

8.2.2 EU Action Plan Integration

TUBITAK was assigned officially by the Turkish government as the contact organisation for EU Framework Programmes from the beginning of 2003. The “National Coordination Office (NCO) for the EU 6th Framework Programme" consists of National Contact Points (NCPs) and NCP Assistants responsible for each thematic and horizontal priority [1][2].

The mission of the office is to provide every kind of support to researchers in submitting FP6 proposals and participating in project consortia in order to facilitate Turkey’s participation in Framework Programmes and the integration of the Turkish Research Area – TARAL, with the European Research Area (ERA). The major project carried out by the office and supported by the European Commission is TR-ACCESS, which aims to encourage the participation of Turkish researchers in FP6. There are 22 ongoing projects in the office. The major project carried out by the office and supported by the European Commission is TR-ACCESS, which aims to encourage the participation of Turkish researches in FP6.

The projects related to climate change are covered in the EU FP6 under the thematic area of sustainable development, global change and ecosystems and are given in Table 8.1.

Table 8.1 EU FP6 funded climate change related projects

Coordinator	Project No:	Acronym	Title
Ege Univ. Fac of Eng. Dept of Bioengineering	517941	BIO-ACE	Aegean Centre of Excellence for Bioengineering and Biotechnology
Istanbul Tech.Univ. (Automotive Controls Research Group)	16426	AUTOCOM	Automotive Controls and Mechatronics Research Centre for Actively Safe, Clean and Efficient Road Vehicles- the AUTOCOM Centre
TUBITAK	16362	HYPROSTORE	Research capacity of TUBITAK-MRC IE in the fields of hydrogen technologies
Fac. of Mines, Istanbul Tech. Univ.	17490	EMCOL	Eastern Mediterranean Centre for Oceanography and Limnology
TUBITAK	16392	BIGPOWER	Research capacity of TUBITAK-MRC Institute of Energy in the Fields of Integrated Biomass Gasification with Power Technologies
METU	17125	METU-CENTER	METU Central Research Laboratory in Nanotechnology, New Materials, New Processes and Biotechnology

8.2.3 TUBITAK Research Finance

Where Turkey falls behind is in the finance for its R&D system. R&D expenditure, as a percentage of GDP (GERD), has increased by a factor of two from 0.32% in 1990 to 0.64 % in 2000. To add complementary public funds to the R&D budget, starting with the 2005 budget, in order to increase the ratio of R&D expenses in GDP up to 2% in 2010, 446 million YTL (279 million euros) has been added to the 2005 Budget for the Turkish Research Area -TARAL (Fig 8.1) (TUBITAK, 2005).

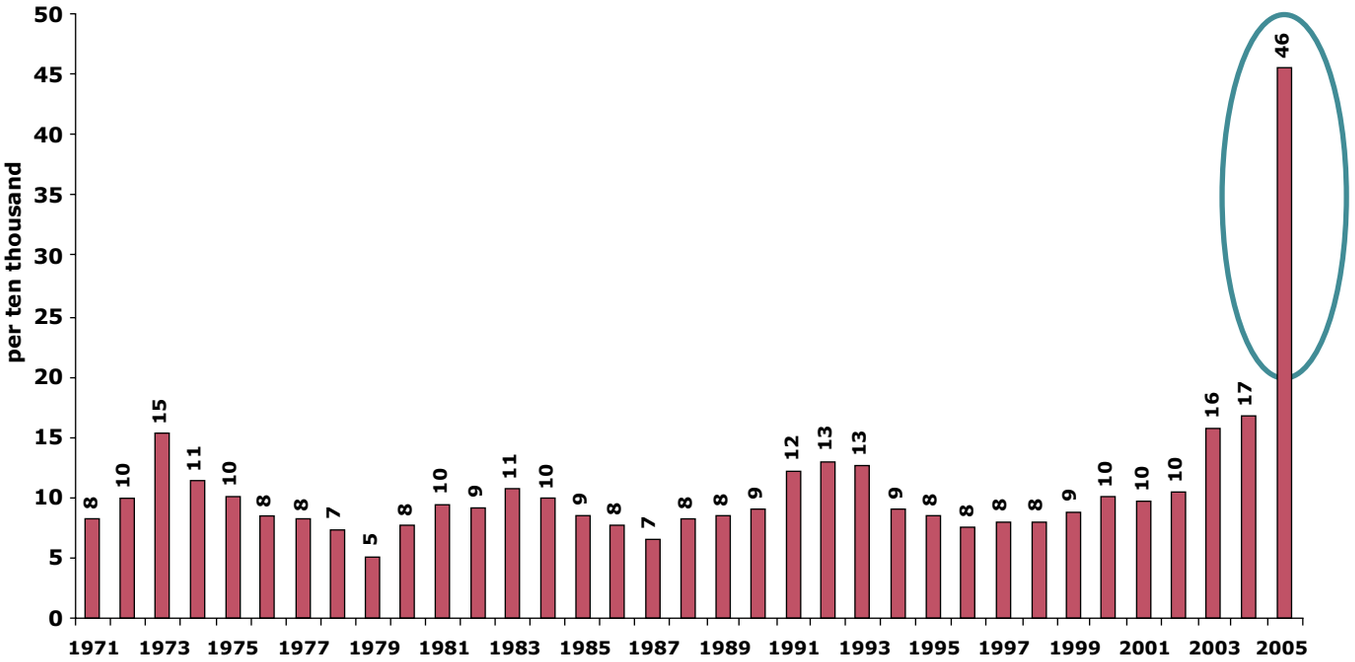

Fig. 8.1 Share of TUBITAK in TR Fiscal Budget

Research on "environmentally sound sustainable development", encompassing research on "global change", is carried out in Turkey, primarily with funds from the TUBITAK. The Turkish research foundation and several individual donors are co-financers of the projects.

There are three focal points for funding:

- "Socio-ecological research – regional sustainability"
- "Industry-related sustainability – integrated environmental technology"
- "Global change"

8.2.4 Research Activities

Research on climate change in Turkey started in the mid 1990s. It mostly focused on climate process and system studies, climate impact research and partially to mitigation. Another important branch of research is the development of existing and new adaptation and mitigation methods and technologies, which are lacking [3].

Background Climate Information Studies

Much research has been done by scientists on Turkey's climate. Some is paleoclimatological by Fairbridge et al. (1997) and paleoceanographic studies by Karaca et al. (1999) on Turkey and the Black Sea respectively. Additionally, Turkes et al. (1995, 1996, 1998, 2002) and Turkes and Sumer (2004), Kadioglu (1997), Tayanc et al. (1997) performed investigations into temperature and precipitation variations and trends in Turkey. Also, the effect of North Atlantic Oscillation on precipitation over Turkey was studied by Turkes and Erlat (2003 and 2006), and the relationship between Sea Level Pressure (SLP) and rainfall in Turkey was studied by Kutiel et al. (2001).

In recent years, due to increased public concern and interest in possible climate change in south-eastern Turkey as a result of the Southeastern Anatolia Project (SAP), in the GAP region, the GAP Regional Development Administration launched the "Analysis of Current and Future Climate Conditions of the GAP Region" Project in 2001. This project was conducted by the TSMS and the Faculty of Agriculture of Ankara University in 2002. This project is of critical importance in determining regional land use, potential for agricultural activity and the utilisation of water resources in the area.

Studies on climate variations and urbanisation were made by Karaca et al. (1995) and (1995), Tayanc et al. (1997), Turkes et al. (2002) and on seasonal heating and cooling degree-days trends by Kadioglu et al. (2001). Trajectories of cyclones affecting Turkey were analysed by Deniz and Karaca (1995) and variability of cyclone tracks by Karaca et al. (2000).

Demirhan et al. (2004) examined regional variations of total ozone levels. Kahya et al. (2003) investigated ozone profiles in the Ankara region and the effect of subtropical jet streams in variations.

Data acquisition started in 2003 partly through the MIPAS, GOMOS and SCIAMACHY modules within the scope of the ENVISAT project. Preparation for the non-active modules is in progress. When the ground-based work is integrated with the ENVISAT project by Incecik et al. (2002), it will be possible to quantitatively determine climatic changes in and around Turkey, thus filling a scientific gap.

Special attention shall be given to water resources and their respective impact on hydroelectricity generation, as it is known that the major share of electrical energy in Turkey is produced from hydropower sources. The EIE and ITU have completed research on trends in river flows (ITU Faculty of Civil Engineering and EIE, 2002). Yildiz and Malkoc (2000) have analysed the expected change in the flow capacities of the Mediterranean, Aegean and Southeast Anatolian rivers under the effects of climate change.

Modelling and Forecast

Dynamic and statistical downscaling studies are performed at Istanbul Technical University. RegCM3 and MM5 models are used as regional climate models by Onol (2004), Tatli (2004) and Tatli et al. (2004a and 2004a). Reflections of climate scenarios for the regions covering Turkey have been studied by Unal and Onol (2004) and Unal and Tan (2004). Preliminary studies of the regional climate model to response of changes in surface coverage over the GAP area have been completed by Unal et al. (2001) and long term impact studies are ongoing. Both models were used in the Research and Application Project (2002-2005), supported by DSI, carried out by DEU SUMER and subcontracted to Kavvas M.L. & Associates, USA on "Performance of Water Inventory Studies in the Euphrates and Tigris Basins".

Besides ITU, the TSMS carries out climate prediction studies by running RegCM3 and PRECIS regional climate models. TSMS also runs MM5V3 model to produce numerical weather forecasts four times daily. The model generates 48- and 72-hour weather forecasts at 00:00, 06:00 and 18:00 UTC for the regions of Turkey and at 12:00 for Europe respectively. Additionally, the wave forecast model (METU-3) firstly developed by Middle East Technical University within the scope of the NATO TU-WAVES Project is used for daily marine forecasts in the TSMS. The METU-3 Waves forecast model is used to generate forecasts for the Mediterranean, Black, Marmara and Caspian Seas, twice daily.

The TSMS has also developed a model for forecasting forest fires. Since 2004, the system operates as a three-day early warning.

In the Institute of Marine Sciences of Middle East Technical University, there are project studies on oceanographic observations and forecasting models. Some of the projects employed are MFSTP (Mediterranean Forecasting System towards Environmental Predictions), ARAL-KUM (Desertification of the Aral Sea Region: A Study on the Natural and Anthropogenic Impacts) and MACE (Multi-Disciplinary Analysis of the Caspian Sea Ecosystem).

The TSMS signed a service agreement in 2006 for two years with the University of Köln, Rhenish Environment Centre on operation of EURAD (European Air Pollution Dispersion) Model and its adaptation to Turkey. The model will be operational by the end of 2006 and will generate air pollution forecasts to boost public awareness.

Climate Impact Research and Socio-Economic Studies

Turkey will be impacted by the negative effects of global warming, such as: the decrease of water resources; an increase in forest fires, drought and desertification; and related ecological factors. Therefore it is considered as a country vulnerable to global climate change.

The future climate scenarios for Turkey predict changes such as increased temperatures, decreased precipitation, reduction of water resources and the loss of arable land. Presently in Turkey, studies in this field are limited and the current level of understanding of climate change adaptation and adaptive capacity is still insufficient. Some preliminary studies on the impact of future climate change have offered limited possible adaptation options.

In the Turkish agricultural sector modelling is performed by Dellal et al. (2004). The effects of climate change on five major crops (wheat, barley, corn, cotton and sunflower) are studied and producer and consumer surplus is forecasted. Further studies are ongoing to improve the model. In the near future it is aimed to include emission levels and adaptation options.

Preliminary studies of the impact of climate change on sea level rise between 1984 and 2004 have been made by TUDES (Demir et al., 2005).

Karaca and Unal (2003) did a study to assess settlement basis and the impact of droughts and flooding on inhabitant's wellbeing.

Caldag and Saylan (2004) surveyed the impact of climate change on wheat production in the Trakya Region. Caldag et al. (2000) investigated the plant–climate model to study the impact on wheat production. Kadioglu et al. (1998) studied changes in the wheat production cycle related with climate change and (2004) its effect on water resources.

Oguz (2003) and Oguz et al. (2003) have done research on the change in fish potential and marine ecosystems in the Black sea.

Beklioglu et al. (2006a) investigated the impact of hydrological changes on wetlands and lake ecosystems, and Tan and Beklioglu (2006) made model studies on lake ecosystems. Wetlands and lakes, salination and eutrophication studies were made by Coops et al. (2003) and Beklioglu et al. (2006).

Impact of Climatic Changes on Agricultural Production System

Impact of Climatic Changes on Agricultural Production System in Arid Areas (ICCAP) is a research project for integrated assessment of climate change impacts on agriculture, it is a five year project from 2002 to 2007, based on the basic policy of Japan Research Institute for Humanity and Nature (RIHN). It is being implemented as an international joint project in cooperation with TUBITAK. The ICCAP is aiming to make clear the interaction between climate systems and the human-agriculture system and to build a new research field on the global environment, adopting a more integrated, cross-disciplinary overall perspective. The project selected case study areas in arid and semi-arid areas in the east coast of the Mediterranean Sea, including the Seyhan River basin in Turkey as a main case study area [9].

Research Projects Financed by TUBITAK

During the last decade, approximately 1,000 scientific research proposals were received annually. Ongoing projects were approximately 1,300. However, after a new S&T strategy, annual submissions reached 4,000 and ongoing projects exceed 2,000. Within the Research Grant Committees (RGC), agriculture, forestry and veterinary, environment, earth, marine and atmospheric sciences exist. Following are the climate change-related projects funded by TUBITAK.

a) Observation and Analysis of Trophospheric and Stratospheric Ozone / UV-B variations
The aim of the project is to monitor and analyse changes in the Total Ozone Column that significantly contributes to man-made climate change by purchasing and installing a new ozone observation instrument, the Brewer Ozone Spectrophotometer. Beside this, ozone forecast studies would be completed with this project. On the other hand, changes in UV-Radiation will also be monitored with the same instrument. The results of research on forecasting the ultraviolet index will be issued to inform and protect the public from t UV-B radiation.
Project partners: TSMS and ITU
Project duration: 24 months
Project budget: 465,000 YTL

b) Integrated Meteorology/Oceanography Network Of Excellence (MONOE)
Pilot project development of satellite and in-situ observation, data assimilation, prediction, and early warning and user services:

The implementation of integrated meteorological-oceanographic observation and prediction systems, as basic tools of sustainable environmental management, are aimed at thorough research performed by academic units under the government's R&D programme. The Meteorology and Oceanography Network of Excellence (MONOE) to be formed with this objective aims to design and develop satellite/in-situ observation and forecast systems, validation-/verification of the data and predictions and the presentation of some products to the end-user in the form of integrated services.

The project covers: regional and local system analysis; shore monitoring systems; monitoring systems for Turkish straits; monitoring systems for the Cukurova area; flow measurements on shore; float systems; satellite monitoring and analysis systems; hydrodynamic models of the Dardanelles; medium scale atmosphere models for shores; modelling forecasts for aerosol dust entrainment; shore area ocean models and sea-atmosphere interactions; data management and data assimilation; 3DVAR data assimilation in MM5 model; development of atmospheric data assimilation methods; application of the variation initial conditions to the shore oceanographic models; and shore area user services.

Project partners: The MoEF, TSMS, METU Marine Sciences Institute, Turkish Maritime Undersecretary, General Directorate of Coastal Safety and Salvage Administrations, Turkish Naval Hydrography and Oceanography, and General Commandership of Mapping.
Project duration: 24 months
Project budget: 1.35 million YTL

c) Climate Change Scenarios Project For Turkey
To enable assessment of the impact of current climate variability and future climate change on all aspects of the country's welfare, from water resources to health, agriculture, and urban environments, local climate change scenarios are needed. This project is aimed at providing such scenarios. It will incorporate several linked tasks, including climate change detection efforts, dynamic and statistical downscaling exercises based on the IPCC/Third Assessment Report (TAR) model output resources, which will provide a set of climate projections for Turkey and its regions and will culminate in a set of climate change scenarios. The principal dynamic downscaling tool of this study will be the MM5 regional atmospheric model of the National Centre for Atmospheric Research (NCAR) and Pennsylvania State University. At a later stage of the study, an attempt will be made to also use RegCM3 of the International Centre for Theoretical Physics (ICTP). A statistical downscaling approach will also be used to relate large-scale fields and point (i.e. station) data, and consequently use large-scale AOGCM simulations to obtain point climate projections for different locations in Turkey. Dynamic and statistical downscaling projections will be combined with 'expert opinions' to produce climate change scenarios for different time horizons and a variety of climate parameters, both for the entire country and for some special focus areas of socio-economic importance.
Project partners: TSMS, ITU, METU
Project duration: 24 months
Project budget: 284,700 YTL

d) Abatement of Greenhouse Gases Emissions Resulted From Transport in Turkey
The purpose of the project is to prepare an inventory of transport-based GHG emissions in Turkey, investigate the major parameters effecting the production of these emissions and provide solutions to control them.

Vehicle fleet specifications in Turkey will be examined and special attention will be focused on the Marmara Region, where a considerable proportion of the road vehicle fleet is in operation. Traffic conditions in the city of Istanbul will also receive special attention and a "city cycle" will be derived and used under laboratory conditions to measure fuel consumption and emissions from sample vehicles in order to obtain country-specific emission factors. Natural gas fuelled-public buses in Istanbul will also be investigated in terms of GHG emission advantages.

The effects of biodiesel as an alternative fuel and hybrid vehicle utilisation on GHG emissions will be considered in two different work packages. A study will be done on prototype vehicles to investigate technology development and the effect of utilisation on GHG reduction.

Project partners: Ministry of Transport; Ministry of Transport General Directorate of Railways, Harbours and Airports Construction; TUBITAK-MAM; Istanbul Technical University Mechanical Engineering Faculty, Istanbul Technical University Civil Engineering Faculty.
Project duration: 36 months
Project budget: 3.26 million YTL

e) CO_2 Capture Storage Project (At final approval stage)
CO_2 capture storage technology holds appeal for coal-dependent economies like Turkey that seek to use coal in a cleaner way. Capturing the CO_2 that results from industrial processes such as steel, cement, chemical plants and refineries, compressing it, transporting it to suitable destinations and injecting it into underground cavities and old petroleum wells for long term storage avoids emissions into the atmosphere. This project will enable Turkey to forecast the potential of CO_2 storage. A pilot scale demonstration will be performed. Other investigated storage options will be deep water reservoirs and old salt mines.
Project partners: MENR, METU- PAL, TPAO, MoEF
Project duration: 24 months
Project budget: This project is under final evaluation phase.

f) Development of Circulating Fluidised Bed Co-combustion of Coal and Biomass and Industrial Application (Approved project is in revision)
Circulating fluidised Bed Co-combustion (CFBC) has received wide research attention in view of its potential as an economic and environmentally acceptable technology for burning low-grade coals, biomass and organic wastes, as well as mixtures of them. Designs of existing fluidised bed boilers for biomass combustion are mainly based on experience from coal combustion because the mechanism of combustion of biomass in fluidised beds is still not well understood. A good understanding of the combustion and pollutant formation processes and the modelling of the combustor can greatly avoid costly upsets at plants. In this project the effect of the main operating conditions on CFBC technology cogeneration unit carbon combustion efficiency shall be improved. Industrial applications are planned.
Project partners: MENR-EIE, MARA, METU Environmental Engineering Dept, Gazi University, TUBITAK-MAM and Gama Power.
Project duration: 24 months
Project budget: Budget is under revision.

g) Water Resources Data Base Preparation
After collecting water data from all around Turkey with the help of related data collection devices over satellite/GPRS/GSM in the central water database, it is aimed to assess these data in terms of hydraulic, hydrologic and water quality aspects, to make simulations and to determine the climate change and environmental effect thereof.
Project Partners: DSI, Gebze Technology School, Bahcesehir University.
Project duration: 30 months
Project budget: 5.56 million YTL

h) Project on Monitoring Parameters Effecting Power Quality and Power Transmission, Evaluation and Realisation of Counter Measures.
The project aims, through the National Power Quality Monitoring Centre, to monitor all important parameters of power quality, comprising all instant potential variations and harmonics as well as flicker strength. A power quality map of the electricity system shall be prepared. As a result of the measurements, weak points in the transmission system shall be determined and it shall be possible to develop necessary solutions. With ongoing work reaching the desired level, our national energy system shall have been re-examined, problem areas shall be identified and necessary precautions shall be developed.
Project Partners: TEIAS, TUBITAK-BILTEN, ODTU, HU, DEU, YTU
Project duration: 36 months (01.03.2006-01.03.2009)
Project budget: 22.68 million YTL

Other projects on water quality monitoring networks supported by TUBITAK and NATO:
i. Assessing the Performance of DSI's (State Hydraulic Works of Turkey) Water Quality Monitoring Networks – II, a research project granted by TUBITAK (The Scientific and Technical Research Council of Turkey) and realised jointly by DSI and DEU, *Project Code:* TUBITAK YDABAG-100Y102, 2001-2003.

ii. Assessing the Performance of DSI's (State Hydraulic Works of Turkey) Water Quality Monitoring Networks - research project granted by TUBITAK (The Scientific and Technical Research Council of Turkey) and realised jointly by DSI and DEU, *Project Code:* TUBITAK YDABCAG-489, 1997-1999.

iii. Design and Evaluation of Water Quality Monitoring Networks for Environmental Management, Research project granted by TUBITAK, Scientific and Technical Research Council of Turkey, Project Code: DEBAG - 23, 1991-1993.

iv. Assessment of Water Quality Monitoring Networks - Design and Redesign. Linkage Grant Project supported by NATO Scientific Affairs Division, Project Code: ENVIR.LG.950779, September '95 - September '97 (this project is realised in collaboration of six countries: USA, Russia, Hungary, Canada, Italy and Turkey).

R&D in Abatement and Mitigation Fields

There are several mitigation projects being undertaken by government institutions and research groups. Details of these activities are given in Chapter 4.

Research Fund for Coal and Steel

Since both sectors are very important for Turkey, there is a considerable amount of coal and steel sector research being undertaken. Turkish Coal Enterprises (TKI) launched the most important initiative in 2002. The initiative covers the following areas; fossil resources (including coal); hydroelectric energy; nuclear energy; new and renewable energy resources; and boron.

Within this initiative, TKI has been in contact with institutions and universities that have laboratory facilities regarding fossil resources. Those institutions are: TKI, Turkish Hard Coal Enterprise (TTK) and TUBITAK; also Directory General for Mineral Research and Exploration (MTA), Turkish Petroleum Corp. (TPAO), The Electricity Generation Company (EUAS), ITU, METU, Hacettepe University, Ankara University, Dokuz Eylul University.

Another programme has also been launched under the coordination of TKI to study the country's lignite coal potential in addition to the current process reserves. The purpose is to develop current reserves and explore lignite reserves. Since coal is the most important energy source and steel is one of the strategic sectors of Turkey, research activities in these sectors are of importance.

UNIDO–ICHET, (United Nations Industrial Development Organization-International Centre for Hydrogen Energy Technologies)

The Turkish Ministry of Energy and Natural Resources signed an agreement with UNIDO to build a $40 million International Centre for Hydrogen Energy Technologies (ICHET) in Istanbul, entirely financed by Turkey. 100,000 m2 of land overlooking the Black Sea and currently under the protection of the Ministry of Environment and Forestry is being allocated to the Ministry of Energy and Natural Resources for use as a permanent campus and headquarters for UNIDO-ICHET.

Beyond helping Turkey to increase the amount of energy produced from non-fossil fuels, UNIDO's project is aimed at transferring existing hydrogen technologies from Turkey to other developing countries, to help them to catch up with the developed world in the field of renewable energy resources.
UNIDO-ICHET's activities are focused on promoting the development, acceptance and use of hydrogen technologies by demonstrating their viability & applicability through pilot projects. [6]

Linkage With Industry

UNIDO-ICHET is to become an applied technology bridge between the demonstration and commercialisation of hydrogen technologies. As an applications incubator, UNIDO-ICHET will showcase production by electrolysis using renewable power, will present their facilities as test sites for comparing storage technologies as they complete their R&D phase and will create business and partnering models with transmission and distribution. This will promote the development of clean production, storage and distribution of hydrogen.

Partnerships

A key element in UNIDO-ICHET's strategy to promote transition to the Hydrogen Economy is the formation of strategic partnerships and the establishment of cooperative agreements with organisations having similar goals and missions. From May 2004 to April 2006, UNIDO-ICHET has established several strategic partnerships with organisations such as

GPCEL (General Popular Committee of Energy of Libya), TUBITAK-MAM (Scientific and Technical Research Council of Turkey – Marmara Research Centre), IAHE (International Association for Hydrogen Energy), Don NTU (Donetsk National Technical University, Ukraine), BOREN (National Boron Research Institute, Turkey), Bahcesehir University (Istanbul, Turkey), STCU (Science and Technology Centre in Ukraine), (Federal Agency for Science and Innovations of the Russian Federation).

Pilot Projects

UNIDO-ICHET is supporting and promoting a variety of pilot projects worldwide. See Chapters 4 & 7 and Annex 6.

Demonstration Projects

UNIDO-ICHET is also collaborating with other organisations on specific demonstration projects to produce hydrogen. These projects are as follows: Hydrogen Fuel Cell Vehicle, Hydrogen Road Map of Turkey, Hydrogen Injection into Natural Gas Pipelines, Wind – Hydrogen, Solar – Hydrogen, Hospital Oxygen - Hydrogen, Biomass - Hydrogen, Ataturk Airport Bus, Internal Combustion Engine Type Tractor, Fuel Cell Powered Fork-lift, Hydrogen House, Sea-Taxi, Kocaeli Municipality Bus, Small Hydro-Hydrogen Production and Fuel Cell Powered Unmanned Airplane.

R&D Activities

NATO Advanced Research Workshop (ARW): ("Assessment of Hydrogen Energy for Sustainable Development: Energy & Environment Security", 7-10 August 2006, Istanbul, Turkey), Nanostructured Catalysts and Nanofluids Dedicated Micro scale Process Control of Catalytic Burning of Hydrogen for Innovative Generation by Emulating Energy Conversion Processes in Biological Cells, NANOCOFC: Enhancement of Research Capabilities on Multi-functional Nanocomposites for Advanced Fuel Cell Technology (in cooperation with an EU-Turkish-Chinese Cooperation), Hydrogen University, Hydrogen Fuelled Boat/Ferry, Unusual Methods of Hydrogen Production: (in cooperation with several universities), HYAIR - Converting air transport to hydrogen, Hydrogen/oxygen bi-functional solid electrolyte energy converter (HOBISEEC) (in cooperation with a consortium consisting of researchers from Turkey, Bulgaria, Romania, Greece, Italy, U.K. and Brazil), Creation of a Metal Hydride Atlas (in cooperation with the Institute for Problems of Material Science and Institute for Metal Physics, Ukraine), Creation of European Research Group on Energetics and Safety of Hydrogen Energy (GDRE).

Database Project

Two databases are being developed to gather information on hydrogen energy-based technologies and R&D activities in the field. They will provide valuable support for hydrogen energy related activities throughout the world, and eliminate duplication of effort. In practical terms, as there is a considerable amount of common information that needs to be shared between the two databases, they are to be viewed as a single set of database tables. Initial design analysis has identified the items of information that need to be stored and manipulated. The information has been analysed and placed in a form more suitable for inclusion in SQL database tables. Software interfaces or forms are being designed data to be entered into the database tables, and additionally provide an initial test of the database design.

Agriculture

The Ministry of Agriculture and Rural Affairs (MARA) in Turkey considers agricultural research essentially a public duty. The General Directorate of Agricultural Reform (GDAR) of MARA and the research funds of universities are financially and administratively supporting the research projects. TUBITAK, SPO, some agro-industry companies, and international bodies, such as CIMMYT, ICARDA, CIHEAM, FAO, IPGRI, CLIMA, CIP, UNDP, UNIDO, EU-FP and UNEP are other important research supporters.

Turkish representatives are on the Standing Committee for Agricultural Research (SCAR) of the EU. The task of identifying community research needs in agriculture is primarily undertaken by the integrated efforts of the MARA, universities, TUBITAK and SPO. In the past, the impact of agricultural research undertaken in Turkey has been difficult to quantify (It has been criticised as being based on personal interest and providing a relatively poor return on investment of public funds). With "Turkey Agricultural Research Project-TARP" the main change of emphasis in research planning and implementation from 1996 has been to move from a uni-disciplinary project or experimental research approach, to an integrated multi- integrated multi-disciplinary disciplinary approach. Investment in research is allocated according to prioritised Areas of Research Opportunity and Research Programmes.

Since 1996, with the implementation of the Agricultural Research Master Plan, the general perception has been to focus agricultural research into areas where the economic, social and environmental impacts are likely to be high.

Current Research Activities

Current research activities are focused on biodiversity-genetic resources, plant improvement, integrated growing-production systems and ICM, post-harvest technologies, agricultural economy-marketing, animal husbandry-breeding-health, fishery management, food and feed technologies, soil and water resources management, organic agriculture and biosafety. A satisfying research infrastructure with up-to-date technological devices and tools was developed using local and international resources, especially over the last 20 years. More specific research is required into the adaptation of climate change on irrigation and adaptive crop selection.

As a consequence of the Decision of Supreme Council for Science and Technology dated March 10th, and within the framework of the National Strategic Plan, MARA, in collaboration with TUBITAK, the National Agricultural Research Strategy Plan for 2005-2014 has been developed. This envisaged the agricultural research strategy would "undertake high quality relevant research for sustainable agriculture ensuring sustainable use of natural resources".

Environment

EIONET

Turkey became a member of the EEA in 2003. The MoEF is the National Focal Point for the EEA. The MoEF is aiming to establish a link to the European Environment Information and Observation Network through the National EIONET system for fulfilling reporting requirements of the EEA and capacity building within the involved institutions, as well as dissemination of the experience and knowledge gained from the EEA to relevant national institutions and experts.

Waste

Environmental Heavy-Cost Investment Planning Project (European Commission Turkey, 2003). The specific objective of the project is to enable Turkish authorities to meet their environmental infrastructural requirements for EU accession by identifying and prioritising projects in the priority environmental sectors which are water, waste, air and industrial pollution control (IPC) and to identify and catalogue existing financial instruments available for environmental investments and their characteristics [4]. Details are given in Chapter 7.

Forestry

Research studies on forestry related to climate change have been carried out by the Forestry Research Directorates of the MoEF, Forestry Faculties and by universities and non-governmental organisations. Details are given in Chapter 4.

8.3 Systematic Observations

8.3.1 Atmospheric and Meteorological Observations

Meteorological observations

The TSMS is responsible for building and operating precipitation, climatological, synoptic and higher atmospheric observation stations, keeping records of these observations, making weather and sea forecasts based on the evaluation of these observations and informing the public and relevant organisations about its forecasts. Besides the TSMS, some public organisations such as the EIE and the DSI operates some stations for meteorological observations.

Earliest observational records of the TSMS date back to 1930 and presently the TSMS operates an active network of 457 stations. Recently, 230 automatic meteorological stations and four meteorological radars have been installed. Observational, quality assurance and archiving procedures are consistent with WMO guidelines.

For the purpose of now-casting, TSMS has installed and is operating a network of four stable "C-Band meteorological radars" to measure cloud cover, precipitation and wind in real time for early warning of meteorological hazards. It is planned to increase the number of these radars to 11 over the next five years.

The TSMS is a member of WMO, ECMWF, EUMETSAT, ICAO and ECOMET. It is also contributing to the GUAN and GSN global observation systems.

Turkey is also a member of the Balkans Sub-Regional Drought Management Centre, which aims to provide member countries with meteorological ad hydrological data for drought forecast, early warning systems for monitoring drought and risk maps for combating the adverse effects of drought.

Ozone and UV Radiation Measurements

Since 1994, the TSMS is monitoring ozone (column) concentrations twice monthly by using the ozonesonde method with balloons in Ankara. Additionally, UV-Biometer monitoring has been conducted since 1997 in Ankara and since 2000 in Antalya. Within the scope of the TUBITAK-financed project, a Brewer Spectrophotometer will be purchased which will enable monitoring of UV radiation at ground level and ozone concentrations up to 50km altitude on a continuous basis. One UV-Biometer is in use, five more are planned. Ozone readings are send to the WOUDC (The World Ozone and UV Radiation Data Centre) in Canada.

Participation in Global Atmospheric Observation Systems

Global atmospheric observation participation Table 8.2 to Table 8.6.

Table 8.2 Participation in global atmospheric observation systems

	GSN	GUAN	GAW	Other*
How many stations are in the responsibility of the Party?	7	1	1	1*
How many of those operating now?	7	1	1	1*
How many are expected to be operationg in 2007?	7	1	1	1*
How many of those are operating to GCOS standards now?	7	1	1	1*
How many are providing data to international data services?	7	1	1	1*

*WOUDC

Table 8.3 GSN participating stations in Turkey

Index No	Station	Latitude	Longitude	Altitude (m)
17040	Rize	41 02N	40 31E	9
17062	İstanbul/Göztepe	40 58N	29 05E	33
17074	Kastamonu	41 22N	33 47E	800
17090	Sivas	39 45N	37 01E	1,285
17170	Van	38 27N	43 19E	1,662
17240	Isparta	37 45N	30 33E	997
17375	Finike	36 18N	30 09E	2

Table 8.4 GUAN participating stations in Turkey

Index No	Station	Latitude	Longitude	Altitude (m)
17130	Ankara/Center	39 57N	32 53E	891

Table 8.5 GAW participating stations in Turkey

Index No	Station	Latitude	Longitude	Altitude (m)
TR01	Ankara/CubukII	40 30N	33 00E	1169

Table 8.6 WOUDC participating stations in Turkey

Index No	Station	Latitude	Longitude	Altitude (m)
17348	Ankara/Centre	39 57N	32 53E	891

8.3.2 Air Pollutant Measurements

The TSMS has local facilities for the monitoring of atmospheric pollution and acid rain in key urban centres. In Ankara, Istanbul-Catalca, Amasra, Balikesir, Bolu and Antalya, there are dry and wet sampling stations. In near future, controls presently made in the western Mediterranean, Marmara and west Black Sea region will be extended to the rest of Turkey.

Air quality in the country in general is measured by using semi-automatic measurement devices that belong to the MoH and in 31 fully automated monitoring stations that were established in 2005 by MoEF. It is planned to establish fully automated air quality measurement stations for all 81 Provinces by 2006 by MoEF.

Air pollution monitoring stations measure concentrations of major air pollutants (PM, SO_2). In some stations, NOx and CO are also measured. Sulphurdioxide (SO_2) and particulate matter concentrations have been evaluated and published as monthly, winter season and annual press releases by TURKSTAT.

Turkey ratified the Convention on Long Range Transboundary Air Pollution in 1979 and the European Monitoring and Evaluation Programme Finance Protocol in 1984. Under the European Monitoring and Evaluation Programme, only one measurement station was established and since 1993 parameters measured by this station were sent to the Norwegian Institute of Air Research (NILU-CCC), Chemical Coordination Centre for evaluation, by the Ministry of Health. Cubuk –II EMEP is the only GAW station of Turkey.

8.3.3 Oceanographic Observations

National Oceanographic Observing Systems

Activities related to oceanographic observation and database are the responsibility of the Turkish Military Forces (Turkish Naval Hydrography and Oceanography, the General Commandership of Mapping) and relevant departments of universities (METU Marine Sciences Institute, Black Sea Technical University Surmene Marine Sciences Faculty, 19th May University Sinop Fishery Products Faculty, DEU Marine Sciences and Technologies Institute) are also involved on a project basis.

The 35 stations of the TSMS in coastal areas observe sea surface temperature and wave height (without instruments) besides other meteorological observations. Although marine observation started in 1930, there are inconsistencies in data. In 1990, sea level monitoring devices, such mareographes, were modernised, GLOSS standards were attained and the National Sea Level Monitoring System (TUDES) was established. There are 11 mareographes operational and Turkey is planning to increase their number (Fig 8.2).

Within the scope of TUDES, sea level and meteorological parameters effecting sea level (atmospheric pressure, air temperature, moisture, wind speed and direction) are being measured as 15-minute and 1-hour averages and the data are being stored. The Data Centre in Ankara implements collection, quality control and analysis of data [3].

Figure 8.2 TUDES mareograph stations

Participation in Global Oceanographic Systems

Since 2001, the General Commandership of Mapping (GCM) of Turkey is a member of ESEAS with their Antalya mareograph station and to MedGLOSS Project by IOC and CIESM with four stations. At the end of each year, they share their monthly and yearly sea level data with the PSMSL.

Within the scope of GOOS, the Marine Sciences Institute (MSI) of METU is an active member of EuroGOOS and MedGOOS and founder and Executive Committee Secretary of Black Sea GOOS. The institute is also participating in IGBP activities. See Table 8.7.

Table 8.7 Participation in global oceanographic observing systems

Measurement Platforms	VOS	SOOP	TIDE GAUGES	SFC DRIFTERS	SUB-SFC FLOATS	MOORED BUOYS	ASAP
For how many platforms is the Party responsible?	-	-	-	-	-	-	-
How many are providing data to international data services?	-	-	-	-	-	-	-
How many are expected to be operating in 2007?	-	-	-	-	-	-	-

8.3.4 Terrestrial Observations

National Terrestrial Observation Systems

Within the scope of terrestrial climate observing systems, phenologic observations are conducted by the TSMS and the MARA whereas hydraulic observations are conducted by the DSI and the EIE. Additionally, data acquisition and study activities on land use, forests and forest fires are conducted by the MoEF and the MARA. Phenological observations are being carried out in 257 stations on 74 different crops.

Since 1935, the EIE has been making hydrological observations. The Nationwide Hydrometric Measurements Network of the EIE is composed of 11 Hydrometric Study Centres. Presently, there are 277 stations for river level, 13 stations for lake level and 14 wells for ground water level. Additionally, the DSI has a network of 1,139 river flow measurement stations, 112 lake level stations and 2,897 ground water level wells.

Participation in Global Terrestrial Observation Systems

Table 8.8 Participation in global terrestrial observing systems

	GTN-P	GTN-G	FLUXNET	Other
How many cites are in the responsibility of the Party?	-	-	-	-
How many of those operating now?	-	-	-	-
How many are providing data to international data services?	-	-	-	-
How many are expected to be operating in 2007?	-	-	-	-

8.3.5 Space-based Observation Programmes

The TSMS is among the founders of EUMETSAT. Through the HRUS (High Rate User Station) and the HRPT (High Resolution Picture Transmission) ground receiving stations installed at the TSMS, satellite data is being received four times a day from NOAA and at fifteen-minute intervals from MSG. Some meteorological parameters such as cloud cover, cloud top heights and temperatures, fog, atmospheric humidity and sea surface temperature can be derived and forest fires can be detected.

Turkey is one of 11 states comprising the H-SAF (Satellite Application Facility-Hydrology) Consortium founded under EUMETSAT and represented by the TSMS, METU and ITU. During the development phase, which covers 2005-2010, Turkey is being responsible for development and validation of new products on precipitation and snow parameters.

Recommendations

As a continuation of present studies, further studies will be needed to estimate the adaptability of Turkish society and the environment to the impact of climate change. During present studies, a priority list of recommendations has been prepared for future research into climate change adaptation:

- Involvement of multiple sectors and stakeholders
- Socio- economic assessments of impacts and adaptation
- Relationships between adaptation and mitigation
- New technologies required for adaptation
- Consideration of methods of evaluating adaptation strategies
- Examination of the process of adaptation
- International research cooperation
- Multidisciplinary - integration of research on the impacts of climate change and adaptation measures with other environmental research and with social and technological research.

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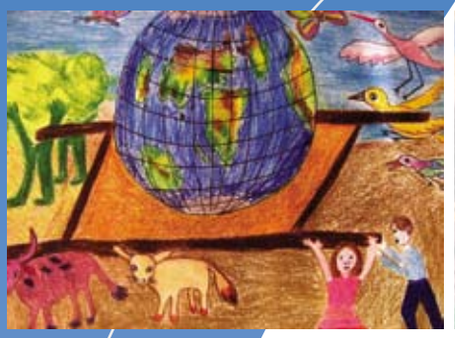

CHAPTER 9
EDUCATION, TRAINING AND PUBLIC AWARENESS

Prize winning paintings and slogans presented in this chapter are the results of climate change competitions organized in primary and secondary schools in Ankara.

9. EDUCATION, TRAINING and PUBLIC AWARENESS

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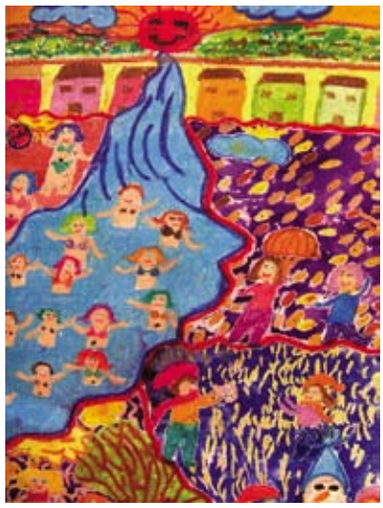

9.1 General Policies for Public Awareness and Training and Legal Basis

Since 1999, Turkey has entered a new era in its relations with the European Union (EU). Being a candidate country, Turkey has series of obligations to attain on the road to eventual membership of the EU. Training and public awareness in the field of climate change have gained apparent momentum in Turkey in line with harmonisation with the EU Acquis Communautaire, legislative arrangements and practices.

In May 2006, the Environmental Law was amended to incorporate new and important provisions regarding the expansion of environmental training and raising public awareness.

The abovementioned provisions include the following:
i) Environmental issues should be incorporated into the curriculum of educational institutions affiliated to the Ministry of National Education. Relevant issues should be reflected in the curriculum of schools, starting from pre-school level, to protect the environment as well as to raise environmental awareness among the public.
ii) Radio and TV channels should broadcast environmental programmes for a minimum of two hours[1] a month for training purposes in order to highlight the importance of the environment as well as to raise environmental awareness among the public. Both Public Service Broadcaster (The Turkish Radio and Television Corporation-TRT) and private television and radio are compelled to broadcast educational programmes.

Another legislative arrangement is the 1995 Regulation on measures to be taken to increase Efficiency in Energy Consumprtion of Industrial Establishment[2], which was enacted to increase energy efficiency in the industrial sector as well as raising awareness of technical personnel concerning energy efficiency in the Turkish industrial sector and ensuring rational and efficient power consumption in industry.

The Draft Bill on the energy efficiency is in the Turkish Parliament. One of the components of this draft bill includes the preparation of training modules for the efficient use of energy in daily life, climate change and the importance of energy efficiency for environmental protection. The trainings target the Ministry of National Education, formal and non-formal education institutions and their curricula, and public agencies and organisations.
The provision of the draft bill concerning public awareness campaigns on energy efficiency reads as follows:

- In the scope of training programmes for public awareness and information, television and radio channels providing national and/or regional broadcasts shall broadcast programs once a month between 19:00 and 23:00 hours for a period of not less than thirty minutes.
- Short films and/or cartoons regarding efficient use of energy.

The draft bill allows training seminars for energy managers especially those working in the building sector, as prescribed by the provision.[3]

The draft bill also includes provisions concerning certification activities. Upon the approval of the Coordination Board for Energy Efficiency, the Directorate General of the EIE grants certification to professional chambers and universities to give practical training and issue authorisations to companies. The draft bill also states that the General Directorate and/or the authorised organisations shall have the right to grant certification to private companies to make surveys, provide consultancy services, and carry out practical activities as well as training activities.

1. In respect to private radio channels, the duration of the programs is stipulated at 30 minutes. 20% of those broadcasts are obliged to be during primetime viewing periods.
2. Published in the Official Gazette of 11/11/1995
3. The management of residential buildings to which energy is supplied from common burning plants shall appoint an energy manager or receive the services of an energy manager for their buildings the total area of construction of which is a minimum of twenty thousand square meters; or in other terms, they shall receive such services if the annual power consumption of the buildings is equal to five hundred TEP or more.

9.2 Public Awareness and Training
9.2.1 Central Administrations

In Turkey, public agencies are involved in activities on climate change, either directly within their fields of activity, or indirectly in associated sector-based areas. In relation to climate change, these agencies carry out awareness campaigns and training activities, take part in international training activities and develop information sources and centres for climate change as a part of their activities.

Ministry of Environment and Forestry

The Ministry of Environment and Forestry (MoEF) is the lead public agency that is responsible for the co-ordination of climate change activities in Turkey. The MoEF organises seminars and workshops and issues assessment reports on issues that have a direct or an indirect relevance to climate change in order to raise environmental awareness of the public.

Within the framework of national preparation for the 2002 Johannesburg Sustainable Development Summit and within the scope of the "National Environment and Development Program" project, which was executed with the co-operation of the MoEF and UNDP, the UN Framework Convention on Climate Change (UNFCCC) was translated into Turkish for the first time with the contribution of the UNFCCC Secretariat. The Turkish version of the convention was then published and distributed to related communities. Further, the Turkish versions of the UNFCCC Caring for Climate and of the Understanding Climate Change: A Beginner's Guide to the UN Framework Convention and the Kyoto Protocol, (the English versions of which were prepared by the UNFCCC) were published and distributed. Non-governmental organisations (NGOs) and universities showed great interest in the "climate change e-group" activities during the project, and contributed significantly to the exchange of information.

Furthermore, the "Ankara Conference on Climate Change", the first comprehensive international meeting in Turkey, was held 1–3 September 2004 within the scope of the UNDP-National Environment and Development Program Project. The MoEF contributed to the organisation of the conference. The conference created significant environmental dialogue among decision makers and key stakeholders concerning the UNFCCC and the obligations and opportunities brought forward when Turkey became a contracting party to the convention. It also facilitated various cooperation agreements between Turkish stakeholders and international organisations.

The Directorate General of State Meteorological Affairs (TSMS), a body affiliated to the MoEF, currently undertakes training and public awareness activities on climate change. (www.meteor.gov.tr)

Since the education year 2003-2004, the TSMS, in co-ordination with the Provincial Directorate of Ministry of National Education in Ankara, has organised seminars each year on "Atmospheric Sciences and Meteorology" in primary, secondary and higher educational institutions within the framework of the "World Meteorology Day" (23 March). So far, 20,000 students from 70 schools in and around Ankara have taken part.

Also, the TSMS recently held an international course as one of its training and capacity building activities.. On 5-9 September 2005, the International PRECIS – Regional Climate Model Course took place in the WMO Regional Meteorological Training Centre (Alanya, Turkey) under the umbrella of the WMO and the Economic Co-operation Organization (ECO). 16 participants from Kazakhstan, Georgia, Kyrgyzstan, Pakistan, Uzbekistan, Afghanistan, Iran, Jordan, Azerbaijan and Turkey participated in the course. During the course, four trainers from the United Kingdom Meteorological Office and the Hadley Centre for Climate Prediction and Research gave practical training on the PRECIS - Regional Climate Model - a model built in the said centre.

The TSMS has translated WMO's "We Care for Our Climate" into Turkish as "Iklimimizi Koruyalim" and distributed the text to the primary education community as part of its awareness campaigns.
Furthermore, Meteor FM,[4] a radio channel of TSMS, broadcasts discussions on climate change as part of its "Guest of the Week" programme from time to time.

Give the nature a chance to live so will it keep you healthy

Protect the environment so will it keep you protected

The Land Use, Land Use Change and Forestry (LULUCF) Working Group, another working group of the CBCC, continues its training and capacity building activities on climate change.

In the framework of the LULUCF Group's professional training and capacity building activities, technical personnel from the Forestry Research Directorates were given relevant training courses with academic support received under the UNDP GEF Project, in relation to the identification of carbon storage and greenhouse gases in forested areas which are included in land use classes, in order to either contribute to this project or implement future projects. Further information can be found on LULUCF and its activities at the website of the R&D Department of the MoEF. (www.arge-cevreorman.gov.tr)

The MoEF organises national and international conferences on the UNFCCC and the obligations and opportunities brought forward for decision makers and key stakeholders (public organisations, private sector, scientific and research institutions and Non-Governmental Organizations - NGOs) when Turkey became a contracting party to the convention. The MoEF carries out these activities together with relevant stakeholders. The first of these thematic conferences, the International Conference on Climate Change, took place 1-3 September 2004 in Ankara, with the contribution of the UNDP and MoEF. Detailed information can be found about climate change at the website of the MoEF. (http://www.iklim.cevreorman.gov.tr/)

Based on a co-operation protocol signed by the MoEF with the Ministry of National Education, several activities have been carried out since 1999 to raise environmental awareness among students, to improve behaviour on consumption, to increase their knowledge of reforestation, the separate collection-at-source of recyclable solid waste and the recycling of waste.

Regarding the abovementioned issues, the Education and Publication Department, one of the main bodies of the MoEF, has undertaken a project in 280 primary schools in Ankara and in around 2,000 primary schools throughout the country under the co-ordination of the Provincial Directorates of Environment and Forestry. In the training courses given at primary schools under the aforesaid project, global warming and climate change are included in discussions on general environmental issues. Some training activities are also carried out at the request of other primary schools not covered by the project, and secondary schools and the private/public agencies and organisations.

The MoEF and the Department of Publication prepare various media programmes, as well as various television and radio programmes, to draw people's attention to the environmental issues on important dates such as Forestry Day – 21 March , and World Environment Day – 5 June, etc. The Ministry has produced TV films on various subjects to introduce environmental values. The films are broadcast on television channels.

The MoEF also undertakes campaigns and distributes posters and brochures to inform the public about environment and forestry. To this end, an "Environmental Handbook" is produced as a source document, and distributed to both teachers and students.

" Let us not destroy the world nature, let us keep it natural"

To raise awareness and boost environmental activities, the MoEF has signed co-operation protocols with the Ministry of National Education as well as other public organisations like the Turkish General Staff, the Presidency of Religious Affairs, TRT and the Radio and Television Higher Council (RTUK) and with NGOs like the Turkish Union of Chambers and Commodity Exchanges of Turkey (TOBB), the Confederation of Turkish Trade Unions (TURK-IS), the Confederation of Turkish Real Trade Unions (HAK-IS), the Confederation of Progressive Trade Unions of Turkey (DISK) and the Turkish Confederation of Employer Associations (TISK). In line with those protocols, awareness campaigns have been completed and are under way in several areas of co-operation with public organisations and NGOs. For instance, training seminars have been organised on the environment for industrialists and employers in the most developed metropolitan provinces of Turkey like Istanbul, Kocaeli, Izmir, Adana and Bursa, in parallel with activities carried out with TISK. Furthermore, training seminars have been organised in various cities[5] on the environment and labour health with contributions from TURK-IS and HAK-IS.

"The Applied Environmental Training Pilot Project" of the ministry, which was executed with the Ankara Foundation for Environmental Protection, aimed to raise public awareness on various environmental issues in the initial phase. The project was extended to the Foundations for Environmental Protection in the remaining provinces of Turkey in 2002.

4. The Meteor FM broadcasts on FM 92.4.
5. The seminars organised by TURK-IS took place in the provinces of Izmir, Zonguldak and Mersin.

"Vehicle free" days, among the preventive campaigns on climate change of the MoEF's Provincial Directorates, have been celebrated in some provinces recently. On such days, people are urged to ride bicycles, or just walk. As an example, Mersin Provincial Directorate of the Ministry of Environment and Forestry in 2005 organised such day. in 2005.

Pirime Ministry Turkish Statistical Institute

The Turkish Statistical Institute (TURKSTAT) was a member of the MED-STAT, a programme jointly developed by the EU. One of the recent activities in this scheme was training given by TURKSTAT to Palestinian experts on how to calculate greenhouse gas emissions using the IPCC methodology.

The General Directorate of the EIE

Since year 1981, the Directorate General of the EIE, an affiliated body of the Ministry of Energy and Natural Resources, has organised training and public awareness activities in relation to important issues in the field of climate change in order to increase energy efficiency in end-product sectors and extend the utilisation of renewable energy resources. In this frame, the Prime Ministry's Co-ordination Board for Energy Efficiency [6], which was formed in 1981, determines saving measures and organizes public awareness activities on energy efficiency, as well.

Parallel to public awareness activities, the EIE has organised and organises several national and international seminars, conferences and workshops on various issues relating to energy efficiency for different sectors. In co-operation with the Ministry of National Education, the EIE also organises seminars to raise students' awareness of energy saving and supplies various documents to both students and teachers regarding energy saving.

Further, the EIE organises energy saving seminars for public agencies and organisations as part of in-house training programmes.

The EIE runs public campaigns and competitions to raise public awareness of energy efficiency. "Energy Efficiency Week" has been celebrated every year since 1981. The Co-ordination Board for Energy Efficiency, chaired by the EIE and the secretarial services of which are provided by EIE, organises painting and story competitions among primary school students and project contests among high school students on energy efficiency during "Energy Efficiency Week", which is celebrated in the second week of January each year, in co-operation with the Ministry of National Education and the TUBITAK. Furthermore, conferences are organised for industry, construction and transport during "Energy Efficiency Week". Various participants representing relevant ministries, public institutions, NGOs, industrialists, production companies and municipalities attend such conferences.

The EIE aims to introduce energy-efficient technologies and ensure information sharing within the sector by organising project contests on energy efficiency among industrial institutions. The "Project Contest on Energy Efficiency in Industry" has been organised among industrial institutions since 1999. These activities continue every year. The "Seventh Project Contest on Energy Efficiency in Industry" will be organised during the 26th Energy Efficiency Week in 2007.

Various kinds of publications have been prepared in line with the EIE's publication activities on energy efficiency. These publications, as well as posters and video cassettes produced for awareness campaigns, are distributed free of charge. Also, so far, plenty of TV spots and information films have been produced and broadcasted on television channels from time to time. The EIE sends its officials and experts to information programmes, debates and panels on energy efficiency screened on various television channels.

In line with professional training and capacity building activities, the EIE gives "Energy Manager" courses to raise awareness on energy efficiency in industry and helps an effective energy management system to be formed in factories. At the end of the courses, an "Energy Manager Certificate" is given to experts and technical personnel.[7]

6. The board members consist of representatives from public agencies and organisations, private sector and universities. The draft bill on Energy Efficiency gives a strengthened role to the board and increases its efficacy.
7. The Energy Manager Certificate is given to those participants who pass the examination at the end of the course and are deemed successful as per the reports prepared by them within three months after they have returned to their factories.

No greenhouse gas accumulation, no human kind degradation

To increase the efficiency of energy manager courses, knowledge and technology transfers have been made from Japan with the help of the Japan International Co-operation Agency (JICA). The EIE has been supported in its training activities with various equipment and materials supplied in the scope of Energy Efficiency Project in industry carried out in co-operation with JICA, an application facility (Application Facility for Energy Saving) has also been established. The centre has been in operation since October 2001.

Individuals and organisations making an application for authorisation to conduct surveys on energy efficiency are granted a certificate of authority if they are found eligible, in accordance with the Regulation on measures to be taken to increase Efficiency in Energy Consumprtion of Industrial Establishment. So far, a number of agencies, including TUBITAK-Marmara Research Centre (MAM), the University of Osmangazi, the University of Ege and the Izmir Office of the Chamber of Mechanical Engineers have been granted authority to give energy manager courses. Two agencies, including TUBITAK-MAM and ENKA Technical Co. have been granted certification to make surveys on energy efficiency. In 2006, TUBITAK-MAM continues to make surveys and gives energy manager courses under the above-cited authority.

Until now, the Directorate General of the EIE and authorised organisations have organised 56 manager courses throughout the country, wherein a total of 896 participants have been trained. Besides manager courses, 10 short-term practical courses for technical personnel have been organised, wherein 122 participants have been trained.

Moreover, five international courses have been held in the Application Centre for Energy Efficiency with 95 international participants. These courses had participants from Afghanistan, Albania, Azerbaijan, Bosnia-Herzegovina, Bulgaria, Georgia, Hungary, Iran, Kazakhstan, Kyrgyzstan, Macedonia, Moldova, Pakistan, Poland, Romania, Slovenia, Syria, Tajikistan, Turkmenistan, Ukraine and Uzbekistan. International participants are granted a certificate of course attendance.

Upon request from factories, a programme known as the Training Bus Program for Energy Efficiency has been implemented by the EIE in recent years. Within the framework of this programme, comprehensive in-situ training was given to factory workers in relation to energy efficiency. It was an "on-the-wheel" training, in a classroom setting created in a bus equipped with television, video, overhead projector and slide machine. The bus visited factories, where workers at all levels were able to participate in the courses without leaving their work for long period of time. In total around 600 technical personnel were trained in this way.

To assist with energy efficiency training, the EIE has put into service a model building in March 2006, which uses at least 30% less energy when compared to a non-insulated building and where solar collectors, solar batteries and an earth-based heat pump are used. Superior heat insulation methods are used in the building and innovative technologies like solar energy, geothermal (earth-based heat pump) energy systems, fibre optic lighting systems and composite walls for cooling/heating are used. These systems provide heating and cooling for the entire building and supply a part of its electrical energy. The building has been built to train certified energy managers and to raise public awareness. It is also open to public.

The EIE constructed in the premises of the General Directorate of Mineral Research & Exploration (MTA) in Ankara an energy park with concepts and visual materials relating to energy, renewable energy and energy efficiency.

Further information about the EIE's studies on energy efficiency and some of its publications can be found at the website www.eie.gov.tr.

Prime Ministry State Planning Organization

The State Planning Organization (SPO) prepares development plans in conjunction with all relevant stakeholders. All related parties and stakeholders are represented on special expertise commissions. Within this framework, since the 7th Five Year Development Plan[8], the special expertise commissions have adopted a multi-participation working procedure. During the preparation of the 8th Five Year Development Plan[9], a Special Expertise Commission on Climate Change was formed in addition to the Special Expertise Commission on Environment. This commission issued the Special Expertise Commission Report on Climate Change in 2000.

Biogas rather than oil for a summer not spoiled

8. The 7th Five-Year Development Plan: 1996-2000.
9. The 8th Five-Year Development Plan: 2001 -2005.

Ministry of Agriculture and Rural Affairs

In parallel to the functions and powers of the Ministry of Agriculture and Rural Affairs, a number of regulations have been enacted and applications have been made to preserve soil, water and vegetation equilibrium and make farmers use soil and water correctly. These issues have a direct relevance to climate change.

In the scope of co-operation that contributes to the national database and inventory activities and of those established with the European Environment Agency (EEA-CORINE 2000 Land Cover Project), experts from the Ministry of Agriculture and Rural Affairs have been trained in land identification using remote sensing techniques.[10]

The ministry has produced some training material including books, journals, brochures and CDs for farmers to give them information about the interaction of climate change with the farming and livestock sectors and the necessary measures, as well as techniques and applications in that regard. Awareness and training includes seminars that have been given to farmers in line with the implementation of the Organic Farming Law of 2004. Farmers are taken to regions where organic farming is practiced, giving them a chance to see model projects. Training activities are under way to fulfill the requirements of the Regulation on Good Farming Practices. For the efficient use of water, training seminars are given to help farmers move from the flooding method to drip and sprinkling systems and ensure the watering of plants only when required. Farmers are urged to become a member of co-operatives to improve their knowledge . There are 9,744 co-operatives in operation at present. The Provincial Directorates of Ministry of Agriculture and Rural Affairs issue journals and newspapers at certain intervals to assist the training of farmers. Examples of those publications are books that contain notes from the Panel on the Impacts of Climate Change on Agriculture and the book named in the title of the conference is published and distributed to farmers. These have both a direct and indirect relevance to climate change.

Ministry of National Education and Higher Education

Pre-school Education, Primary Education, and Secondary Education

In line with educational policies in Turkey, a systematic and regular environmental education should be in place, starting from pre-school level to primary and secondary levels. In this context, there have been increasing activities to extend environmental education toward all communities. To this end, within the framework of the co-operation protocol signed by the Ministry of National Education with the MoEF in 1999, the following activities have been carried out:

i) Emphasising practical environmental education to raise environmental awareness of students at pre-school and primary education levels.

ii) The inclusion of environmental education in the curriculum to raise environmental awareness of both teachers and students at the secondary education level.

iii) The inclusion of a compulsory "Environment Lesson" in the curriculum to be given for a period of one hour once a week in programmes that the Ministry of National Education deems appropriate, at the primary education level,

iv) The inclusion of environmental issues in apprenticeship training programmes as in vocational training programmes.

v) The organisation of in-house training courses for teachers on environmental education to give both teachers and students environmental information at higher school level.

The curriculum for the formal education system of the Ministry of National Education at each level of education includes social and natural sciences, human and environmental relations, and natural resources and their utilisation. These are formulated around one primary objective: to educate individuals who are aware of the environment and who are sensitive to theenvironment and have gained a positive attitude rather than simply getting environmental information.

As part of the Turkish education system, topics like energy saving in relation to climate change, among several environmental issues are reflected in the following curricula according to the decisions of the Board of Education, an affiliated body of the Ministry of National Education: pre-school education, at the primary education level and at the secondary education level.

10. The training has made significant contributions to the continuation of data and inventory activities in the field of LULUCF.

Environmental issues are incorporated into laws and regulations concerning certain days and weeks that will be celebrated in primary, secondary schools, and high schools and their equivalents.

A strong partnership is achieved by means of the co-operation protocols made between the Ministry of National Education and NGOs to expand services, knowledge, experience, the combination of sources and education. In line with these protocols, various public awareness activities and a number of environmental conferences, courses and seminars are organised, as well.

The Ministry of National Education attaches special importance to the needs of individuals and the community as well as to scientific and technological developments, human health, efficiency, various environmental issues, and environmentally-friendly energy resources when developing vocational training programmes. The contents of each programme include topics such as environmentally-friendly technologies, efficiency, efficacy, economics, human health and labour safety, quality management, energy saving, installation and natural gas technology. Moreover, the topics of air, water, soil and noise are incorporated into vocational knowledge under the "Environment Section " in the programmes of 113 branches of the profession.

For raising public awareness, the Ministry of National Education also gives lessons on citizenship, preventive health, environmental awareness, consumer rights, protection of the natural environment throughvocational, social-cultural, reading/writing courses in public education centers. Through these education activities, people learn to be more sensitive to the social environment.

Higher Education Level

The Turkish higher education system comprises 85 universities and institutes. 53 out of these 85 higher education institutions are state universities, 23 are private (foundation) universities, and nine are higher education academies including military and police academies. 30 universities have Environmental Engineering departments. Other university departments like biology, chemistry, geography, geology, sociology, public administration, have included environmental issues in their education programmes. In suchdepartments, a number of meetings, panels and symposia with the participation of representatives from the public and private sectors as well as NGOs, are organised in addition to the curriculum. In recent years, the studies of EU harmonisation on environment has been given priority in the curricula of higher education institutions.

Energy management is taught in universities pursuant to the Regulation on Measures on Increasing Efficiency in Energy Consumption of Industrial Establishments. The University of Ege and the University of Osmangazi have programmes on energy management.

Some of state and private universities organise seminars, courses, etc. forstaff from various agencies and organisations through national or international centres for training and research. In this context, a number of environmental issues are considered, with particular attention to the theme of climate change.

Some universities have formed technical groups concerning renewable energy resources. These groups have publications in this field,[11] for example, the Middle-East Technical University's Solar Group.

The TOBB Economy and Technology University (TOBB-ETU), a foundation university opened in 2004 in Ankara, aims to contribute to the shift to an information society and to a market economy in Turkey. Some of the centres TOBB-ETU owns are: the Centre for Economic Studies;

The Centre for Energy Researches; and the Life-long Training Centre.[12] These centres will serve as places of educational excellence, strategy-building for the expansion of Turkey internationally and economically, and the development of technological analysis, recommendations and practices needed by Turkey and the private sector. Activities on global warming and climate change are planned. These activities will be carried out in the related centre among those listed above.

Being a research organisation, the TUBITAK-MAM have several institutes, including: the Institute of Research for Communication Technologies (IRCT); the Institute of Research for Energy Systems and Environment (IRESE); the Institute of Research for Gene Engineering and Biotechnology; the Institute of Research for Energy Systems and Environment (IRESE); the Institute of Research for Energy Systems and Environment (IRESE); and the Institute of Energy (IE). All these institutes have executed several projects, together with plenty of scientific, national and international publications related to these projects.

11. Gunes Kent, Assoc. Prof.Dr. Cetin Goksu, METU 1st Ed. 1993, 2nd Ed. 1999, Ankara; Anadolu Gunes Uygarligi, Assoc. Prof.Dr. Cetin Goksu METU, 2001, Ankara.
12. In the Life-long Training Centre, adults will be provided with up-to-date information and integration with the community and the environment will be achieved.

Industrial Guidance and Administration Institute of Turkey (IGAIT), an institute of the TUBITAK-MAM, uses its database in sectors where it is needed, following innovative approaches as well as advanced methods and techniques, it also carries out training activities. It prepares training material and issues research results. Preparations are under way to initiate an inter-disciplinary postgraduate programme on Climate Change in the Graduate School of Natural and Applied Sciences of the Middle-East Technical University (METU), with co-operation from the MoEF. The programme will admit students in the academic year 2006-2007.

The UNIDO-ICHET (UN International Centre for Hydrogen Energy Technologies), an Istanbul based centre, conducts studies in the provision of clean, widespread and sustainable energy systems by means of applied research, capacity building, conferences, training programmes and consultancy services. Studies and training programmes (Courses on Hydrogen Energy Technologies) are to be devised with the UNIDO-ICHET for the establishment of an International Hydrogen University in Istanbul, which will have programs and courses incorporating various dimensions of hydrogen energy technologies.

The Institute of Energy of Istanbul Technical University is actively involved in, and contributes to, policymaking and public awareness processes as well as organising conferences and seminars regularly on clean energy and energy policies.

9.2.2 Local Authorities

Although in Turkey local administrations do not yet raise awareness or provide information on climate change, many local activities are in place in many fields relating to the environment, particularly urban problems. More common in metropolitan provinces, such activities are organised together with NGOs. For instance, the Greater Ankara Municipality raises public awareness of environmental, water and air pollution. These are carried out through an effective public relations system, city councils, youth centres, etc.. The Greater Ankara Municipality broadcasts TV and radio programmes on sustainable urban development and the environment with the co-operation of local television and radio channels. It also makes contributions to the raising of public awareness by means of banners, posters, leaflets, handbills, bulletins, press releases, meetings, seminars and conferences.

9.2.3 Non-governmental Organisations

In Turkey, since the 1980's, there has been an increase in the number of voluntary environmental organisations, they are also diversified and distributed countrywide. Environmental NGOs founded in recent years are now common out of the three big cities - namely, Istanbul, Ankara and Izmir. This indicates a rapid increase in awareness of environmental organisations in less developed provinces as well as in rural areas. In parallel to this development, NGOs have tended to diversify and specialise. In this context, NGOs have shown a diversified and an increasing interest in the conservation of plants and animals that are in danger of extinction, the conservation of wetlands and coasts, energy policies, climate change, the conservation of biodiversity and bio-safety policies.

NGOs often take part in environmental negotiation mechanisms initiated by central government and/or local governments. (Special Expertise Commissions on the Environment and/or Climate Change of Five Year Development Plans, Technical Committees, local committees for the implementation of the Regulations – local committee on wetlands, city councils, local environmental councils, etc.)

Today, although the issue of climate change has found a greater place in raising public awareness, there are fewer NGOs which are directly involved in climate change activities in Turkey. Someof these NGOs mainly focus on energy policies and the effective utilisation of renewable energy resources. Among these NGOs are: the Technology Development Foundation of Turkey (TTGV); the Foundation for Clean Energy (TEMEV); the Foundation for the Research of National Policies (UPAV); the World Energy Council – Turkish National Committee; the Turkish Geothermal Association; the Turkish Foundation for the Research and Utilization of Energy Resources (JEVAK); the Association of Heat, Sound and Water Isolators (IZODER); the Turkish - International Solar Energy Society (UGET/TR); and Eurosolar Turkey.

In this regard, the TTGV has produced a publication titled "Climate Change and the Applications of Technology", with the co-operation of the UNDP Small Grants Program country office co-coordinator. In March 2006, booklets were published and distributed free of charge to all concerned organizations, mainly NGOs.

Some NGOs carry out activities and produce publications on national policies on climate change as well as on policies related relevant sectors. Among these NGOs are: the Turkish Foundation for Combating Soil Erosion, for Reforestation and the

Protection of Natural Habitats (TEMA); related chambers under the Union of Chambers of Turkish Engineers and Architects (TMMOB); the Environment Foundation of Turkey; the Society for Global Balance; the Association for the Research of the Problems of Rural Environment and Forestry; the Nature Society; Greenpeace/Turkey; the Environment Platform of Turkey (TURCEP); the Environment Platform for the Eastern Black Sea (DACE); and the Izmir EGECEP Climate Change Platform.

For instance, the TEMA Foundation has been conducting studies into global climate change since 2002. Since then, 6,000 individuals from several circles (teachers, members of the Turkish Armed Forces, volunteers) have participated in TEMA training courses on Erosion and Environmental Problems, including the issue of global climate change. The "TEMA Kids", consisting of primary school students, have been involved in climate change since 2005. Several training activities have been carried out in this context. At the 1st General Meeting of the TEMA Kids held 26-27 May 2006, the causes of global warming and its results were discussed and recommendations for solutions were presented, with the participation of 160 students and 60 teachers from 49 provinces. At a supplementary meeting to the General Meeting of the TEMA Kids, the "Training Seminar on Global Warming and Climate Change in the Mediterranean" took place on 25 November 2005 within the scope of the Mediterranean Action Day, with the co-operation of the Mediterranean Information Office for Environment, Culture and Sustainable Development (MIO-ECSDE), a Federation of Mediterranean NGOs for Environment and Development, and the EU and the TEMA Foundation. At the seminar, around 400 TEMA Kids were given information about global warming from Istanbul Technical University, Meteorology Engineering Department.

Furthermore, the International Meeting of the TEMA Kids took place on 21 April 2006, where the issue of climate change and its adverse effects were discussed, recommendations for solutions were also presented, with the participation of 250 young people from 39 countries.

9.2.4 Business World

The Turkish Union of Chambers and Commodity Exchanges consists of 363 members including local chambers of commerce, industry, maritime chambers of commerce and commodity exchanges. More than 1.2 million companies of various sizes from all sectors are part of these chambers and commodity exchanges in the entire country.

The chambers under the TOBB carry out several activities aimed at reducing environmental pollution. For instance, the Istanbul Chamber of Industry (ISO) has produced several publications that have either a direct or an indirect relevance to climate change as part of the Chambers' activities since 1991.

Waste exchange is another important activity of the TOBB regarding the environment. With waste exchange, the TOBB allows the trading of waste, bringing together sellers and buyers of waste. Waste exchange operates as part of the chambers, serving as a mechanism through which suppliers and users of waste can get information and trade.

The TOBB, in a joint Panel with the MoEF and UNDP on the Effects of Climate Change on Turkey and Industry, which took place in November 2005 within the scope of the Preparation Project for the First National Communication, gave information to representatives of industry and the business world about the steps that should be taken in that field.

The Turkish Cement Manufacturers' Association (TCMB) has formed a Technical Work Group on Climate Change, which conducts regular studies and organises panels, conferences, information campaigns and workshops on several topics. These include energy efficiency, obligations under the Framework Convention on Climate Change and the Kyoto Protocol, environmental legislation, dust removal/dust removal technologies and emission reduction.

Activities carried out by the Turkish iron and steel industry, one of the key industries inTurkey, in the field of climate change are undertaken by the Iron-Steel Manufacturers' Association. Regarding energy saving, environmental training, clima deliver papers in symposia and conferences to raise environmental awareness.

The Sustainable Environment Platform of the Turkish Industrialists' and Businessmen's Association (TUSIAD) is a voluntary organisation, which was formed in 2003 to establish a better understanding of the concept of sustainable development in the business world. The following institutions are members to the platform: the Istanbul Chamber of Industry; the Environmental Technologies Association (ÇEVRETED); the Istanbul Water and Sewage Administration (ISKI); the Turkish National Committee of Solid Waste, the Foundation for the Promotion of Protection of Environment and Culturage Heritage (CEKUL); the Turkish

Environmental Initiative Cocoon; İstanbul Technical University(ITU); the Research and Implementation Centre on International Textile and Confection Tachnologies (UTKAR); GTZ; IZOCAM Insulation Co.; Turkish Standards Institution(TSE); Society for Petroleum Industry (PETDER); the Istanbul Chamber of Environmental Engineers; CAMIS Packaging Co. and Boğazici University. The platform organises several information meetings, panels, TV programmes, conferences, workshops, fairs, symposia and exhibitions on a number of topics. These include the development of Turkish environmental laws, environmental pollutants and removal technologies, recycling/recovery technologies, environmentally-friendly businesses, environmental management systems, development of these systems, reforestation and environmental protection. The platform produces printed material on these topics, as well.

In addition, there has been an increasing number of NGOs in the business world in the field of energy policies, and thus in the field of climate change (e.g., the Association of Investors in Wind Energy Plants (RESYAD), the Association of Wind Energy Plants' Industrialists and Businessmen (RESSIAD), the Turkish Union of Wind Energy (TUREB) and the Association of Hydraulic Plants' Businessmen-HESIAD).

9.2.5 Media

TRT carries out activities related to the formation of public opinion and the raising of public awareness as part of its General Broadcasting Plan. Since 2004, TRT has included environmental issues in its work schedule as a "genre of program". Several agencies and organisations that either directly or indirectly use the theme of climate change in their activities (e.g., public and private sectors, NGOs, international organisations and universities) resort to media communication tools to carry out public awareness and information activities. Recently, both TRT and private television channels have been broadcasting more programmes on global warming.

The issue of climate change is discussed weekly in programmes on a private radio station, Acik Radyo (Open Radio), broadcasting on 94.2 FM. Experts working on climate change are invited onto these programmes, with the purpose of contributing to public awareness campaigns.

The International Festival of Environmental Films is an important activity aiming to raise environmental awareness among the public. This festival is organised every year by the Turkish Foundation of Cinema and Audiovisual Culture (TURSAK). The leading environmental NGOs in Turkey (The Society for the Protection of Nature (DHDK), ÇEKUL Foundation, WWF - Turkey, TEMA Foundation) as well as their international counterparts, (ECOWOODASIA) sponsor the festival.

9.3 International Activities

In addition to national public awareness, training and capacity building activities on climate change in Turkey, several organisations co-operate with international counterparts in this regard. Furthermore, some international organisations are active in these areas, as well.

Having direct relevance to climate change and the energy sector, the UN International Centre for Hydrogen Energy Technologies, established by the UNIDO in Istanbul, organises a number of research and training programmes as well as conferences on hydrogen energy technologies and the hydrogen economy. Technical training courses include a one-week training on hydrogen technologies, delivered to 250 science teachers. The UNIDO-ICHET's International Hydrogen Energy Congress and Exhibition took place 13-15 July 2005 in Istanbul. A conference on the "Chemical, Thermal & Fluid Transport in Fuel Cell Systems" is planned for July 2007. (www.unido-ichet.org)

The UNDP Turkey office, which has supported activities in this field by means of conferences and expert contributions since the year 2000, has acted as an intermediary for receiving GEF funding for the 1st National Communication Project within the scope of the National Climate Change Program and provided both financial and expert contributions to the development of projects with a view to bringing long-term projects under the TUBITAK Public R&D Aid programme under the scope of priority areas[13]. For the purpose of receiving GEF funding, the UNDP-Turkey Environment and Sustainable Development Program has designed projects on Building Codes, Eco-labeling, Sustainable Transportation and organised activities toward capacity building and public awareness within the scope of these projects. Additionally, the UNDP Turkey country office entered into a agreement with the MoEF within the framework of the Five Year Development Plan (2006-2010), to continue to give support to some necessary research and awareness activities on climate change.
(http://www.undp.org.tr/undp/EnergyAndEnvironment.asp)

13. For further information on these projects, please refer to the section "Researches and Systematic Observations".

Within the framework of the 1st National Communication Project on Climate Change,[14] the first national thematic project on climate change was implemented with GEF funding and with the co-operation of UNDP and the MoEF. (www.iklimnet.org)

Capacity Building Activities by GEF FNC Project

- Training course on the "LULUCF IPCC guidelines" delivered to twelve forestry researchers, working in different climate regions, in relation to long-term data generation and inventory activities regarding forestry, with expert contribution from the University of Istanbul, October 2005.

- Training course delivered by an international consultant to the members of the CBCC in relation to the National Communication and Inventory Preparation, November 2005.

- Training course in relation to Effective Communication Techniques given to CBCC experts working in the field of climate change in an inter-disciplinary approach, at METU-Permanent Training Centre, February 2006.

- At the Panel on the Effects of Climate Change on Turkey and Industry, which was organised with the contribution of the TOBB, some papers were delivered stressing that the issue should be handled by integrating it into the economy and natural systems, with an emphasis on the relevant actions required to be taken in the future, this was in November, 2005.

- A special hands-on training delivered to the sector representatives in relation to Greenhouse Gas and Air Emissions Inventory Preparation, in co-operation with the MoEF and with expert contribution from the EEA, February 2006 (This was the first course offered to a large group on the guidelines and programmes in relation to the joint reporting of air emissions to UNFCCC, UNECE, and EEA). Training course given to a number of experts from the sectors of energy, transportation, F gases and from TURKSTAT, in particular, in relation to Uncertainty Analyses for Inventory by an international consultant, March 2006.

- Open Forum on NGO and Climate Change, which aims to create synergy and co-operation particularly in sensitivity and adaptation activities between NGOs and research institutions and public organisations working on the issue of climate change and achieve the involvement of groups during information process, was organised by the MoEF and UNDP with the participation of NGOs as well as academic institutions and public organisations, March 2005.

- Panel on the Energy Sector in line with the Convention on Climate Change took place in Ankara with the co-operation of the Ministry of Energy and Natural Resources and UNDP, with a view to facilitating the exchange of information among energy organisations concerning the requirements of the Framework Convention on Climate Change and areas in which those requirements overlap with the EU alignment process and provide information to the sector, May 2006.

The activities in the field of research, policies and strategies under the GEF Project included the following workshops and panels:

- Brainstorming meeting on climate change pursuing a "Macro Economic Stability" approach with the co-operation of the Iron-Steel Manufacturers' Association and with the active involvement of the TOBB and TCMB, January 2006.

- A joint workshop with the UNDP, the TSMS and the MoEF-R&D on climate change took place 2-3 March 2006 in Antalya. The scope of the workshop, entitled the Relation of Climate Change with Land Use and Climate Change Impacts, Vulnerability and Adaptation, was to identify circumstances in studies into the effects of climate change on natural systems, to find out the effects of climate change on land use, water resources, water ecosystems, health, flora and fauna, and particularly on agriculture and to develop strategies and determine needs for adaption activities.

- A workshop attended by75 representatives from public agencies, NGOs, the academic community, and the Preparation Workshop for the Climate Change Action Plan (CCAP)[15], aiming to set long-term goals and strategies for climate change, ensuring incorporation of climate change issues in the National Environmental Strategy Plan, and communicating the principles adopted in the field to the UNFCCC Secretariat. Within the framework of the CCAP, action will be taken to reduce greenhouse gas emissions, identify the circumstances specific to Turkey, minimise vulnerability to hazards caused by climate change, ensure sustainable use of resources, and improve adaptation capabilities to climate change in order to fight against climate change, June 2006.

14. The project was implemented by the UNDP under the responsibility of the General Directorate of Environmental Management of the MoEF.
15. The Commitment for Preparation of CPAP is recognised by the 9th Seven Year Development Plan(2007-2013).

Others

Painting and Slogan on Climate Change competitions were held in 2006 at the pilot primary schools in Ankara with help from the MoEF's Department of Education and Publications and the UNDP. The prize winning students were awarded prizes on 5 June World Environment Day. The prize winning slogans and paintings are reproduced in this chapter.

Training for children on major environmental issues, in particular global warming and the depletion of the ozone layer, and what can be done to solve those problems as an individual, was provided in 2006 in some southeastern provinces of the country with help from UNDP Entrepreneur Support Center(UNDP-GIDEM) and GEF Climate Change Enabling Activity Projects.

Among planned activities in the short term is the publication of educational booklets and interactive educational tools, which contain information about climate change[16] and aim to show the efficient use of energy and the recycling of wastes. The booklets are aimed at students at the primary level, with the co-operation of the UNDP, the MoE, and the MoEF.

The UNDP GEF Small Grants Program (SGP) has provided funding for climate change projects, in particular energy saving projects, undertaken by NGOs since 2004. In this context, the GEF SGP continues to provide funding for projects on the reduction of climate change and soil loss, as well as projects on clean transportation and on renewable energy sources. In addition, awareness campaigns on the issue continue with periodicals from the GEF SGP. For this purpose, a publication entitled "Local Solutions to Global Climate Change and the SGP Approach" was distributed free of charge to the related organisations, to serve as a guideline, with the co-operation of the TTGV[17]. (http://www.undp.org.tr/undp/gef-sgp.asp)

WWF-Turkey, which has implemented several national and international projects for the conservation of biological diversity in Turkey, has launched public awareness and training programs in various regions with a view to reduce greenhouse gases by allowing the storing of carbon in the forests, as it is directly related with the issue of climate change.

Unconsumed natural resources, unchanged climate

Recently, a number of NGOs have taken part in international projects which are financed through EU funds and which aim to improve the capacity of Turkish NGOs in the field of environment. These projects attempt to create a dialogue between Turkey and theEU at the level of civil society on sectoral policies relating to climate change in energy, industry, agriculture, etc. One such project is theNew NGO Forum, European Environmental Bureau.

REC-Turkey issues a quarterly Climate Change Bulletin titled in Turkish "Cemre". Further, REC-Turkey has issued news bulletins in Turkish on the UNFCCC and the Kyoto Protocol - texts and basic information - and COP diaries. In addition, the Turkish versions of the UNFCCC and the Kyoto Protocol, as well as several useful documents, have been turned into a single publication and distributed to relevant public organisations and NGOs. Moreover, in line with capacity building activities, the introduction and co-ordination in Turkey of the Renewable Energy and Energy Efficiency Partnership (REEEP) and the Partnership for Clean Fuels and Vehicles (PCVF) have been carried out.

The MoEF is conducting the public awareness and training activities in co-operation with REC Turkey. With regard to public campaigns, REC-Turkey has printed 5,000 first editions and 70,000second editions, of posters and brochures with the slogan: "Climates are changing... what about you?". These were distributed throughout Turkey with the June 2006 edition of National Geographic Turkey, aiming to reach larger communities as part of a public awareness campaign. In parallel to the assistance programme for NGOs, REC-Turkey's workshop on Stakeholders' Meeting for Climate Change took place 27-28 April 2006 in Istanbul in order to introduce NGOs to activities under the UNFCCC.

16. These publications and interactive tools for children are distributed free by UNDP-Tunisia and the Sustainable Energy Institute of Ireland.
17. The publication, which was funded by the GEF SGP, contains sections on Energy Saving, Renewable Energy and Sustainable Transportation, with examples from the other parts of the world.

In the MoEF's and REC-Turkey's LIFE assistance under the EU/LIFE Project for the Introduction of Climate Change Policies, which commenced in 2005, the current curriculum will be supplemented by material on the environment and sustainable development in order to raise awareness in primary schools under the Ministry of Education through a "Green Pack Project"[18], to be implemented in primary schools during the period 2005-2007. The Green Pack Education Set, containing materials relating to climate change (a climate change CD, etc.) has been prepared in compliance with the curriculum, which is revised phase-by-phase by the Ministry of Education. This provides a more efficient use of the set. It is expected that the project will in this way make a contribution to the raising of students' awareness on climate change at primary education level and to a positive change in the behaviours of students in that regard.

The Britisch Council's "Zero Carbon City" is a two-year global project which aims to highlight the challenges of climate change, encourage building of an environment for discussion and strengthen the commitment of the United Kingdom to studies on climate change. The project has been implemented by the British Council inTurkey with the co-operation of REC-Turkey and the MoEF.

Further information can be found in Annex 7 concerning other activities and conferences that have been carried out in recent years by relevant organisations in the field of climate change and which make a direct and an indirect contribution to the issue.

Turkey, a heaven in four seasons, only in a protected environment

18. The Green Pack Project started on 21 December, 2005 under a tripartite protocol signed by the Ministry of National Education, the MoEF, and the REC Head Office.

ANNEXES

ANNEX-1 Legislations, International Agreements and Conventions which Turkey is a Party and Organizations in the Field of Environment

ANNEXES

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Laws

- Laws and by-laws about environment will be re-examined and they will conform to EU rules step by step.
- The Constitution of 1982
- The 2872 Numbered Environment Law (11.8.1983 dated and 18132 numbered Official Gazette)
- The 4856 numbered law on The Organization and Responsibilities of The Ministry Of Environment and Forestry, (Accepted on 9.8.1991, published on 21.8.1991 dated and 20967 numbered Official Gazette.)
- The 5216 Numbered Law On Grand City Municipalities (23.07.2005 dated Official Gazette 25531)
- The 5393 Numbered Municipalities Law (24.12.2004 Official Gazette 25680)
- The 2464 Numbered Municipality Revenues Law
- The 3194 Numbered Public Development Law (1985)
- The 180 Numbered Decision On The Article Of The Law About The Organization and Responsibilities Of The Ministry Of Public Works and Housing (1983)
- The 1593 numbered Public Hygiene Law. (6.5.1930/1489 numbered Official Gazette)
- The 3017 Numbered Law On The Organization and Responsibilities Of The Ministry Of Health and Social Security (1936)
- The 3348 Numbered Law On The Organization and Responsibilities Of The Ministry Of Transport
- The 3143 Numbered Law On The Organization and Responsibilities Of The Ministry Of Industry and Commerce
- The Decision On The Article Of The 491 Numbered Law About The Organization and Responsibilities Of The Undersecretary Of Navigation
- The 2399 Numbered Law prohibiting hazardous gases and their production and importation into the country
- The Law of Tax Reduction and Vehicle Taxes and Tax and Finance Laws
- The Law of Sea Ports
- The 5442 Numbered City Management Law
- The Legal Criminal Code of Turkey
- The Turkish Civil Code
- The 4708 numbered law on construction auditing
- The traffic law of highways
- The Law of Pastures
- The 1380 Numbered Water Products Law (22.03.1971, 13799)
- The 2873 Numbered National Parks Law
- The 4915 Numbered Land Hunting Law
- The 6831 Numbered Forests Law
- The 5312 Numbered Law About The Emergency Interference and Indemnification In Case of The Pollution of Sea Environment By Petroleum and Other Harmful Substances (11.03.2005 dated and 25752 numbered Official Gazette.)
- The 4077 Numbered Consumer Protection Law, 2003 (revision)
- The Law Approving The Cartegena Protocol About Biological Security(2003)
- The Law of Management Unions For of Local Sites
- The Law About Organized Industry Regions
- The Law About Realizing Some of The Investments and Services In The Frame Model As Install-Operate-Transfer
- The 6200 Numbered Law About The Organization and Responsibilities of The Public Management of The Government Water Works(1953)
- The 167 Numbered Law About Underground Waters. (1960)
- The YAS Law
- The Legal Decision About The 181 Numbered Law About The Organization and Responsibilities Of The Ministry of Health and Social Security.

- The 5302 Numbered Private City Management Law
- The 5326 Numbered and 30.03.2005 Dated Law of Guilt
- The 24.06.2004 Dated and Numbered Animal Protection Law
- The 2863 Numbered Law of The Protection of Cultural and Natural Creatures
- Providing Information Law 09.19.2003 dated and 4982 numbered
- Law on Measures and Assistance Regarding Natural Disasters Affecting General Public Life, Law No. 7269
- Turkish Coastal Law, Law no 3621
- Building Code Law and the issued directive, Law no. 3194

B. International Agreements and CONVENTIONS

- The Basel Convention- The Convention on the Control of Transboundary Movement of Hazardous Waste and Their Disposal. (15/05/1994 – 21933 Official Gazette)
- The protocol on the prevention of pollution of The Mediterranean sea by the Transboundary movements of hazardous waste and their disposal (Izmir) (06.03.2003)
- The contract forbidding nuclear weapon tests in the atmosphere, in space or under water Moscow 1963 (Turkey 13.5.1965 Official Gazette)
- The Agreement Of International Energy Program Paris 1974 (Turkey 4.5.1981 Official Gazette)
- The International Air Pollution Contract Geneva 1979 (Turkey 23.3.1983 Official Gazette) The additional protocol for the cooperation program started on this issue (EMEP), Geneva 1984 (Turkey 23.7.1985 Official Gazette)
- The 1985 dated Vienna Agreement about the protection of ozone layer (Turkey 22.9.1988 Official Gazette)
- The Montreal Protocol about substances consuming ozone layer (1987) (Turkey 20.6.1990 Official Gazette)
- The Frame Agreement About Climate Changes
- Ramsar Agreement
- The Founding Agreement Of International Sailors Organization-MO Convention 1948 (16.07.1956)
- The IMO Convention Changes 1993 (01.02.2001)
- The International Agreement Of Life Safety At Sea-SOLAS'1974 (25.05.1980)
- The International Agreement On Loading Lines-LL'1966 (28.06.1968)
- The International Agreement On The Measurement Of Ships-Tonnage' 1969 (15.11.1979)
- By-law on Preventing Collision At Sea -COLREG' 1972 (18.11.1984)
- International Contract Of The Education, Certification of Sailors and The Essentials Of Nautical Watch -STCW' 1978 (29.09.2003)
- The International Agreement Of Search and Rescue at Sea -SAR' 1979 (24.03.1986)
- International Agreement Of The Organization Of Marine Communication By Satellites -INMARSAT' 1976, 1994, 1998 (04.11.1999)
- INMARSAT Operational Changes -OA' 1976 (04.11.1999)
- The International Agreement On The Prevention Of The Sea Pollution By Ships. (MARPOL' 73/78 and ANNEXES: ANNEX I, ANNEX II), ANNEX I-The rules of preventing the sea pollution caused by petrol, ANNEX II-The control of sea pollution caused by poured hazardous liquid substances, ANNEX V The rules of preventing the sea pollution caused by thtash poured from ships., 24.06.1990)
- The International Contract About The Limitation Of Responsibility On Sea Claims -LLMC' 1976 (04.06.1980)
- The Agreement About The Security Of The Sea Traffic Against Illegal Activities and The Protocol For Preventing Illegal Activities Against The Safety Of The Stable Platform At The Continental Shelf. -SUA' 1988 (09.10.1990)
- The Barcelona Agreement accepted on 1976 (It is approved on 22 August 2002 by Turkey) and annex protocols of this Agreement.
- The Bucharest Agreement On Preventing Black Sea Against Pollution (6 March 1994) and annex protocols of this Agreement.
- The International Agreement On Being Ready For Petrol Pollution and Interference and Cooperation With It. (OPRC' 1990, 18.09.2003)
- The International Contract About Civil Responsibilities Caused By The Harms Of Petrol Pollution. (CLC'1992, 27.07.2001 dated and 24472 numbered Official Gazette)
- International Contract About Assembling An International Fund For Indemnification Of The Harms Of Petrol Pollution. (FUND' 1992, 18.07.2001 dated and 24466 numbered Official Gazette)
- Agreement Of Contention With Becoming Dessert
- In addition to all the above, Turkey has many other help and cooperation agreements with different countries.

- Paris Agreement (Contract About The Protection Of Birds)
- The Bio-variety Agreement Of United Nations, Cartagena Bio-safety Protocol.
- Ramsar Agreement (Contract about internationally important well-watered places as life environments of especially water birds)
- Bern Agreement (The Agreement Of The Prevention Of Wild Life Of Europe)
- CITES Agreement (The Agreement About The International Trading Of Wild Animals and Plant Types Under Danger Of Extinction)
- European Agreement About The Protection Of Vertebrates Used For Experiments and Other Scientific Objectives
- European Agreement About The Protection Of Pets
- The European Agreement Of Landscape

C. By-laws

- By-law on Packaging and Packaging Wastes (30.07.2004 - 25538 Official Gazette)
- By-law on Vehicle Examination and Opening, Operating Vehicle Examination Stations
- By-law on The Control Of Waste Batteries and Accumulators (31.08.2004 – 25569 Official Gazette)
- By-law on The Control Of Waste Oils (21.01.2004 – 25353 Official Gazette)
- By-law on Hunting and Wild Animals and Keeping, Production and Trading Of The Products Of These Animals.
- By-law on Hunting and Wild Animals and Production Places and Stations and Rescue Centers.
- By-law on The Basis and Methods Of Hunter Education and Hunting Certificate.
- By-law on The Basis and Methods For The Establishment, Management and Audit of Hunting Areas.
- By-law on Gasoline and Diesel Quality.:
- By-law on Heat Insulation Of Buildings.:
- By-law on The Control Of Vegetable Waste Oils (19.04.2005 – 25791 Official Gazette)
- CITES By-law
- By-law on Environment Audit (5 January 2002, 24631 repeated Official Gazette)
- By-law on Environment Health Audit and Auditors (13.9.2002-24875 Official Gazette)
- By-law on The Environmental ımpact assessment (16.12.2003 – 25318 Official Gazette)
- By-law on The Evaluation and Management Of Environmental Noise: (2002/49/EC)
- By-law on Experimental Animals Used For Experiments or Other Scientific Tests, Production Places Of Experimental Animals, and The Methods and Basis Of The Establishment, Operation and Auditing Of Experiment Laboratories. (2005)
- By-law on The Control Of Air Pollution Caused By Industry
- By-law About The Methods Of The Detection Of The Crime and Punishment and The Punishment Receipts. For Ships and Sea Vehicles. , 1987
- By-law about getting wastes from ships and waste control (26.12.2004 – 25682 Official Gazette)
- By-law on the control of excavation soil and wastes of construction and demolition (18.03.2004 – 25406 Official Gazette)
- By-law on the protection of air quality: 1986
- By-law on the control of air pollution caused by warming.:
- By-law on providing economy on the fuel consumption of heating and steam plants and decreasing air pollution.: 3 November 1977
- By-law about the quality of surface waters from which drinking water is provided or is planned to be provided. (20 November 2005 dated and 25999 numbered Official Gazette)
- Type approval by-law about some of the spare parts and properties of motor vehicles with two or three wheels. (97/24/AT) ,
- About By-law on the bases of realizing and changing development plan;
- By-law about the quality of water consumed by people. (17 February 2005 dated and 25730 numbered Official Gazette)
- By-law about establishing and operating licenses of employment places. (10.08.2005 dated and 25902 numbered Official Gazette)
- By-law about the principals of applications of abundant laboratories and certification of testing laboratories, 2002
- By-law about the auditing of the abundant laboratories and the control of the operations., (25.06.2002 – 24796 Official Gazette)
- By-law on the control of solid wastes. (14.03.1991 - 20814 Official Gazette)
- By-law about the basis and methods of the duties and operation of Central Hunting Commission and Hunting Commission of Cities and Towns.

- By-law about heat insulation at existing buildings and providing fuel economy and decreasing air pollution.: 18 November 1984
- Type approval by-law about external noise emissions and exhaust systems of motor vehicles. (870/157)
- The type approval by-law on fuel consumption and carbon monoxide emission of motor vehicles.,
- By-law on organized industry areas. (28.06.1997 – 23033 Official Gazette)
- By-law on the education of heating system operators, the operation, control and maintenance of heating systems at private or official buildings.
- By-law on observation and auditing of the market., (11.01.2002 – 24643 Official Gazette)
- By-law on water pollution control (31.12.2004 dated and 25687 numbered Official Gazette)
- By-law on water products (10.03.1995 dated and 22223 numbered Official Gazette)
- By-law on the protection of well-watered places
- By-law on the protection of the waters against nitrate pollution caused by agriculture (18.02.2004 dated and 25337 numbered Official Gazette)
- By-law on the control of hazardous wastes. (14.03.2005 - 25755 Official Gazette)
- By-law on dangerous chemicals, (11.07.1993 - 21634 Official Gazette.)
- By-law on the control of the pollution in water and water environment caused by hazardous substances. (26.11.2005 dated and 26005 numbered Off. News.)
- By-law on the control of medical wastes. (22.07.2005 - 25883 Off. News.)
- By-law on vibration,
- By-law on the control of soil pollution (31.05.2005 dated and 25831 numbered Off. News.)
- By-law on the control of exhaust gas emissions caused by motor vehicles in traffic.
- By-law on the protection of wild life and the development of wild life areas.
- By-law on the protection of wild animals and their life areas and contention with the harmful ones.
- By-law on local or foreign hunters to hunt in the embrace of hunting tourism.
- By-law on the bases and methods of the certification of pesticide and similar substances used for agricultural contention., (17.02.1999 – 23614 Off. News.)
- By-law on refinery of city waste water. (08.01.2006 - 26057 Off. News.)
- By-law on bathing water quality (09.01.2006-26048 Off. News.)
- By-law about the election, education, duties and responsibilities of volunteer hunting inspectors. (03.07.2004 25511 Off. News.)
- By-law on clothing of hunting protection employees. (06.08.2004-25545 Off. News.)
- By-law on the collection, preservation and usage of genetic plant variety. (1992-21316 Official Gazette).
- By-law on the removal, production and external sale of natural flower bulbs. (1995-22371 Official Gazette)
- By-law on national parks application (1986 dated and 19309 numbered)

2004/7189 numbered Providing Information Law

Institutions and Organizations in the Field of Environment

1. The Prime Ministry: It is directly related to conformity period and /or the protection of the environment.

2. State Planning Organization: It is connected to The Prime Ministry and it prepares five year development plans and yearly investment plans. It also gives special importance to macro-environment policies and prepares sectoral plans. It is responsible for the preparation and the coordination of application of yearly investment plans for local management. Also public sector investments requires the approval of DPT including projects requiring financing or external credit.

3. The Undersecretariat of Treasury: It has an important function about financing of the projects about environment, as it has access to external resources and credits.

4. The Undersecretary of Maritime: It is responsible for assignment and development of navigation system and services due to the interests and advantages of the country. It is the duty of The Undersecretary Of Navigation to take all precautions against the pollution and harms made to the sea, observation and auditing of these and cooperating with other institutions and organizations about this subject.

5. Secretariat General for EU Affairs: It is responsible for joining to EU, it has duties of coordination between different governments about international programs of conformity activities of European Union rules

6. Turkish Statistical Institute: Collects, operates and analyses data and information including environment data

7. The Ministry of Foreign Affairs: It has duties and responsibilities due to 1173 numbered International Affairs and Their coordination Law, on performing relation and communication, international contracts with foreign countries, international companies or their representatives. The Ministry Of Foreign Affairs has responsibilities and duties on determination of external politics about environmental and over frontier waters, together with other ministries, institutions or organizations and the defense of regional and international organizations.

8. The Ministry of Interior Affairs: It has responsibilities on local management by city management. The Governors are assigned by The Committee Of Ministers. Due to the 5442 numbered City Management Law's 9th article, the governor is the representative of the government in cities and the representative of each minister and the connection of administrative and political performance. Also The Ministry of Interior Affairs and governors have guardianship authority on local management and the head and performance point of The Private City Management as the governor.

9. The Ministry of Public Works and Settlement: In order to cover the substructure needs of the country, it is responsible for constructing public constructions, highways, railways, harbors, and coast constructions, airports, pipe lines for oil and natural gas, and repairing and giving permission to repair all these, construction materials, earthquake investigations, effective, proper and fast disaster services. The MPWS is also one of the institutions actively involved in making investment for municipalities in line with the Bank of Provinces Law with a law no 4759.

10. Bank of Provinces: It is one of the effective institutions on providing investment to the municipalities. The bank provides all financial needs and if required investment services for drinking water, sewer system, refinery.

11. The Ministry of Health: It is responsible for taking and making others take all precautions about environment health, preventing unhealthy institutions from harming the public health and auditing due to the 1593 numbered Public Hygiene Law and 181 numbered Legal Decision. The license and permission procedures, establishment of employment places and working licenses are performed due to By-law.

12. The Ministry of Transport: It is responsible for the installation and development of transport and communication systems and services due to the needs of the country.

13. The Ministry of Agriculture and Rural Affairs: It is the responsible institution for water quality, observation, protection and applications at all seas and interior waters as these areas are announced as the production areas of water products due to the 1380 numbered Water Products Law and By-law. On the other side, it is responsible for the usage of land and the development of water resources on rural areas. The Ministry observes the pollution caused by the nitrate and insecticides at surface waters in agricultural areas. The Ministry also has responsibilities on fish farms, water products and control of insecticides and it is responsible about Genetically Changed Organisms.

14. The Ministry of Labor and Social Safety: It is responsible for operating and auditing the studies about air, noise and industrial accidents in interior places caused by the production of industrial plants, harming the health of the workers

15. The Ministry of Industry and Trade It is responsible for creating and managing industry policies for Turkey due to the economical and technical conditions, supporting and auditing all activities of big or small sized enterprises, preparation of standards for industrial products and publishing the prepared standards, auditing the quality of industrial goods

16. The Ministry of Energy and Natural Resources: Responsible for performing the determination of the main targets containing energy policies, the environmental usage of continuous energy, productivity of energy and replaceable energy.

17. The General Directorate of State Hydraulic Works: As the responsible institution for underground and surface waters' assignment and the management of water resources, it has defined duties due to its establishment law about water quality observation and develops projects on providing water for drinking, usage, watering and industry.

18. Electricity Generation Corporation: It is responsible for the operation, maintenance of the thermal and hydraulic power plants that belong to the public and install new plants if necessary.

19. The Ministry of Culture and Tourism: It has important responsibilities about determining touristic regions and applications of drinking water, city waste water, and solid waste elimination plants on these areas.

20. The Ministry of Environment and Forestry :It is established for providing a general coordination for development and application of the environment policies in Turkey, due to The 4856 numbered Law Of Establishment and Organization Of The Ministry of Environment and Forestry with the aim of providing environment services including conformity to EU environment rules. The main duty of The Ministry of Environment and Forestry is generally protecting the environment, determining essentials on preventing and decreasing pollution, arranging and applying the necessary by-laws.

21. Private Management Of Environmental Protection: It is responsible for increasing environmental conscious and providing economical development of the regions in the framework of sustainability of natural beauties, historical and cultural sources, biological variety, all alive and other creatures.

22. The Institute of Turkish Standards: It is responsible for creating definite standards embracing wastes, air quality, water quality, protection of forests, soil and erosion control.

23. Local Administrations (Municipalities,) the most important duty on the protection of environment quality is given to the local management. The 5393 numbered Municipalities Law and the 5216 numbered Metropolitan Municipalities Law charges the municipalities to apply the above mentioned laws and by-laws inside municipality borders and to take necessary precautions for people to live in a healthy environment.

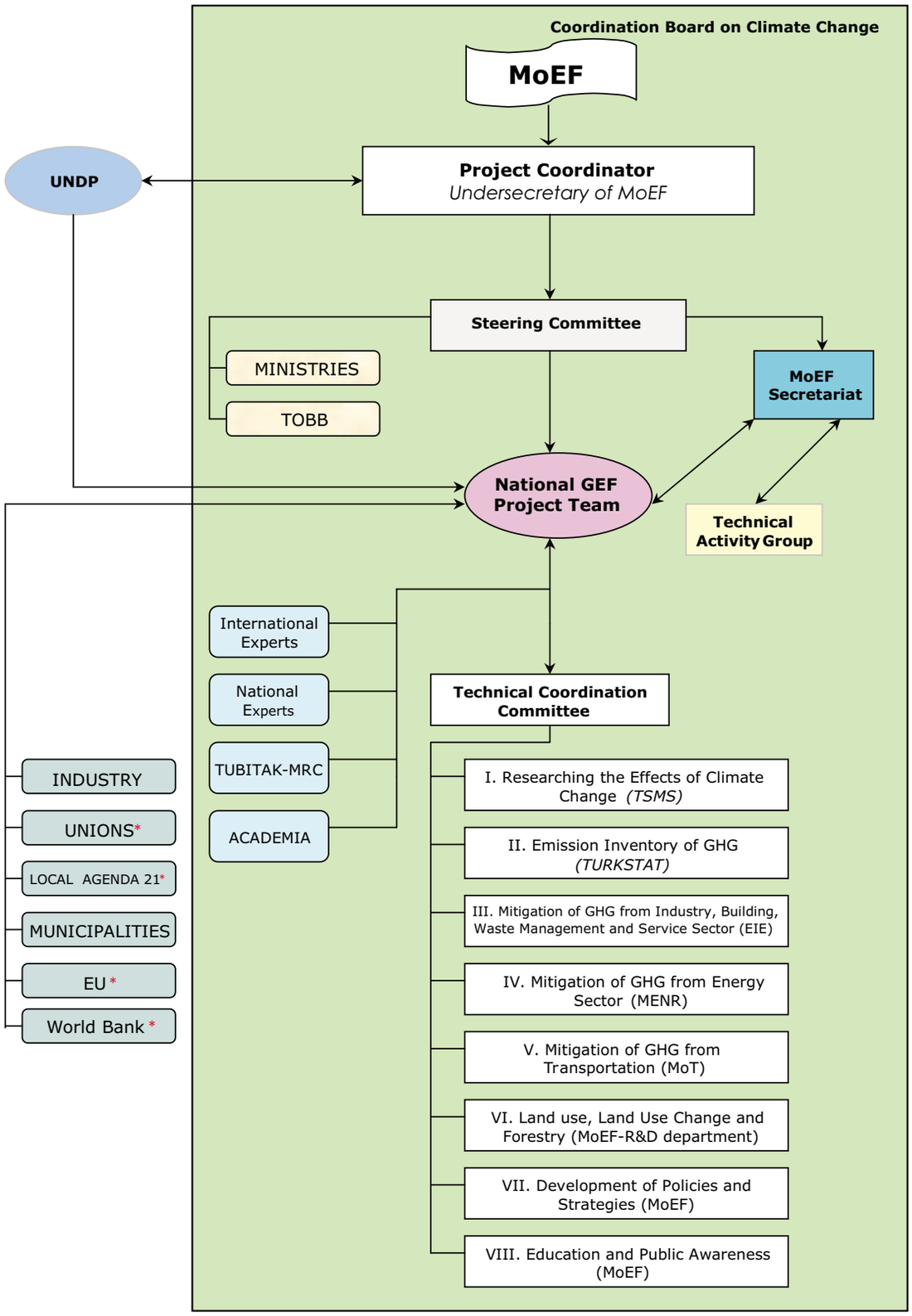
24. The Unions Of Sectors: The unions like The Union Of Association and Stock Exchanges, The Associations Of Industry, The Associations Of Commerce, or sectoral unions like The Union Of Cement Producers, The Union Of Lime Producers, are responsible for informing, application and auditing of applications about the laws.

25. The Research Groups : The Scientific And Technological Research Council of Turkey(TUBITAK),Turkish Technology Development Foundation(TTGV) are the institutes and research centers of universities and other research institutes are responsible for giving consultancy services by following the technologies and developments on environment pollution and control

26. Non Governmental Organizations: These are organizations formed by civil initiative, financed by the public and non-profit. TEMA, ÇEVKO, Deniz Temiz (TURMEPA), DHKD, BÇM are examples of these institutions.

ANNEX-2 The Institutional Framework of the GEF Project for Preparation of FNC of Turkey and the Outputs of the Project

ANNEX-2 The Institutional Framework of the GEF Project for Preparation of FNC of Turkey and the Outputs of the Project



Abbreviations illustrated in the parenthesizes stand for coordinator institution title of working groups

Concrete Outputs of the GEF Project

Output 4.1.1. Identification and evaluation of the "special circumstances and commitment scenarios" of Turkey in accordance with social, economic, geopolitical and environmental indicators, i.e.

Output 4.1.2. Identification of policy making tools and modeling various scenarios in terms of potential adaptation programs with outputs of cost-benefit analysis to feed into special circumstances of Turkey

Output 4.2.5. Building IT capacities of the emission inventory working group

Output 4.2.6. Collection and estimation of the inventory data related to the gases of HFCs, PFCs, SF6 , CO, NOx, NMVOCs and SOx

Output 4.2.7. Enabling studies for emission estimation in the areas where below mentioned bottlenecks encountered and for rapid, reliable, continuous data collection, emission estimations based on relative factor values identified

Output 4.2.8. Enabling inventory studies in terms of producing reliable database used as basis in the course of estimations of energy efficiency projections of industry and building sectors

Output 4.2.9. Improvement of present emission calculation techniques and methodology, and conducting evaluation studies in order to define quality and uncertainty status of data values produced

Output 4.2.10. Process a model for estimation of energy demand in households

Output 4.2.11. Use available model producing inventory outputs for fuel, vehicle type, size class and technology according to transportation modes such as model

Output 4.3.1. Investigation of future energy types of GHG and determination of technical implementation on energy scenarios under an integrated system analyzing model (In terms of preserving time and financial sources, re-processing of ENPEP model for is proposed for the years requiring projections.)

Output 4.3.2. Energy sector development scenarios for GHG reduction

Output 4.3.3. Developing national energy policies based on cost-benefit evaluation of energy alternatives

Output 4.3.4. Monitoring energy consumption and efficiency activities of Industry

Output 4.3.5. Policy identification in terms of GHG abatement measures and preparation of an activity schedule including monitoring phase for policy implementations and estimation of potential GHG reduction values based on current policies and alternative scenarios on the Industry, Building, Waste Management and Service sectors

Output 4.3.6. Conduct the model analyses 'total energy cycle' in order to estimate per mile energy cycle emission and energy use of both near and long-term transportation technologies

Output 4.3.7. Determination of a method for estimation of emission reduction rates for an average railway and highway construction and rehabilitation project in order to identify national transport policies

Output 4.3.8. Assessment of physical and economic impacts of climate change on LULUCF and also effects of LULUCF to climate change, development and strengthening of existing models (Modeling of changes and trends in land degradation, afforestation and reforestation)

Output 4.3.9. Establishment of bio-physiologic and economic models for improvement of agriculture, forestry and water management, expansion of applications of the existing models (Sustainable forest management and agricultural development, development of good practice codes in farming on affected areas, formulation of pilot projects for integrated sustainable rural development

Output 4.4.1. Identification of impacts on human and natural systems based on three global climate scenarios (temperature variation, rainfall, agriculture and biodiversity, soil, temperature, water resources, human settlements, human health)

Output 4.4.2. Assessing national vulnerability and abatement measures on the basis of local and global impacts in socio-economic area (economical growth, technology, population and governance) and searching for appropriate climate change adaptation measures

Output 4.4.3. Formulate and promote an overall system to provide long-term systematic data and information

Output 4.5.1. Designing an active climate change web page and enabling sustainability of info-flow for continuous updating
Output 4.5.2. Strengthening capacities of interactive mail groups

Output 4.5.3. Establishment of Climate Change Library Room

Output 4.5.4. Organization of a workshop between institutions and industrial unions as to ensure capacity building in the areas of scientific and technical potential and institutional relations

Output 4.5.5. Provide training for TAG members in 'Communication Management Techniques' in order to strengthen efficient and precise relations

Output 4.6.1. Prepare a project proposal for 'National Climate Plan' and activate the project on national scale

Output 4.6.2. Economical evaluation and reviewing of the past indicative years varying with increasing and decreasing emission values

Output 4.6.3. Development of an integrated calculation model for overall projections synthesizes all sectors under same model structure

Output 4.6.4. Evaluation of incentive mechanisms planned to be regulated under the GHG reduction action program and determination of preventive policy tools by taking these mechanisms into account

Output 4.6.5. Organization of four thematic workshop in terms of building cooperation and consensus on ongoing activities for sustainability of programs in different primary industry

Output 4.6.6. Development of public awareness and respective educational program methods and determination of activity schedules in short and long term periods

Output 4.6.7. Organization of informative meeting series informative and updating for the responsibilities and obligations of Turkey and targeted for members of decision making bodies

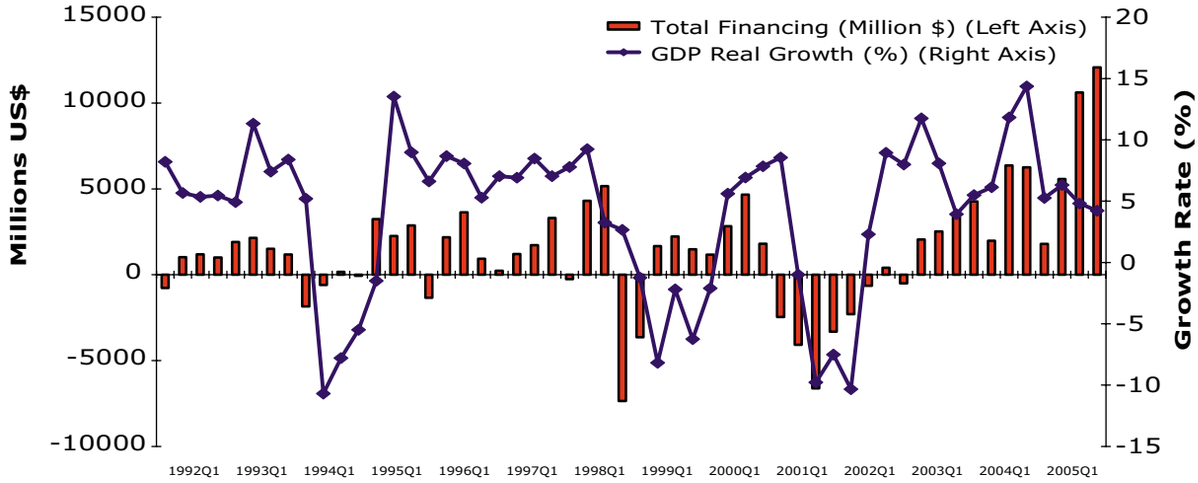
Output 4.6.8. Organization of a Climate Change Slogan Contest among primary school students and awarding 3 top applicable slogans

Output 4.6.12. Maintaining synergy with other relevant projects and programs on combating desertification, preservation of biodiversity, energy efficiency, and energy saving, expanding use of renewable energy sources

ANNEX-3 Macro Economic Indicators and Macroeconomic Phases of the Turkish Economy 1980-2004

ANNEX-3 Macro Economic Indicators and Macroeconomic Phases of the Turkish Economy 1980-2004

Balance of Payments Finance Account + Net Errors and Omissions (Millions $) and Real Growth Rate of GDP (%)



Source: TR Central Bank, www.tcmb.gov.tr

Macroeconomic Phases of the Turkish Economy 1980-2004

	Post-Crisis Adjustment	Export -Led Growth	Exhaustion	Unregulated Financial Liberalization					Financial Crisis	Reinvigoration to Short-Term Foreign Capital-Led Growth			Contagion of World Financial Crisis		Exchange Rate Based Disinflation and Financial Meltdown		IMF-led Post-Crisis Adjustment		
	1981-82	1983-87	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
I. Production and Accumulation (Real Rate of Growth, %)																			
GDP	4.2	6.5	2.1	1.2	7.9	1.1	5.9	8.0	-5.5	7.2	7.0	7.5	3.1	-5.0	7.4	-7.6	7.6	5.8	9.0
Fixed Investment																			
Private Sector	-1.0	14.1	29.2	-6.2	20.6	8.1	3.3	38.8	-9.6	16.9	12.5	10.1	-6.7	-18.8	14.1	-34.9	-7.2	20.3	41.5
Public Sector	4.8	12.0	-2.3	-8.2	6.7	12.7	2.2	14.1	-39.5	-18.7	24.4	30.1	8.0	1.0	20.8	-22.0	14.5	-6.6	3.1
As % of GDP:																			
Savings	17.7	19.5	27.2	22.1	22.0	21.4	21.6	22.7	23.1	22.1	19.8	21.3	22.7	21.2	18.2	17.4	19.0	19.3	22.1
Investments	18.3	20.9	26.1	22.5	22.6	23.7	23.4	26.3	24.5	24.0	25.0	26.3	24.3	22.1	22.8	19.0	17.4	17.6	19.2
Public Sector Borrowing	3.7	4.7	4.8	5.2	7.4	10.3	10.6	12.1	7.9	5.2	8.8	7.6	9.2	15.1	12.5	16.5	12.6	9.4	5.9
Stock of Domestic Debt		3.5	5.7	6.3	7.0	8.1	11.7	12.8	14.0	14.6	18.8	21.4	22.5	29.3	28.7	69.2	54.8	54.6	52.0
I . Distribution and Prices																			
I Inflation Rate (CPI)	33.2	39.5	75.4	64.3	60.4	71.1	66.1	71.1	106.3	88.0	80.4	85.7	90.7	70.5	54.9	54.4	45.0	25.3	10.6
Annual Rate of Change in Exchange Rate (TL/$)	45.0	39.7	66.0	49.0	23.0	60.0	65.0	59.0	170.0	54.0	77.0	87.0	71.7	58.2	28.6	114.2	23.0	-0.6	-4.9
Real Interest Rate on GDIs [a]	..	..	-5.8	-2.7	-4.0	5.3	13.9	9.9	28.6	18.1	31.1	22.1	29.5	36.8	4.5	31.8	9.1	15.4	13.1
Real Wages Growth Rate:																			
Private Manufacturing [b]	0.4	-1.5	-5.7	16.1	22.2	20.2	-5.4	-0.1	-30.1	1.4	-1.4	2.1	0.8	4.9	2.1	-20.1	1.1	5.1	3.9
Public Manufacturing [b]	-0.4	-5.9	-7.8	47.5	18.8	37.1	5.8	-0.9	-18.1	-18.0	-3.2	12.5	4.6	22.5	17.2	-21.0	6.9	-1.1	2.9
III . Internationalization																			
As % Share of GNP:																			
Imports [c]	14.0	15.9	15.8	14.5	14.6	13.8	14.3	16.2	17.8	20.8	23.6	25.2	22.5	21.7	27.2	28.2	30.7	27.4	30.2
Exports [c]	8.5	10.8	12.8	10.7	8.5	8.9	9.2	8.4	13.8	12.6	17.8	17.1	13.2	14.2	13.7	21.7	19.2	21.5	22.2
Current Account [c]	-2.7	-1.9	1.8	0.9	-1.7	0.2	-0.6	-3.6	2.0	-1.4	-1.3	-1.4	1.0	-0.7	-4.8	2.4	-1.0	-3.4	-5.2
Foreign Debt [d]	27.1	37.8	44.8	38.8	32.5	33.6	35.2	37.7	63.2	53.1	55.5	57.3	55.4	69.5	64.4	93.9	76.2	58.5	53.7

Sources: SPO Main Economic Indicators; Undersecretariat of Foreign Trade and Treasury Main Economic Indicators;
SIS Manufacturing Industry Surveys.

a. Annual average of Compounded Interest Rate on Government Debt Instruments deflated by the WPI.

b. Real wages per hour, as reported by the TR Central Bank from the SIS sources.

c. Inclusive of Luggage Trade after 1996.

d. Debt stocks are denominated in TL by using the end-of-year CB sale prices of foreign exchange.

EMISSIONS TRENDS (CO_2)

GREENHOUSE GAS EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	CO_2 equivalent (Gg)														
Net CO_2 emissions/removals	96056	91309	93714	102424	99566	111763	130531	141125	138900	137171	159273	137201	150352	166162	167809
CO_2 emissions (without LUCF)	139594	146545	152932	160908	159104	171854	190668	203723	202713	201712	223806	207379	216433	230987	241884
CH_4	29207	33173	3664	38979	39187	42539	44985	46445	47706	48826	49269	48703	46875	47757	46290
N_2O	1264	2249	4046	4099	2188	6330	6071	4738	5558	5725	5752	4839	5417	5255	5498
HFCs	0	0	0	0	0	0	0	0	0	0	818	871	1419	1807	2229
PFCs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SF_6	0	0	0	0	0	0	374	611	660	517	323	308	447	479	705
Total (with net CO_2 emissions/ removals)	126527	126731	134424	145502	140941	160631	181961	192919	192824	192238	215435	191923	204540	221460	222529
Total (without CO_2 from LUCF)	170065	181967	193642	203986	200479	220722	242098	255517	256637	256637	279969	262101	270620	286286	296605

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	CO_2 equivalent (Gg)														
Energy	132128	137956	144268	150776	148624	160788	178960	191389	190621	190614	212546	196020	204018	218004	227430
Industrial Processes	13071	15223	17231	18591	16930	21644	22453	22167	22621	21447	22232	21197	23420	24125	26448
Solvent and Other Product Use	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture	18473	19043	18843	18618	18315	17974	17984	16838	16704	16743	16135	15768	14771	14796	15178
Land-Use Change and Forestry	-43531	-55233	-59211	-58478	-59522	-60088	-60130	-62594	-63810	-64538	-64521	-70176	-66078	-64822	-74073
Waste	6386	9742	13293	15995	16595	20314	22694	25119	26688	27972	29043	29113	28408	29357	27546
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

EMISSIONS TRENDS (CO_2)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	(Gg)														
1. Energy	126701	132471	138638	145247	143209	155347	173367	185596	185004	185203	207054	190879	198951	212964	222284
A. Fuel Combustion (Sectoral Approach)	126701	132471	138638	145247	143209	155347	173367	185596	185004	185203	207054	190879	198951	212964	222284
1. Energy Industries	34015	36632	41795	40565	47175	47314	51977	58189	64072	69346	76780	79722	74056	74196	76185
2. Manufacturing Industries and Construction	37531	40470	39432	40813	37080	41982	51995	56995	55376	49770	59875	46894	58083	67360	68302
3. Transport	25955	24674	25312	30942	29380	32830	34883	33270	31428	33291	34969	35026	36044	37765	40458
4. Other Sectors	29201	30694	32100	32927	29573	33220	34513	37143	34129	32796	35431	29236	30768	33643	37339
5. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B. Fugitive Emissions from Fuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1. Solid Fuels	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Oil and Natural Gas	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Industrial Processes	**12893**	**14074**	**14294**	**15661**	**15895**	**16507**	**17300**	**18126**	**17709**	**16508**	**16752**	**16501**	**17482**	**18023**	**19601**
A. Mineral Products	11106	12489	12668	13745	14173	14788	15335	15909	16089	15527	15841	15754	16479	16965	18399
B. Chemical Industry	826	736	721	1065	857	964	1013	1041	634	206	153	169	614	602	703
C. Metal Production	961	850	904	851	866	754	952	1176	986	776	758	577	389	456	499
D. Other Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
4. Agriculture	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
A. Enteric Fermentation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Manure Management	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C. Rice Cultivation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Agricultural Soils	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

EMISSIONS TRENDS (CO_2) – Continued

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	(Gg)														
5. Land-Use Change and Forestry	-43538	-55236	-59217	-58484	-59538	-60091	-60137	-62597	-63813	-64541	-64533	-70179	-66081	-64825	-74076
A. Changes in Forest and Other Woody Biomass Stocks	-41661	-55866	-55908	-56301	-57143	-58109	-57919	-60431	-61642	-62515	-62255	-64780	-63368	-64844	-67482
B. Forest and Grassland Conversion	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Abandonment of Managed Lands	-1877	-1877	-1877	-1877	-1877	-1877	-1877	-1877	-1877	-1877	-1877	-1877	-1877	-1877	-1877
D. CO_2 Emissions and Removals from Soil	NE	2507	-313	-200	-440	-52	-114	-78	-155	44	-262	-3515	-821	1896	-4717
E. Other	NE	NE	-1119	-105	-78	-54	-227	-212	-139	-192	-140	-7	-15	0	0
6. Waste	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
A. Solid Waste Disposal on Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
B. Waste-water Handling	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Emissions/Removals with LUCF	96056	91309	93714	102424	99566	111763	130531	141125	138900	137171	159273	137201	150352	166162	167809
Total Emissions without LUCF	139594	146545	152932	160908	159104	171854	190668	203723	202713	201712	223806	207379	216433	230987	241884

EMISSIONS TRENDS (CH_4) - Continued

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	(Gg)														
Total Emissions	**1390.82**	**1579.65**	**1745.93**	**1856.14**	**1866.05**	**2025.66**	**2142.15**	**2211.67**	**2271.71**	**2325.04**	**2346.15**	**2319.19**	**2232.13**	**2274.14**	**2204.27**
1. Energy	**211.13**	**213.27**	**219.56**	**212.54**	**207.26**	**206.10**	**208.93**	**217.63**	**210.22**	**199.63**	**199.45**	**186.17**	**180.38**	**175.61**	**174.48**
A. Fuel Combustion (Sectoral Approach)	143.02	146.04	147.30	143.04	132.54	137.27	136.96	142.00	132.50	124.00	122.46	109.01	111.65	114.08	115.94
1. Energy Industries	0.61	0.60	0.73	0.74	0.83	0.82	0.91	1.01	1.11	1.20	1.42	1.47	1.42	1.41	1.41
2. Manufacturing Industries and Construction	3.02	3.28	3.14	3.23	2.95	3.29	4.39	4.90	4.79	4.28	5.36	4.03	5.14	6.00	6.15
3. Transport	3.37	3.25	3.63	4.24	5.10	5.63	6.05	6.36	6.44	6.54	6.47	6.09	5.89	5.92	5.97
4. Other Sectors	136.03	138.91	139.80	134.83	123.66	127.53	125.61	129.72	120.15	111.97	109.21	97.42	99.21	100.76	102.41
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	68.11	67.23	72.26	69.50	74.72	68.83	71.97	75.63	77.72	75.63	76.99	77.16	68.73	61.53	58.54
1. Solid Fuels	68.11	67.23	72.26	69.50	74.72	68.83	71.97	75.63	77.72	75.63	76.99	77.16	68.73	61.53	58.54
2. Oil and Natural Gas	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Industrial Processes	**2.35**	**2.33**	**2.28**	**2.13**	**2.17**	**2.34**	**2.39**	**2.42**	**2.35**	**2.22**	**2.25**	**2.06**	**2.15**	**2.46**	**2.46**
A. Mineral Products	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Chemical Industry	2.35	2.33	2.28	2.13	2.17	2.34	2.39	2.42	2.35	2.22	2.25	2.06	2.15	2.46	2.46
C. Metal Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Other Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
4. Agriculture	**873.22**	**900.15**	**891.07**	**879.81**	**866.39**	**849.89**	**850.13**	**795.47**	**788.28**	**791.21**	**761.45**	**744.62**	**696.85**	**698.09**	**715.61**
A. Enteric Fermentation	811.75	838.35	830.17	815.43	802.36	784.24	783.13	730.56	716.67	719.41	692.46	674.43	629.75	630.25	641.52
B. Manure Management	29.22	31.48	31.47	31.75	36.59	35.50	35.10	32.72	35.76	38.38	34.38	37.38	33.14	33.24	36.22
C. Rice Cultivation	10.60	8.00	8.60	8.97	8.10	10.00	10.97	11.00	12.00	13.00	11.60	11.80	12.00	13.00	14.00
D. Agricultural Soils	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	21.65	22.33	20.83	22.66	19.34	20.15	20.93	21.20	23.86	20.42	23.01	21.01	21.96	21.61	23.87
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

EMISSIONS TRENDS (CH_4) - Continued

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
5. Land-Use Change and Forestry	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
B. Forest and Grassland Conversion	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Abandonment of Managed Lands	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
D. CO_2 Emissions and Removals from Soil	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**304.12**	**463.89**	**633.01**	**761.65**	**790.22**	**967.32**	**1080.69**	**1196.15**	**1270.85**	**1331.98**	**1382.98**	**1386.33**	**1352.75**	**1397.97**	**1311.72**
A. Solid Waste Disposal on Land	304.12	463.89	633.01	761.65	790.22	967.32	1080.69	1196.15	1270.85	1331.98	1382.98	1386.33	1352.75	1397.97	1311.72
B. Waste-water Handling	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

EMISSIONS TRENDS (N2O)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	(Gg)														
Total Emissions	**4.08**	**7.25**	**13.05**	**13.22**	**7.06**	**20.42**	**19.59**	**15.28**	**17.93**	**18.47**	**18.56**	**15.61**	**17.47**	**16.95**	**17.73**
1. Energy	**3.21**	**3.25**	**3.29**	**3.44**	**3.43**	**3.59**	**3.89**	**3.94**	**3.88**	**3.93**	**4.20**	**3.97**	**4.13**	**4.36**	**4.78**
A. Fuel Combustion (Sectoral Approach)	3.21	3.25	3.29	3.44	3.43	3.59	3.89	3.94	3.88	3.93	4.20	3.97	4.13	4.36	4.78
1. Energy Industries	0.37	0.41	0.48	0.45	0.53	0.52	0.58	0.64	0.69	0.71	0.75	0.76	0.67	0.65	0.67
2. Manufacturing Industries and Construction	0.45	0.49	0.46	0.46	0.43	0.47	0.62	0.67	0.67	0.60	0.75	0.55	0.70	0.79	0.80
3. Transport	0.84	0.80	0.79	0.97	0.98	1.08	1.19	1.10	1.04	1.21	1.33	1.39	1.50	1.69	2.08
4. Other Sectors	1.54	1.55	1.56	1.55	1.49	1.52	1.51	1.53	1.47	1.41	1.38	1.27	1.26	1.24	1.23
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1. Solid Fuels	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Oil and Natural Gas	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2. Industrial Processes	**0.41**	**3.55**	**9.32**	**9.31**	**3.19**	**16.41**	**15.25**	**10.90**	**13.56**	**14.11**	**13.85**	**11.20**	**12.89**	**12.14**	**12.46**
A. Mineral Products	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Chemical Industry	0.41	3.55	9.32	9.31	3.19	16.41	15.25	10.90	13.56	14.11	13.85	11.20	12.89	12.14	12.46
C. Metal Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Other Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
4. Agriculture	**0.44**	**0.45**	**0.42**	**0.46**	**0.39**	**0.41**	**0.42**	**0.43**	**0.48**	**0.41**	**0.47**	**0.42**	**0.44**	**0.44**	**0.48**
A. Enteric Fermentation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Manure Management	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C. Rice Cultivation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Agricultural Soils	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	0.44	0.45	0.42	0.46	0.39	0.41	0.42	0.43	0.48	0.41	0.47	0.42	0.44	0.44	0.48
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

EMISSIONS TRENDS (N_2O) – Continued

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	(Gg)														
5. Land-Use Change and Forestry	**0.02**	**0.01**	**0.02**	**0.02**	**0.05**	**0.01**	**0.02**	**0.01**	**0.01**	**0.01**	**0.04**	**0.01**	**0.01**	**0.01**	**0.01**
A. Changes in Forest and Other Woody Biomass Stocks	0.02	0.01	0.02	0.02	0.05	0.01	0.02	0.01	0.01	0.01	0.04	0.01	0.01	0.01	0.01
B. Forest and Grassland Conversion	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Abandonment of Managed Lands	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
D. CO_2 Emissions and Removals from Soil	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Solid Waste Disposal on Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
B. Waste-water Handling	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

EMISSION TRENDS (HFCs. PFCs and SF6)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	(Gg)														
Emissions of HFCs - CO_2 equivalent (Gg)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	818.43	871.48	1418.94	1806.71	2228.73
HFC-23															
HFC-32															
HFC-41															
HFC-43-10mee															
HFC-125															
HFC-134															
HFC-134a											0.63	0.67	1.09	1.39	1.71
HFC-152a															
HFC-143															
HFC-143a															
HFC-227ea															
HFC-236fa															
HFC-245ca															
Emissions of PFCs - CO_2 equivalent (Gg)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CF_4															
C_2F_6															
C_3F_8															
C_4F_{10}															
c-C_4F_8															
C_5F_{12}															
C_6F_{14}															
Emissions of SF_6- CO_2 equivalent (Gg)	0.00	0.00	0.00	0.00	0.00	0.00	373.84	611.10	659.64	516.81	322.89	308.45	476.76	479.43	704.57
SF_6							1.55	2.52	2.73	2.15	1.26	1.09	1.86	1.65	2.57

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ANNEX-6 Research and Projects on Hydrogen Energy

Hydrogen Projects (UIDO-ICHET Istanbul –Turkey)

a) Status of Hydrogen Demonstration Projects

Title 6a - Hydrogen Fuel Cell Vehicle
Location Istanbul, Turkey
Description: The aim of this project was to design and construct a fuel cell powered race car to participate to the 'prototype vehicles' category in the Shell Eco-Marathon race. The race took place in Nogaro-France between 19 - 21 May 2006. The vehicle was designed and built by the Istanbul Technical University Hydrobee Team in collaboration with UNIDO-ICHET and other sponsor companies. The importance of this vehicle is that it is the first hydrogen fuel cell powered vehicle designed and built completely in Turkey. It is a successful example for hydrogen fuel cell vehicles to be constructed for coming races in the series, which take place each summer. In 2008 the event will be held in Turkey.

The vehicle was powered by a 1.2 kW Ballard Nexa fuel cell and a single 800 W direct drive (hub) DC motor. It used compressed hydrogen gas from a 2 litre, 200 bar hydrogen canister. The total weight of the vehicle was 50 kg. Its three wheels were configured with two at the front and 1 in the rear. The vehicle body was built from kevlar based composites.

Status: The fuel cell vehicle participated in the Eco-Marathon in France on 21st May 2006. It finished in 68th place from among 230 entrants.

Title 6b - Hydrogen Road Map of Turkey
Location Istanbul, Turkey
Description: A hydrogen road map of Turkey has been prepared by UNIDO-ICHET together with interested parties such as the Turkish Ministry of Energy, universities and other research institutes. When preparing the hydrogen road map of a specific country it is necessary to take into account the facts and resources of a country and refer to the ideas of various organisations working in the energy field.

A questionnaire on hydrogen production, storage, transportation and fuel cell development was prepared by UNIDO-ICHET and sent to interested institutions. The hydrogen road map for Turkey starting from 2010 until 2035 was prepared based on the response obtained from the questionnaires. The schematics for the hydrogen production, storage and delivery road map and the hydrogen applications and fuel cell road map are given as an attachment.

Status A first draft of about 120 pages has been completed.

Title 6c - Hydrogen Injection into Natural Gas Pipelines
Location Istanbul, Turkey
Description: While much is known about the transport of hydrogen in steel pipes at high pressure, there is very little knowledge about the suitability of natural gas distribution grids for operation with hydrogen. The purpose of this project is to assess the suitability of existing natural gas pipeline systems for distribution of hydrogen. Hydrogen will be produced from low cost, off peak electricity and injected to natural gas pipelines. The Ambarli power plant will be used in this project as it already uses natural gas to produce electricity and accordingly there is no need to rebuild any pipelines. The system will be monitored for leakage and for the effect of hydrogen on the system components, especially lubrication and sealing compounds, welds, correct reading of gas meters and tightness of fittings in domestic installations. EÜAS will provide low cost electricity, SP Engineering will provide the electrolyser unit and İGDAS will buy the injected hydrogen.

Status Preliminary arrangements have been completed.

Title 6d - Wind-Hydrogen Project
Location Istanbul, Turkey
Description: It is important to produce hydrogen from renewable energy sources not only because of the environmental problems caused by the use of fossil fuels but also the rapidly diminishing supply of petroleum.

Total utilization of the potential of renewable energy resources in isolated locations requires efficient means of energy storage. Hydrogen, generated by the electrolysis of water, could be used as both a storage medium and as a fuel for heating or transportation. Wind energy has become a reliable source of electricity in grid-connected applications during the last decade and is the cheapest method of producing hydrogen utilising renewable sources.

Extracted wind power depends on the wind speed, so producing hydrogen from a wind turbine and storing it for later use, improves system reliability and matches supply to demand. It is also important to demonstrate that industrial applications can benefit from the use of renewable systems. For that reason wind turbines will be installed in a Margarine factory, and hydrogen produced from water using electricity from these turbines will be utilised in the manufacture of margarine. A forklift company will use hydrogen for fuel cell powered forklifts. This system will include an 800 kW wind turbine and a 250 kW electrolyser, in addition to storage facilities. An important consideration is that produced hydrogen must be competitive in terms of cost and quality with the existing sources.

Status The fork lift company is purchasing a suitable fuel cell for their fork lifts.

Title 6e - Solar – Hydrogen Project
Location Istanbul, Turkey
Description: The ultimate hydrogen production system is expected to comprise elements from renewable energy sources such as solar and wind etc. Although the initial cost of PV panels is high, hydrogen production from solar power seems to be one of the cleanest and easiest renewable methods since PV panels provide DC current required for the electrolysis of water. The project objective is to produce hydrogen through photovoltaic electrolysis and use this hydrogen to fuel a small vehicle. The photovoltaic panels will be placed directly on the roof of a car park enabling the produced hydrogen to be pumped easily into cars and other vehicles. The project will demonstrate the clean and local production of hydrogen for both internal combustion engine and fuel cell powered cars.

Status PV panels are ready to install.

Title 6f - Atatürk Airport Bus Project
Location Istanbul, Turkey
Description: This project aims to develop and operate two buses that use hydrogen as fuel at Atatürk Airport, to give service to THY personnel and to carry passengers between the terminal building and aircraft. One of the buses will use a fuel cell/electric motor while the other will use a specially adapted internal combustion engine (ICE). TPAO will produce the hydrogen fuel using steam reforming of natural gas and the produced hydrogen will be stored and transported in steel tanks. TPAO will construct a dispenser unit to supply hydrogen to both buses. Following completion of the project, it is intended to establish an information centre where passengers can be informed about the project and the hydrogen buses. The Atatürk Airport Project will have social, economical and environmental impacts. It will demonstrate the future of clean

transportation systems and the applicability of hydrogen technologies in Turkey. The project will attract the attention of many companies and organisations and may well lead to an increase in hydrogen energy studies in Turkey. Conversely, the disadvantages of fossil fuels and their actual damage to the environment can be readily demonstrated to a popular audience with the realisation that hydrogen is the only effective solution to current and future energy problems.

Status The Bus Manufacturing Company is designing the hydrogen fuelled bus and TPAO is preparing for hydrogen production.

Title6g - Hospital Oxygen-Hydrogen Project
Location Ankara, Turkey
Description: In the scope of this project, hydrogen and oxygen will be utilized in different sections of Ankara hospital, and produced via electrolysis using off peak electricity. Hydrogen will be bottled for used as an energy source in the kitchens and as a fuel for the ICE engine ambulance. Oxygen will be used in various departments of the hospital.

Production of hydrogen and oxygen inside the hospital during off-peak hours when the electricity cost is low will have various advantages. First of all, it will be demonstrate that hydrogen can safely be used in buildings as well as in ambulances. Secondly, there will be no need to buy oxygen from industry, since oxygen will be produced via electrolysis together with hydrogen. Other hospitals can be encouraged to initiate similar projects and this can speed up the transition to the hydrogen economy in Turkey.

Status Funding is being sought.

Title 6h - Biomass-Hydrogen Production
Location Istanbul, Turkey
Description: The current store of photosynthetic energy in biomass is huge although its efficiency is low. The annual increase of photosynthetic energy amounts to about ten times the world's total energy requirements, particularly in developing countries where over 2 billion people depend on biomass as their primary source of energy. Additionally it is environmentally friendly as it results in no net increase of CO_2 in the atmosphere.

The Turkish climate and the land are suitable for plant growth. Therefore the use of biomass for energy production is expected to contribute to sustainable energy development with minimised environmental damage as domestic resources are utilised. Sweet sorghum can be cultivated under different climatic conditions and is considered a promising crop with the potential of multiple energy uses. It has high calorific value and a CO_2 balance close to zero. The realisation of this project will lead to significant reductions in the emissions of greenhouse gases.

Sweet sorghum appears to be a most suitable energy source for Turkey. Turkey has over 77 million hectares of land, of which at least 5% can be used for cultivation of energy plants. Recently, extensive research has been made in the EU and elsewhere to explore biomass productivity and energy potential of sweet sorghum under various environmental conditions and cultural practices. Sweet sorghum can provide 2-3 toe per hectare of ethanol every year from sugars and 6-9 toe of fuel from biogas. The biological production of hydrogen also shows great promise for pure hydrogen streams with high hydrogen yield. The project is now in its preliminary stage and will demonstrate production of hydrogen from biomass. Negotiations with parties interested in this project are continuing.

Status Funding is being sought.

Title 6i - Internal Combustion Engine Type Tractor Project
Location Ankara, Turkey
Description: A tractor constructed by a tractor company will be powered by hydrogen fuel provided by TPAO (Turkish Petroleum Company) and use an internal combustion engine specially adapted for this purpose. The technology of the internal combustion engine is seen as a "corner stone" in Turkey's challenging journey towards transition to the hydrogen economy. Fuel cells are not as yet fully commercially available and suffer with high cost per kW power output. Internal combustion engines on the other hand are not only an established technology but are ubiquitous having been available for over 100 years and are correspondingly cheaper. This demonstration project is intended to lead the way for Turkish industry to investigate the technologies needed to convert internal combustion engines to run on hydrogen in real and relevant applications. Agricultural tractors were selected as a suitable case applicable to the needs of a large sector of the Turkish economy.

Status Partners have agreed and started to work on the Project.

Title 6j - Fuel Cell Powered Fork-lift Project
Location Adana, Turkey
Description: The project is a joint venture involving forklift manufacturing company and United Oxygen Industry, and aims to realise the utilisation of fuel cells of 5 kW power in forklifts. A prototype will be developed around an appropriate fuel cell. Hydrogen will be supplied by electrolysis of water.

BOS has participated in several hydrogen energy related activities and applications, and has provided hydrogen for the first hydrogen fuelled car in Turkey, the Hyundai Tucson. It was a high profile contributor to the International Hydrogen Energy fair organized in 2005 as part of the IHEC-2005 conference held in Istanbul.

The Hydrogen-Forklift Project aims to demonstrate the successful and feasible utilisation of hydrogen in forklift trucks with the active involvement of two large companies with considerable experience in this field. The advantages of hydrogen as an environmentally benign and renewable energy carrier as opposed to the standard lead acid types of accumulators commonly used in forklift trucks will also be investigated.

Status Forklift manufacturing company has initiated the project

Title 6k - Hydrogen House Project
Location Denizli, Turkey
Description: The objective of this project is to display a demonstration house independent of the power grid, generating its own power using several means of alternative and renewable energy systems based on hydrogen and solar technologies.

This project is also in receipt of a 400,000 USD grant from the Turkish State Planning Organisation.

The main goals of the project are: achieving a system that is a combination of PV and electrolysis technologies to produce hydrogen; storing hydrogen safely; and using hydrogen in fuel cells. Material research, energy losses and balances and operational experience will be important aspects of the project investigations. The system will consist of photovoltaic panel arrays coupled to a PEM fuel cell system with a gas management system for hydrogen storage and deployment. Safety issues are met by the system being equipped with hydrogen sensors that can set acoustical and optical alerts.

Status The Turkish State Planning Organization has allocated full funding for the project and PV cells will be ordered shortly.

Title 6l - Sea–Taxi Project
Location Istanbul, Turkey
Description: The air qualities of Istanbul have been suffering as industrial and domestic sources burn huge quantities of fossil fuels CO2 and NOx emissions is certainly to be expected.

Sea taxis are a proven viable alternative solution to the problems of Istanbul traffic since they carry passengers, relieving significant traffic congestion on the city's road-based transport system. Being relatively small in size and power, they provide an ideal demonstration platform for the viability of the hydrogen energy approach. This project will convert a sea taxi for use with hydrogen, providing suitable refuelling and service facilities to enable a taxi full service to be provided. Status A private boat company has initiated the project.

Title 6m - Kocaeli Municipality Bus Project
Location Istanbul, Turkey
Description: The increasing number of transportation vehicles leading to high values of air pollution have constituted the core reasons for the project, which aims to convert to hydrogen usage, two buses and an ambulance in Kocaeli. In this project, Kocaeli Municipality is partnered by UNIDO-ICHET and Bus Manufacturing Company.

Internal combustion engines will be purchased and integrated into both the buses and the ambulance. Fuel injection systems, storage systems, fuel flow, emission measurements and combustion parameters will be studied as part of the research and development programme. Hydrogen production, storage and delivery regimes will be assessed along with maintenance

schedules. Daily hydrogen production requirements will be determined according to the consumption levels of the vehicles. Demonstrating the safe and clean utilisation of hydrogen in transportation and the high efficiency of hydrogen-fuelled vehicles are among the expected major results of the project. Based on the experience and know-how obtained from this project, it is expected that there will be fresh investment into hydrogen-fuelled vehicles in other cities in Turkey. Among the benefits this project is expected to bring are a significant decrease in air pollution as a result of utilizing hydrogen as a fuel and that public awareness of importance hydrogen energy will be increased. It is hoped that it will constitute a significant example of the

Status Funding proposal has been prepared and submitted to the Turkish Scientific and Research Council.

Title 6n - Small Hydro-Hydrogen Production Project
Location Istanbul, Turkey
Description: In this project, the objective is to produce hydrogen from excess electrical capacity and inject the produced hydrogen into natural gas pipelines. The collaborative organisations comprise some of Turkey's leading companies with core competences in the fields of energy generation and distribution.

There is a class of small and medium sized hydro power stations used in remote areas, either to supply regional demand and/or connect to the grid to provide peak demand. Excess power in the stations is available for use in hydrogen production by electrolysis of water. The hydraulic power-electrolyser system studied consists of a small hydro power plant and an electrolyser system. The hydro power systems are mostly used to supply local electrical energy needs and provide peak power for grid connected systems, and include the necessary dam, intake and discharge subsystems, buildings, hydraulic and electrical machines. The electrolyser system is a “turn-key” installation consisting of electrolyser cells and water treatment unit.

If required the generated hydrogen can be compressed or delivered at process pressure. The produced hydrogen will inject into natural gas pipelines close to the hydro power plant.

Title 6o - Fuel Cell Powered Unmanned Airplane Project
Location Ankara, Turkey
Description: The goal of the project is to design an autonomous power generation system that uses a regenerative fuel cell in a satellite system and unmanned aerial vehicle. In the scope of the project, hydrogen will be produced from water using electrolysis, with electric power for the electrolyser, provided by single crystal silicon solar cells. Sodium borohydride will be utilised both as a hydrogen source and a storage facility. Hydrogen will be used to meet the power demand of the satellite system and unmanned aerial vehicle.

Upon completion of the project, the demand for regenerative fuel systems in satellites and unmanned aerial vehicles will be met, the technological basis for the usage of photovoltaic/solar batteries in space studies will be established and the technology of hydrogen production from sodium borhydrite and electrolysis will be better understood. Lastly, after approval of the system integration, the developed regenerative fuel cell system will be used in satellites and aerial vehicles, sea/land vehicles, home appliances, trade/military applications and other fields.

Status: Full funding is expected from the Ministry of Defence.

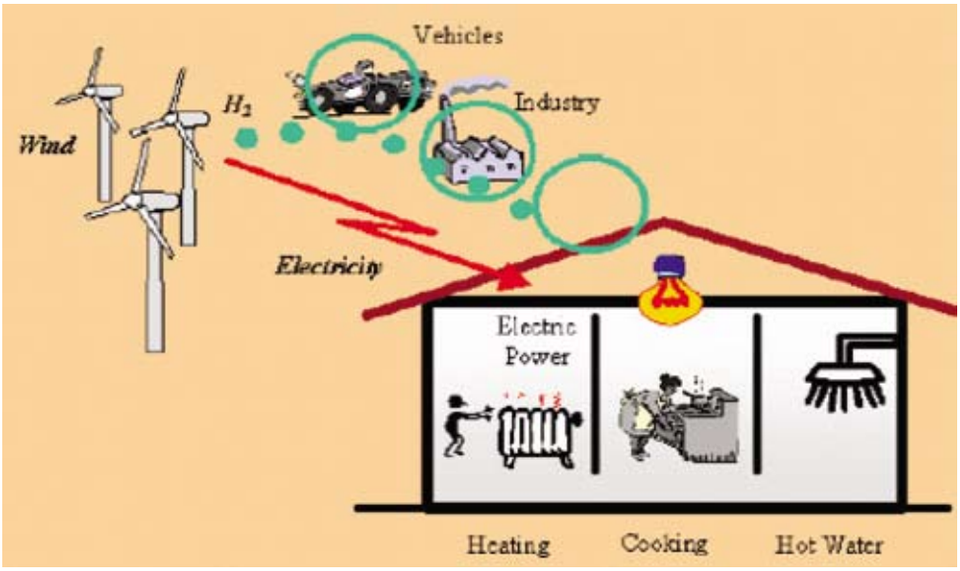
Status: The engineering report is in preparation.

Status: The engineering report is in preparation.

National Pilot Projects

Title: 5k - Bozca Island Wind-Hydrogen - Turkey
Location: Bozca Island, Turkey
Description: The concept consists of a large-scale integrated wind-hydrogen energy system designed to meet all energy demands of approximately 3000 residents living in Bozca Island, Turkey. The energy system will utilize renewable-based hydrogen production through water electrolysis, delivery through trucking, and utilization through pure catalytic hydrogen combustion in a residential district where homes will be equipped with hydrogen compatible appliances and energized by hydrogen gas. Bozca Island is one of the locations with the highest wind capacity of Turkey, having 9.8 m/s average wind speed, classified as "superb" according to the US-DOE wind-capacity classification. Most importantly, the island has already a wind power plant consisting of 17 turbines and 10.2 MW capacity. A private RES COMPANY established the power plant in 2000. The company has already invested US$13,200,000 to establish the plant and put it into service. The average annual wind electricity production rate is about 37.75 GWh. Of this amount, 5% of the energy is used to meet all electric energy demands of the island; the remaining 95% is transmitted to Canakkale City, one of the cities on the west cost of the mainland of Turkey. The company is interested in being an integral part of the large-scale energy system proposed by the subject matter project. The technical analysis showed that Bozca Island could be 100% self-sustained and emission free residential island. Due to many challenges and limitations, the entire project can be realized through several phases. The first phase that will take five years should focus on utilization of hydrogen in daily life at homes. The other phases can handle converting transportation vehicles, farming equipment as well as electricity generation through employing hydrogen driven fuel cells.

Status: The UNDP/GEF proposal is pending submission



Title: 5l - Hydrogen Fueled Buses - Turkey
Location: Istanbul, Turkey
Description: Istanbul Hydrogen Project (H2 Istanbul) addresses the state of the art in using advanced technologies for transportation to reduce greenhouse gas emissions (GHG) from ground transport in the Metropolitan Area of Istanbul.

Hydrogen fuelled vehicles in this respect hold the potential for reducing transport emissions and energy inefficiencies in the next decades which constitute more than 20% of total global emissions. A small hydrogen fuelled bus fleet comprising of twelve urban city buses will be operated in Istanbul Metropolitan Municipality (IMM). Eight of the buses will use fuel cells and four will be powered by internal combustion engine and heavy-duty batteries. Hydrogen will be generated on site by a small steam methane reformer unit. The total demonstration trial period will be five years. The major objective of the project is to support Turkey and surrounding developing countries to implement hydrogen based zero emission bus technologies for reducing local air pollution and global GHG emissions starting with urban public transport market. The project will also provide a valuable information and feedback to the international communities that are already implementing hydrogen fueled transportation systems. The GEF Operational Programme is OP.11 Sustainable Transport.

Status: The UNDP/GEF proposal is pending submission

b) Status of Hydrogen Pilot Projects

The entire International project Directors are financed and identified by UNIDO-ICHET to prepare engineering reports and a Financing Proposals. The project Directors work in collaboration with UNIDO –ICHET.

Title: 5a - Wind-Hydrogen - Argentina
Location: Patagonia, Argentina
Description: An experimental demonstration plant for hydrogen production using water electrolysis is being constructed under an agreement between the Municipality of Pico Truncado (province of Santa Cruz, Patagonia Argentina) and the Asociación Argentina del Hidrogeno (Argentine Hydrogen Association). It is proposed to utilize the wind and hydrogen produced by this facility to provide energy for Koluel Kayke, a small town with some 500 inhabitants, situated 23 km south west of Pico Truncado. In addition to basic experimental research, this venture is expected to supply technical training and increase public awareness of the benefits of using hydrogen as a clean and renewable fuel by replacing conventional energy applications with clean alternatives. It is intended that the whole village including all domestic, municipal, agricultural and transportation activities operate using entirely renewable energies. This project is designed to reduce the risks of global climate change while providing energy for sustainable development, removing barriers to energy efficiency and energy conservation and reducing time implementation costs.

Status: A GEF proposal form (PDF A for Medium sized projects) has been submitted to UNIDO-ICHET, but is waiting for accompanying documentation. In lieu of an engineering report, a concept paper has been submitted. The local authorities have already installed the wind mills for electricity generation. Partial Funding will be requested from GEF through UNDP for hydrogen production to meet the local fuel needs

Title: 5rb - Hydro-Hydrogen - Azerbaijan
Location: Kuba-Khachmas, Azerbaijan.
Description: A planned hydro-electric generation plant is expected to have surplus capacity. It is intended to use 500 kW of this surplus to produce gaseous hydrogen via water electrolysis for industrial purposes. The Niyazoba Hydropower Plant has 2,100 kW in total capacity. Norsk Hydro electrolyzer plant with a size of approximately 500 kW will be used to produce hydrogen. The proposed plant will generate an estimated 82 normalized cubic meters of hydrogen gas per hour (Nm3 hr-1, or 7.4 kg-hr-1) and 1968 Nm3 day-1 (176.9 kg-d-1). The plant can be stopped and started at any time, is automatic and the production can be regulated down to 20%. The electrolyser can therefore operate at between 20-100%, allowing for variations in the quantity of electricity available to generate hydrogen. The regulating range of the electrolyser (20 to 100%) does not affect the gas quality. The offered electrolyser capacity can easily be increased to between 100-150 Nm3 hr-1 by extending the foundation and adding more cells (the modern electrolysis cells consume 5-6 kWh for each Nm3). The hydrogen produced by the electrolyser is compressed and stored in a container that can hold up to 2,400 Nm3 of hydrogen gas. This is sufficient for two full days of energy supply to the households in the autonomous system. The plant will generate approximately 41 normalized cubic meters of oxygen gas per hour (Nm3 hr-1).

Status: The funding report is in preparation. The same questions for all project mentioned below
Title: 5c - Hydro-Hydrogen - China
Location: Youtang, China.
Description: An existing 3 MW hydropower station situated in Gansu Province of China is to be used to produce and store hydrogen during off-peak times. The hydrogen will be utilized by selected local industrial and domestic clients. Status: The original project director resigned during 2005 without completing the funding proposal. In the interim and until a new director can be appointed, Dr. J. Sheffield of ICHET is deputizing.

Title: 5d - Biological Hydrogen - India
Location: Hyderabad, India
Description: A 135-tonne/day biohydrogen pilot plant is proposed for a total project outlay of US$ 58 million to encompass all production parameters optimisation of an end-to-end solution platform. The techno-commercial assessment clearly shows that it is scientifically feasible and would be commercially viable once scaled up. This will also demonstrate the proof value as the most economical hydrogen production path. The cost targets at the end of process optimisation expected is $1.10/kg of hydrogen. From the financial analysis, it is clear that the 135-tonne/day is the minimum size of the pilot plant to demonstrate

the “Proof-Of-Value” for biological hydrogen production. Anything smaller than this size would only provide “Proof-Of-Concept” but would not be commercially viable. To accomplish the project goal of biological hydrogen production (high rate and yield) from biomass, the process brings about the followings: Development of dedicated and engineered energy crops (sweet sorghum & sugar beet) with high sugar, large biomass with less lignin; process development for (except lignin) all the components of the biomass to optimally convert into sugars followed by two stage fermentative process to covert all the sugars to hydrogen. Additional hydrogen production would be targeted via gasification of lignin. Further scientific challenges involves in the engineering of different organisms required in the entire process and synchronization of all the process involved. In many areas, critical equipments and machinery design will be essential for the optimisation of the upstream and downstream process development.

Status: The UNDP/GEF proposal pending submission.
Title: 5e - Hydrogen Fueled Tri-wheeled Vehicles - India
Director: Dr. Lalit Das, Indian Institute of Technology
Location: New Delhi, India
Description: The project proposes a two and a half year duration hydrogen internal combustion based vehicle development and field trial project. In Phase I of the project, six hydrogen compatible three-wheelers would be retrofitted for a 30 month field test. During Phase II of the project, hundred three-wheelers would be demonstrated for 36 months to gain operation and maintenance experience of the hydrogen compatible three-wheelers and the hydrogen fueling infrastructure. It would also demonstrate hydrogen fuelling infrastructure and hydrogen production from renewable glycerin technology. The major objective is to introduce hydrogen vehicles on Indian roads for reducing local air pollution and global greenhouse gas emissions. It will assist the Indian transport sector to gain capability of manufacturing, operating, and servicing hydrogen vehicles under local conditions. It will also help create an initial volume demand and provide useful feedback of operating experience for the hydrogen vehicle developers/manufacturers to further improve the vehicle design and reduce the vehicle cost. The project is consistent with the terms of GEF Operational Program 11.

Status: Partial Funding will be requested from GEF through UNDP for hydrogen production to meet the fuel needs of three wheelers in Delhi.

Izmir Location: Misurata, Libya
Description: The core of this solar-hydrogen project is the proposed 1.0 MW solar photovoltaic (PV) cells installed capacity of mainly single-crystalline silicon cells. Few arrays of polycrystalline and amorphous silicon cells are proposed for studying, testing, and evaluating in the Libyan environment. 246 kW of the electricity generated by the PV cells will be used for sea water desalination. 593 kW will be connected for the electrolyser, for hydrogen production, through DC/DC power conditioning; and the remaining 161 kW, will be used to supply the community with electricity during day time and to compress hydrogen and oxygen and for other services. Excess electricity and desalinated water will be sold to the local grid and water-supply authorities. The community, or end users, of the project are envisioned to consist of 20 pre-selected families (100 persons) living in new houses, mostly engineers and technicians who are working in steel industry, near the project site. So they can be trained to maintain the new technology in their homes and around them. The cost of desalinated water, using RO, depends to a certain level on plant size and cost of electricity. For this project the plant capacity is relatively small (100 m3/day), so the estimated capital cost is about $0.434 million. ($1.32/m3 for 10 years of production and 1.0% for O&M), which is cheaper than the bottled water that is sold to the public at an average price of $0.06/litre. The project-desalinated water could be sold to the public at a much cheaper price of $0.01/litre.

Status: The funding report is being prepared. Partial Funding will be requested from GEF through UNDP for hydrogen production and fresh water production.

Title: 5g - Wind-Hydrogen - Morocco
Location: Rabat, Morocco
Description: In this project, hydrogen will be produced by sea water electrolysis using electricity harnessed from the strong trade winds experienced along coastal Morocco. The economics of hydrogen distribution against electrical distribution by power grid will be investigated. This project is to be an adjunct to an existing GEF sponsored project. As a benchmark, assuming a wind turbine spacing of only 2.4 MW/km² over the 2000 kilometers of coastline from Morocco to Mauritania, a production of more than 1000 TWh per year could be achieved. This would be sufficient to cover close to half of the entire electricity needs of the European Union (2300 TWh). Noting that 54 MW of rated capacity has been operation since the year 2000, the Koudia Al Baida Wind Park located next to the city of Tetouan, represents one of the largest single production units

on the continent. Thus the existing Euro-Mediterranean economic framework will enable this vast wind energy source to become one of the main economic drivers of a sustainable development for the entire region. Taking advantage of the relative proximity of both continents to tap into a widely available clean and renewable power source serves two complementary objectives, namely to satisfy growing European energy needs while strengthening the integrated economic take-off, social and industrial development of North Africa.

Status: The engineering report is in preparation. Partial Funding will be requested from GEF through UNDP for hydrogen production to meet the local fuel needs.

Title: 5h - Geothermal-Hydrogen - Portugal
Location: Azores, Portugal
Description: The renewable electricity and hydrogen project for Terceira will be spread through three major production Campus: i) The "Serra do Cume" hill campus, ii) The "Industrial Park of Angra do Heroismo" Campus and iii) the "Praia da Vitoria Hydrogen Complex and Hydrogenopolis" Campus. The "Serra do Cume" Campus will be mainly devoted to the large scale generation of hydrogen, using wind energy and to stationary storage of hydrogen and oxygen. The two gases will be delivered by pipeline to the "Industrial Park of Angra do Heroísmo", which is placed some 3 km away from the hydrogen production field. At this Industrial Park we will install and hydrogen - electrical power station that will deliver renewable electricity on demand and CoGen hot water and/or steam on demand to some of the industries installed there. The future geothermal field and power station will be placed some 10 km away from this Industrial Park. At the Praia da Vitoria Hydrogenopolis campus, there will be also a hydrogen and oxygen generation unit (through wind and ocean wave resources) with local stationary storage. Also a small biogas unit for methane generation will be installed solely for research purpose. This Hydrogenopolis will include several demo/ research subunits.

Status: The first draft of the funding proposal was not in a format suitable for submission to GEF and revisions have been requested. Partial Funding will be requested from GEF through UNDP for hydrogen production to meet the local fuel needs.

Title: 5i - Biomass Hydrogen – Romania
Location: Constanza, Romania.
Description: The vast quantities of biomass material available around the Danube delta are to be assessed in terms of their potential as a raw material for the production of hydrogen. Methods of hydrogen production, purification, storage and distribution will be investigated along with an analysis of possible end-user applications

Status: The engineering report is in preparation. Partial Funding will be requested from GEF through UNDP for hydrogen production.

Title: 5j - Hydrogen Fueled Vehicles – South Korea
Location: Gwanju, South Korea
Description: This project proposed to operate, demonstrate and analyze 10 fuel cell transit buses (city and highway) and 8 taxis in South Korea. Hydrogen is proposed to be produced by electrolysis from solar energy (1,700 kW and 900 kW units) and wind energy (1,000 kW) energy sources. An additional goal is the establishment of a new "Hydrogen Highway" in South Korea. Project plans include the construction and operation of four hydrogen fueling stations. Finally, project plans include the development of a hydrogen energy education and R&D program. Safety codes and standards have repeatedly been identified as a major institutional barrier to deploying hydrogen technologies. Hence, these safety efforts will be harmonized with International Electrotechnical Commission (IEC), International Organization for Standardization (ISO) and Global Regulation on Pollution and Energy (GRPE) programs.

Status: The project director is continuing to seek backing from various Korean companies, local authorities and the national government. Once suitable commitment has been obtained, the proposal will be submitted to GEF. Partial Funding will be requested from GEF through UNDP for hydrogen production for transportation use.

ANNEX-7 List of Pictures and Paintings

Chapter 1
From left to right

Symbol of the Hittites who were the ancient people lived in the Anatolia (Anadolu)
Turkey's touristic icon
Mountain Nemrut, listed under UNESCO World Heritage List

Chapter 2
From left to right

Turkish style glazed ceramic
A view of the Bosphorus (Bogazici) and the Bosphorus Bridge
Atatürk (Father of the Turks), the founder and first president of the Turkish Republic

Chapter 6
From left to right

Flamingo birds in one of the lakes home to the largest flamingo colony in Turkey
Flooded city center on the North Sea region of Turkey
Snowdrop flower - Galanthus nivalis

Page 166, A view from the Gokova Bay
Page 175, A flamingo on Agean Region of Turkey

Chapter 9
From left to right

by Özge H. AYDOĞAN , Ö. İlkem Primary School, ANKARA; among 4th-5thlevel classes, mansion prize
by Mehmet Ali Dilek, Yeni Mutlu Primary School, ANKARA; among 4th-5thlevel classes, second prize
by Medine KENDİRCİOĞLU, Yeni Mutlu Primary School ANKARA; among 3rdlevel classes, third prize

page 217, on left: Tilbenur MERT, Şehit Öğretmen Kubilay Primary School, ANKARA, among 4th-5th level classes, first prize
page 217, on right: Özge KAHRAMAN, Altınordu Layıka Akbilek Primary School, ANKARA among 3rd level classes, second prize

page 228, Celebration of World Environment Day by MoEF in 2006

ANNEX-8 Glossary and Units

Glossary

ANL	Argonne National Laboratory
AP42	Compilation of Air Pollutant Emission Factors
APF	Adaptation Policy Framework
ARAL-KUM	Desertification of the Aral Sea Region: A Study on the Natural and Anthropogenic Impacts
ARBIS	Researcher Information System
ASAP	The Automated Shipboard Aerological Programme
BALANCE	Energy Supply and Demand Analysis Module of ENPEP
BAT	Best Available Technology
BOF	Basic oxygen furnaces
BOREN	National Boron Research Institute, Turkey
BOTAS	Turkish Gas Company
BSEP	Black Sea Environment Program
$CaCO_3$	Calcium carbonate
CAMP	Coastal Area Management Program
CBCC	Coordination Board on Climate Change
CEEESA	Center for Energy, Environmental, and Economic Systems Analysis
CEVKO	Environmental Protection, Packaging Waste Recovery and Recycling Trust
CFBC	Circulating Fluidized Bed Combustion
CFC	Chlorofluorocarbon
CH_4	Methane
CHP	Combined heat and power production (co-generation)
CIESM	International Commission for Scientific
CITES	Exploration of the Mediterranean Sea Convention on International Trade in Endangered Species
CNG	Compressed natural gas
CO	Carbon Monoxide
CO2	Carbon Dioxide
CoHE	Council of Higher Education
CONGEN	WASP Configuration Generator
COP	Conference of Parties
CRF	Common Reporting Format
CSE	cost of saved energy
CYG	General Directorate of Environmental Management
DAM	Decision Analysis Module of ENPEP for Windows
DEU	Dokuz Eylul University
DHKD	Turkish Society for the Conservation of Nature
DLH	General Directorate of Railways, Harbours and Airports Construction
DSI	General Directorate of State Hydraulic Works
DSM	Demand-side management
EAFs	electric arc furnaces
EBRD	The European Bank for Reconstruction and Development
EC	European Commission
ECMWF	European Centre for Medium-range Weather Forecasts
ECOMET	Economic Interest Grouping of the National Meteorological Services of European Economic Area
EE	Energy Efficiency
EEA	European Environment Agency
EIE	General Directorate of Electrical Power Resources Survey and Development Administiration
EIGM	General Directorate of Energy Affairs
EIONET	Environmental Information and Monitoring Network
EMRA	Energy Market Regulatory Authority
ENPEP	Energy and Power Evaluation Program
ERA	European Research Area
ESCO	Energy Service Company
ESEAS	European Sea Level Service
ETU	Economy and Technology University
EU	European Union
EUAS	Electricity Generation Corporation
EUMETSAT	European Organisation for the
EUROGOOS	Exploitation of Meteorological Satellites European Global Ocean Observing System
EU FP6	European Union Framework Program- 6
FAO	Food and Agriculture Organization
FGD	Flue Gas Desulphurization
FLUXNET	Integrating Worldwide Co2 Flux Measurements
FNC	First National Communication
GAP	Southeast Anatolia Project
GAW	Global Atmosphere Watch
GCM	Military Commander of Mapping
GCOS	Global Climate Observing System
GDP	Gross Domestic Product
GEF	Global Environment Facility
GERD	R&D expenditures, as percent of GDP
GHG	Greenhouse Gas
GLOSS	Global Sea Level Observing System
GNP	Gross National Product
GOMOS	Data acquisition modules within the scope of the ENVISAT project
GOOS	Global Ocean Observing System
GSN	GCOS Surface Network
GTN-G	Global Terrestrial Network for Glacier
GTN-P	Global Terrestrial Network for Permafrost
GUAN	GCOS Upper-Air Network
GWP	Global Warming Potential
HAK-IS	Moral Rights Workers Union
HCFC	Hydrochlorofluorocarbon
HF	Hydrogen Fluoride

HFC	Hydrofluorocarbon
HOBISEEC	Hydrogen/oxygen bi-functional solid electrolyte energy converter
HYAIR	Converting air transport to hydrogen
IAHE	International Association for Hydrogen Energy
IBRD	International Bank for Reconstruction and Development (World Bank)
ICAO	International Civil Aviation Organization
ICARUS	Investigating Costs and Reliability in Utility Systems
ICCAP	Impact of Climatic Changes on Agricultural Production System in Arid Areas
ICHET	International Centre for Hydrogen Energy Technologies
IEA	International Energy Agency
IEE	Intelligent Energy for Europe
IMPACTS	Environmental Impact Module of ENPEP for Windows
IOC	Intergovernmental Oceanographic Commission
IPC	Industrial Pollution Control
IPPC	Integrated Pollution Prevention and Control
ISPs	Integrated Steel Plants
ITU	Istanbul Tehcnical University
JICA	Japanese International Cooperation Agency
KESK	Confederation of Public Sector Unions
KOSGEB	Small and Medium-Sized Enterprises Development Organisation
LEAP	Local Environmental Action Plan
LNG	Liquefied natural gas
LPG	Liquified Petroleum Gas
LULUCF	Land use, land use change and forestry
MACE	Multi-Disciplinary Analysis of the Caspian Sea Ecosystem
MAED	Model for Analysis of Energy Demand
MAP	Mediterranean Action Plan
MARA	Ministry of Agriculture and Rural Affairs
MEDGOOS	Mediterranean Global Ocean Observing System
MENR	Ministry of Energy and Natural Resources
METU	Middle East Technical University
METU-PAL	METU- Petroleum Research Center
MFA	Ministry of Foreign Affairs
$MgCO_3$	Magnesium carbonate
MoE	Ministry of Education
MoEF	Ministry of Environment and Forestry
MoEF – CYG	MoEF - General Directorate of Environmental Management
MoH	Ministry of Health
MoIT	Ministry of Industry and Trade
MONOE	Integrated Meteorology / Oceanography Network Of Excellence
MoT	Ministry of Transport
MPWS	Ministry of Public Works and Settlement
MSI	Marine Sciences Institute
MTA	Directory General for Mineral Research and Exploration
N_2O	Nitrous Oxide
NA	Not applicable
NAP	National Action Plan
NATO	North Atlantic Territory Organization
NC	National Communication
NCO	National Coordination Office
NCP	National Contact Point
NE	Not estimated
NEAP	National Environmental Action Plan
NGO	Non-Governmental Organisation
NMVOC	Non-methane Volatile Organic Compounds
NO	Not occurring
NOx	Nitrogen Oxides
NPC	National Project Coordinator
OECD	Organization for Economic Cooperation and Development
OHF	Open Hearth Furnaces
OPET	Organisation for the Promotion of Energy Technologies
PETDER	Petroleum Manufacturers Association of Turkey
PFC	Perfluorocarbon
PM	Particulate Matter
PSC	Project Steering Commitee
PSMSL	Permanent Service for Mean Sea Level
PV	Photovoltaic
QA/QC	Quality Assurance/Quality Control
R&D	Research and Development
REC	Regional Environment Centre
RES	Renewable Energy Sources
RIHN	Japan Research Institute for Humanity and Nature
SAP	Southeastern Anatolia Project
SBAA	Standard Basic Assistance Agreement
SCIAMACHY	Data acquisition modules within the scope of the ENVISAT project
SCST	Supreme Council of Science and Technology
SF6	Sulphur Hexafluoride
SFC Drifters	Surface Drifters
SGP	Small Grants Program
SHW	State Hydraulic Works
SLP	sea level pressure
SME	Small and Medium Enterprises
SO_2	Sulfur Dioxide
SOOP	Ship-of-Opportunity Programme
SOx	Sulphur Oxides
SPO	State Planning Organization
SWOT	Strengths, Weaknesses, Opportunities, Threats
T&D	Transmission and Distribution
TAEA	Turkish Atomic Energy Authority
TAG	Technical Activity Group
TAR	IPCC/Third Assessment Report
TARABIS	National Research Infrastructure Information System
TARAL	Turkish Research Area
TR	Turkey
TCDD	Turkish State Railways
TARP	Turkey Agricultural Research Project
TCMA	Turkish Cement Manufacturers'

	Association
TEAS	Turkish Electricity Transmission-Generation Company
TEG	Technical Expert Group
TEIAS	Turkish Electricity Transmission Corporation
TEM	Trans European Motorway
TEMA	Turkish Foundation for Combating Soil Erosion, for of Natural Habitats Reforestation and the Protection
TESEV	Turkish Economic and Social Studies Foundation
TESK	Tradesmen and Craftsmen
TGNA	Turkish Grand National Assembly
TISK	Turkish Confederation of Employer Associations
TISPA	Turkish Iron and Steel Producers Association
TKI	Turkish Coal Enterprises
TOBB	Turkish Union of Chambers and Commodity Exchanges
ToR	Terms of Reference
TPAO	Turkish Petroleum Corporation
TPES	Total Primary Energy Supply
TSI	Turkish Standards Institute
TSMS	Turkish State Meteorological Services
TTGV	Turkish Technology Development Foundation
TTK	Turkish Hard Coal Enterprise
TUBA	Turkish Academy of Sciences
TUBITAK	Turkish Scientific and Technical Research Council
USAMP	University & Industry Joint research Centers
TUCEV	Turkish National Environmental Foundation
TUDAV	Turkish Marine Research Foundation
TUDES	National Sea Level Monitoring System
TURKSTAT	Turkish Statistics Institute
TUSIAD	Turkish Businessman Association
TWCCC	Technical Working Commission on Climate Change
UCES	Integrated National Environmental Strategy for EU Accession
ULAKBIM	Turkish Academic Network and Information Center
UME	National Meteorology Institute
UN	United Nations
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
UNIDO – ICHET	UNIDO - International Centre for Hydrogen Energy Technologies
UoT	Undersecretariat of Treasury
USAMP	University & Industry Joint research
V&A	Centers
VALORAGUA	Vulnerability and Adaptation Hydro Simulation Model
VAT	Value Added Tax
VOC	Volatile Organic Compound
WASP	Wien Automatic Planning Package
WB	World Bank
WM	With Measure Scenario
WMO	World Meteorological Organization
WOM	Without Measure Scenario
WOUDC	The World Ozone and UV Radiation Data Center
WWF	World Wildlife Fund

Units

$/GJ	US Dollars per Giga Joule
$/kW	US Dollars per kilowatt
$/kW-month	US Dollars per kilowatt month
$/MMbtu	US Dollars per Million Btu
$/MWh	US Dollars per Megawatt hour
$/ton	US Dollars per metric ton
% p.a.	percent per year
¢/10^6 kcal	U.S cents per million kilocalories
°C	degree Celsius
bcm	billion cubic meters
boe	barrel of oil equivalent
Cal/cm^2	Calorie / square centimeter
Gg	1 gigagram =10^9 g = 1 kilotonne (kt)
Gt	Giga tones
GW	Gigawatt
GWh	Giga Watt-hour
kboe	1000 barrels of oil equivalent
kcal	kilocalorie
kcal/kg	kilocalorie per kilogram
kcal/kWh	kilocalorie per kilowatt hour
km	Kilometer
km^2	square kilometer
kt	1000 tons
ktoe	1000 tons of oil equivalent
ktp.a.	kilo ton petroleum per annum
kWe	kilowatt electric
kWh	kilowatt hour
kWh/m^2, a	kilowatt hour / square meter, area
m	meter
m/s	meter per second
m^3	cubic meter
Mcal	Mega calories
mg/Nm^3	milligram per norm cubic meter mm
Mt	Million metric tons
MTCE	million metric tons of carbon equivalent
Mtcs	Million ton crude steel
Mtoe	Million tons oil equivalent
mtp.a.	mega ton per annum
MW	Megawatt
MWe	Megawatt electric
MWth	Megawatt thermal
p.a.	per annum
PJ	1015 Joule
Tg	terra gram 1012 g = 1 megatons (Mt)
TL	Turkish lira
toe	tons of oil equivalent
TWh	Terawatt-hour
US$	US Dollars (all costs in this report are in constant US$2000)
$Watt/m^2$	Watt per square meter
YTL	New Turkish Lira

REPUBLIC OF TURKEY

Ministry of Environment and Forestry
Çevre ve Orman Bakanlığı

General Directorate of Environmental Management
Çevre Yönetimi Genel Müdürlüğü

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